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First MSC Re-Assessment

Northern Prawn Fishery

Public Certification Report

Prepared for

NPF Industry Pty Ltd

Prepared by

MRAG Americas, Inc.

January 18, 2018

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List of Abbreviations

AAT	Administrative Appeals Tribunal	JBG	Joseph Bonaparte Gulf
ABARES	Australian Bureau of Agriculture and Resource Economics and Sciences	LRP	Limit Reference Point
ABC	Acceptable Biological Catch	MAC	Management Advisory Committee
AFMA	Australian Fisheries Management Authority	MLS	Minimum Landing Size
AFZ	Australian Fishing Zone	MSE	Management Strategy Evaluation
AMCS	Australian Marine Conservation Society	MSC	Marine Stewardship Council
ANAO	Australian National Audit Office	MEY	Maximum Economic Yield
BBL	Biologically Based Limits	MSE	Management Strategy Evaluation
B	Biomass	MSY	Maximum Sustainable Yield
BMSY	Biomass at Maximum Sustainable Yield	NPOA	National Plan of Action
BRS	Bureau of Rural Sciences	NGO	Non-Governmental Organisation
BRD	Bycatch Reduction Device	NPF	Northern Prawn Fishery
CRD	Catch Receiver Document	NPFI	Northern Prawn Fishery Industry Pty Ltd
CFRAB	Commonwealth Fisheries Research Advisory Body	NPFREC	NPF Research & Advisory Committee
CFINS	Commonwealth Fisheries Infringement Notices	NORMAC	Northern Prawn Management Advisory Committee
CSIRO	Commonwealth Scientific and Industrial Research Organisation	NPRAG	The Northern Prawn Resource Assessment Group
CITES	Convention on International Trade in Endangered Species	OMC	Operations Management Committee
CLCIPA	Carpentaria Land Council Indigenous Protected Area	OVI	Objective Verifiable Indicators
CMO	Crew Member Observer Program	PI	Performance Indicator (MSC)
CMS	Convention on Migratory Species	PSA	Productivity Susceptibility Analysis
CRIS	Cost Recovery Impact Statement	QDPI	Queensland Department of Primary Industries
CoC	Chain of Custody certification	RAG	Regional Advisory Group
CPUE	Department of Agriculture, Fisheries & Forestry	REC	Research & Environment Committee
CW	Carapace width	RBF	Risk-Based Framework (MSC)
DAFF	Department of Agriculture, Fisheries & Forestry	SAG	Scientific Advisory Group
DoE	Department of Environment	SC	Scientific Committee
DoEE	Department of Environment, and Energy	SG	Scoring Guidepost
DEWR	Department of Environment and Water Resources	SICA	Scale Intensity Consequence Analysis
EAFM	Ecosystem Approach to Fisheries Management	SSB	Spawning Stock Biomass
EPBC	Act Environment Protection and Biodiversity Conservation Act 1999	SSF	Spawning Stock Fecundity
ERA	Environmental Risk Assessment	SSN	Spawning Stock Number
ERM	Environmental Risk Management	SFR	Statutory Fishing Right
ESDP	Ecologically Sustainable Development Policy	SPM	Surplus Production Model
EEZ	Exclusive Economic Zone	SAFE	Sustainability Assessments for Fishing

			Effects
ETP	Endangered, Threatened or Protected (species)	TRP	Target Reference Point
FMA	Fisheries Management Act, 1991	TAP	Threat Abatement Plan
F	Fishing mortality rate	TVH	Transferable Vessel Holders
FMSY	Fishing mortality rate at Maximum Sustainable Yield	TAC	Total Allowable Catch
FRDC	Fisheries Research and Development Corporation	TED	Turtle Exclusion Device
FAO	Food and Agriculture Organisation of the United Nations	UN	United Nations
FCR	Fisheries Certification Requirements (MSC)	UNEP	United Nations Environment Programme
FMP	Fisheries Management Plan	UoA	Unit of Assessment (MSC)
GoC	Gulf of Carpentaria	UoC	Unit of Certification (MSC)
HCR	Harvest Control Rule		
HS	Harvest Strategy	VMP	Vessel Monitoring Plan
HSP	(Commonwealth) Harvest Strategy Policy	VMS	Vessel Monitoring System
HMS	Highly Migratory Species	VPA	Virtual Population Analysis
IMO	International Maritime Organization	WGSA	Working Group on Stock Assessment
IT	Incidental Take	WTO	Wildlife Trade Operation
IUCN	International Union for the Conservation of Nature	WWF	World Wide Fund for Nature
IUU	Illegal, Unregulated and Unreported		

1. Executive Summary

This Public Certification Report sets out the results of the assessment of the Northern Prawn Trawl Fishery, Australian Commonwealth, carried out by MRAG Americas, Inc. against the Marine Stewardship Council (MSC) Principles and Criteria for Sustainable Fishing. The purpose of this report is to provide background information, evaluation of the fishery, and justification for scoring the performance indicators provided by the MSC in the generic assessment tree of the Fishery Certification Requirements, as defined in the Guidance to MSC FCR Version 1.3. MRAG conducted no primary research as part of this assessment, and relied on existing information to conduct the analysis. The report intends to clearly set out key issues for consideration during annual surveillance audits and for subsequent recertification.

The record of document amendments is provided in Table 1

Table 1. Document Amendment Record

Version	Start	End
Client Draft	16 January, 2017	21 August, 2017
Peer review draft	22 August, 2017	18 September, 2017
Public comment draft	3 October, 2017	27 November, 2017
Final report and determination	28 November, 2017	5 December 2017
Public Certification report	3 January, 2018	18 January, 2018

MRAG Americas is an independent 3rd-party Conformity Assessment Body (CAB) that has undertaken the MSC re assessment of the Northern Prawn Fishery in accordance with the MSC Principles and Criteria for sustainable fishing. The assessment complies with the MSC Certification Requirements v1.3 (FCR, January 2013) and the guidance to the Certification Requirements v1.3 (GFCR, January 2013). The default assessment tree was used without adjustment except for Principle 1 assessment of red endeavour prawns, for which the risk-based framework (RBF) was used.

This is the 2nd MSC assessment for the Northern Prawn Fishery (NPF). A previous MSC assessment for the fishery was undertaken by MRAG Americas in 2012 and certificate issued on 6 November 2012. A total of 4 conditions applied to the initial certification of the fishery. All of these conditions were closed by the 3th surveillance audit in 2015.

The assessment team for this re-certification consisted of Richard Banks (Team Leader and Principle 3 Expert), Kevin McLoughlin (Principle 1 Expert) and Mihaela Zaharia (Principle 2 Expert).

The announcement for the site visit was posted onto the MSC website on 20 December, 2016. The site visit commenced on 13 February, 2017 in Brisbane, and was completed on 14 February. Meetings with fisheries scientists took place at the offices of CSIRO, Oceans and Atmosphere, Dutton Park, Brisbane and with the Australian Fishery Management Authority (AFMA), Northern Prawn Fishery Industry Pty Ltd (NPF) and other stakeholders at the Riverview Hotel, Brisbane. Documents were presented by fishery representatives and fisheries scientists and are also available on the AFMA website (<http://www.afma.gov.au/fisheries/northern-prawn-fishery/>). Client representatives and the management authority were thorough in their approach and provided the assessment team with supporting documents.

There are three subfisheries covered in this assessment, the banana prawn subfishery, operating from 1 April to mid-June), the tiger prawn subfishery operating from 1 August until the end of November, and the Joseph Bonaparte Gulf (JBG) subfishery, with two seasons, coinciding with the banana and tiger prawn fishery, respectively. Prawns account for >95% of the landed catch in the three fisheries combined. Retained species (by-product) include bugs, squid and cuttlefish, king prawns and mixed prawns, and a small amount of finfish.

Six target species across the subfisheries are considered in this assessment: brown tiger prawn (*Penaeus esculentus*), grooved tiger prawn (*P. semisulcatus*), blue endeavour prawn (*Metapenaeus endeavouri*), red endeavour prawn (*M. ensis*), white banana prawn (*Fenneropenaeus merguiensis*) and red-legged banana prawn (*F. indicus*). These six species are fished with the same fishing gear across the Northern Prawn Fishery Management Area by all fishers operating in the fishery, the client group. Hence these six species represent six Units of Certification (UoC) and are equivalent to the Units of Assessment (UoA).

Landings of banana prawn (white and red-legged), ranged from 3050 tonnes to 6330 tonnes in the years 2012-2015 (Laird 2016). In the same period, the two tiger prawns (brown and grooved) ranged from 1203 tonnes to 3295 tonnes, and endeavour prawns (blue and red) ranged from 487 to 675 tonnes.

Fishing effort in the NPF peaked in the early 1980s at a total of more than 40,000 fishing days, with more than 250 vessels fishing. Over the next three decades, fishing effort and participation were reduced to the current levels of around 8000 days of effort and 52 vessels.

Australian Bureau of Agriculture and Resource Economics and Sciences (ABARES) *Fishery Status Reports 2016* (Patterson *et al.*, 2016) provides an overview of the fishery and summarizes the current status of the target prawn species. White banana prawns, red-legged banana prawns, brown tiger prawns, grooved tiger prawns and blue endeavour prawns are all assessed as not overfished and not subject to overfishing. The status of red endeavour prawns is judged as uncertain for both the current level of fishing and current biomass. Brown tiger prawns, grooved tiger prawns, blue endeavour prawns and red endeavour prawns are managed under the tiger prawn fishery harvest strategy. White banana prawns are managed under a separate banana prawn fishery harvest strategy. Red-legged banana prawns are also managed under their own harvest strategy applying to the fishery within the JBG.

The tools in place comprise catch trigger points in each fishery based on regular monitoring of catch rates. These are underlined by a series of seasonal and temporal closed areas. The estimated footprint for this fishery is around 1.6% annually.

The underlying management system is governed by the Fisheries Management Act 1991, Fisheries Management Regulations 1992 and Northern Prawn Management Plan 1995, implemented through revisions to the harvest strategy for the three fisheries. The management system also contains a bycatch management strategy 2015-2018, supported by an annual workplan.

In this assessment report the assessors provide the rationales for all scores proposed. Detailed rationales are presented for all Performance Indicators (PIs) under Principle 1 (Stock status and Harvest strategy), Principle 2 (Ecosystem Impact) and Principles 3 (Governance, Policy and Management system) of the MSC Standard.

The fishery attained a score of 80 or more against each of the MSC Principles and did not score less than 60 against any Indicators. The assessment team concluded that the Australia Northern Prawn fishery should therefore be recertified according to the Marine Stewardship Council Principles and Criteria for Sustainable Fisheries.

Following this Recommendation of the assessment team, and review by stakeholders and peer-reviewers, a decision is hereby made by the MRAG Americas Certification Decision Making Process to recertify the Australia Northern Prawn fishery according to the Marine Stewardship Council Principles and Criteria for Sustainable Fisheries.

Three conditions are proposed for the fishery in this reassessment. No conditions were raised in relation to Principle 1 for the original certification of the fishery. Two of these conditions relate to red endeavour prawn and result from changes in the Northern Prawn Fishery harvest strategy since the original assessment. The third condition relates to red-legged banana prawn and results from uncertainty in recent stock assessment.

Summary of the evaluation results

Principle 1 examines the status of the target stock and whether the management system maintains the reproductive capacity within safe and rational limits. Exploited populations should be maintained at levels of abundance sufficient to maintain their productivity and reproductive capacities for yields over the long term, provide margins of safety for error and uncertainty, and restore and rebuild stocks that have become depleted.

Overall scores for Principle 1 species were as follows:

Brown tiger prawn (<i>Penaeus esculentus</i>)	100
Grooved tiger prawn (<i>P. semisulcatus</i>)	100
Blue endeavour prawn (<i>Metapenaeus endeavouri</i>)	97.5
Red endeavour prawn (<i>M. ensis</i>)	82.1
White banana prawns (<i>Fenneropenaeus merguensis</i>);	81.9
Red-legged banana prawns (<i>Fenneropenaeus indicus</i>)	80

Principle 2 examines five components, which are considered to cover the range of potential ecosystem elements that may be impacted by a fishery, taking into account the status, management strategies and information relevant to each of these components.

Overall scores for Principle 2 were as follows:

Brown tiger prawn (<i>Penaeus esculentus</i>)	94.3
Grooved tiger prawn (<i>P. semisulcatus</i>)	94.3
Blue endeavour prawn (<i>Metapenaeus endeavouri</i>)	94.3
Red endeavour prawn (<i>M. ensis</i>)	95
White banana prawns (<i>Fenneropenaeus merguensis</i>);	97
Red-legged banana prawns (<i>Fenneropenaeus indicus</i>)	95.7

Principle 3 examines the structure and performance of the management system.

Overall score for Principle 3 were as follows:

Brown tiger prawn (<i>Penaeus esculentus</i>)	100
Grooved tiger prawn (<i>P. semisulcatus</i>)	100
Blue endeavour prawn (<i>Metapenaeus endeavouri</i>)	100
Red endeavour prawn (<i>M. ensis</i>)	100
White banana prawns (<i>Fenneropenaeus merguensis</i>);	100
Red-legged banana prawns (<i>Fenneropenaeus indicus</i>)	100

Harmonisation with other MSC assessments

There is no requirement for harmonisation of the P1 components of the NPF fishery with other prawn trawl assessments as the stocks are distinct. There are some commonalities for P3 with the MSC assessed Australian Blue Grenadier Fishery, also managed by AFMA.

Conditions and recommendations

Condition 1: (Red endeavour prawn, PI 1.2.1, scoring issue a). By the fourth surveillance audit, demonstrate that the harvest strategy for red endeavour prawn is responsive to the state of the stock and the elements of the harvest strategy work together towards achieving stock management objectives reflected in PI 1.1.1 SG80.

Condition 2: (Red endeavour prawn, PI 1.2.2, scoring issue a). By the fourth surveillance audit, demonstrate that well defined HCRs are in place that ensure that the exploitation rate is reduced as the PRI is approached, are expected to keep the stock fluctuating around a target level consistent with (or above) MSY.

Condition 3: (Red-legged banana prawn, PI 1.2.2, scoring issues b and c).

SIa: By the fourth surveillance audit, provide evidence that the HCRs take into account the main uncertainties.

SIb: By the fourth surveillance audit, demonstrate that available evidence indicates that the tools in use are appropriate and effective in achieving the exploitation levels required under the HCRs.

No recommendations have been proposed for this re-assessment.

2. Authorship and Peer Reviewers

2.1 Authorship

Assessors

Mr. Richard Banks, lead assessor. Richard Banks has considerable MSC experience having served as the Lead Assessor on the PNA free school skipjack full assessment, as well as the Australian Northern Prawn and Spencer Gulf King Prawn fishery assessment. Mr. Banks is trained in the MSC RBF. Richard has also designed several fishery improvement plans in South East Asia and the Pacific, and has acted as external reviewer to a number of MSC assessments on behalf of WWF. Richard is also co-author of *The Blueprint for Sustainable Tropical Shrimp Trawl Fisheries*, prepared for WWF. He has over 30-years' experience in fisheries management, research and consultancy covering all regions of the World. Richard currently works as an advisor to PNA, FFA and MFMR as an offshore tuna advisor. He is an economist and fisheries management and policy programming specialist having worked on similar issues for international agencies including FAO, World Bank, ADB and the European Union in more than 70 countries. Richard has also worked with a number of Australian Commonwealth and State Fisheries. Richard holds a Bachelor's degree in Fisheries Economics and a Masters in Agricultural Economics from the University of Portsmouth, and Imperial College, London, respectively.

Mr. Kevin McLoughlin. Kevin McLoughlin has over 25 years' experience in fisheries science and currently works as a fisheries consultant. His recent work includes Marine Stewardship Council assessments and pre-assessments. Kevin was a team member for the full assessment of the Fiji albacore longline fishery, the New Zealand Albacore Fishery, the Tri Marine Western and Central Pacific Skipjack and Yellowfin Tuna Fishery, Australia's blue grenadier fishery, as well as the Western Australia Exmouth Gulf and Shark Bay prawn trawl fisheries. In addition, he has undertaken reviews of fisheries assessed under the World Wildlife Fund Common Wild Capture Fishery Methodology. Previously, as a Senior Fisheries Scientist with the Bureau of Rural Sciences (BRS), he engaged in a wide range of international and domestic fisheries issues with close links to Government policy. Responsibilities included production of BRS Fishery Status Reports—these have had a major influence on the direction of Australia's fisheries management and policy. Mr McLoughlin represented BRS on many committees and groups such as Australian Fishery Management Authority fishery assessment groups (including for the Southern and Eastern Scalefish and Shark Fishery, the Northern Prawn Fishery, the Bass Strait Scallop Fishery, and the Western Tuna and Billfish Fishery), DAFF's Shark Implementation Group for implementation of the National Plan of Action for Sharks, and others. He represented Australia on scientific issues at the Indian Ocean Tuna Commission and was Chair of the IOTC Working Party on Ecosystems and Bycatch for its first 3 annual meetings. Mr McLoughlin was also a delegate at meetings of the Commission for the Conservation of Southern Bluefin Tuna.

Ms. Mihaela Zaharia earned her B Sc. in Marine Biology and M Sc. in Ecosystem Sciences. Her relevant experience includes involvement as a marine science researcher for Poseidon Aquatic Resources Management Consultants Ltd and National Institute for Marine Research and Development (NIMRD) Gr. Antipa. At the latter she worked in the aquaculture research department where her focus was, among other activities, on prawn growth research and she contributed to several publications in this field. Ms. Zaharia has participated in several international professional development courses on coastal resource management, including courses organized by the Balkan Environmental Association (B.EN.A) in Romania, and Leonardo da Vinci sub-program (Integrated Coastal Zone Management) in Bologna, Italy. She was the P2 assessor in the Spencer Gulf Prawn Trawl Fishery Recertification Assessment and has also participated in a number of preassessments and Fisheries Improvement Plans. Ms.

Zaharia is a qualified assessor to use the MSC RBF and has prepared RBF templates for various data poor fisheries. In addition to her employment history, Ms. Zaharia was part of the WWF/Poseidon pre-assessment team for the Tien Giang Clam fishery. Mihaela is currently involved in training and Capacity building in data poor fisheries in Indonesia and Vietnam as part of an MSC sponsored Coral Triangle programme.

2.2 Peer Reviewers

The Peer Review College provided technical oversight.

3. Description of the Fishery

3.1 Unit(s) of Certification and scope of certification sought

The MSC Guidelines to Certifiers specify that the unit of certification is "The fishery or fish stock (=biologically distinct unit) combined with the fishing method/gear and practice (=vessel(s) pursuing the fish of that stock) and management framework."

Units of Certification

The fishery assessed for MSC certification is defined as:

Australian Northern Prawn Fishery

There are four species covered in the tiger prawn subfishery, each representing a separate unit of certification.

- Brown tiger prawn (*Penaeus esculentus*)
- Grooved tiger prawn (*P. semisulcatus*)
- Blue endeavour prawn (*Metapenaeus endeavouri*)
- Red endeavour prawn (*M. ensis*)

There is one species in the banana prawn subfishery, this representing a separate unit of certification:

- White banana prawns (*Fenneropenaeus merguensis*);

There is one species in the Joseph Bonaparte Gulf (JBG) subfishery, this representing a separate unit of certification:

- Red-legged banana prawns (*Fenneropenaeus indicus*)

Geographical Area: The Northern Prawn Fishery (NPF) occupies an area of 771,000 km² off Australia's northern coast. The Fishery extends from the low water mark to the outer edge of the Australian fishing zone (AFZ) along approximately 6,000 km of coastline between Cape York in Queensland 142° 09' 00" E and Cape Londonderry in Western Australia 126° 58' 00" E.

Method of Capture: Twin, quad or triple rig otter trawl

Stock: North Australian brown tiger prawn, grooved tiger prawn, blue endeavour prawn, red endeavour prawn, white banana and red-legged banana prawn stocks:

Management System: The fishery is managed through a combination of input controls (limited entry, seasonal closures, gear restrictions and operational controls), implemented under the *Northern Prawn Fishery Management Plan 1995*.

Client Group: NPF Industry Pty Ltd.

The Units of Certification are equivalent to the Units of Assessment in this assessment.

The fishery client is NPF Industry Pty. Group members comprise 18 company owners and 52 associated vessels (Table 2). This sentence now precedes Table 2.

Table 2. Northern Prawn Fishery, Client Group Vessels, 2017.

Client Name	Fmu Name	Vessel Id	Vessel Name	Symbol
ADVANCE PTY. LTD.	NPF Class B	4428	SHOMAC	FWSZ
AUSTFISH PTY LTD	NPF Class B			
AUSTFISH PTY LTD	NPF Class B	12396	LIBERTINE	PS20
AUSTFISH PTY LTD	NPF Class B			
AUSTRAL FISHERIES PTY LTD	NPF Class B	10954	KFV HERON	F701
AUSTRAL FISHERIES PTY LTD	NPF Class B	12275	KODIAK T	F635
AUSTRAL FISHERIES PTY LTD	NPF Class B	11148	NEWFISH II	P216
AUSTRAL FISHERIES PTY LTD	NPF Class B	11079	COMAC ENDEAVOUR	F639
AUSTRAL FISHERIES PTY LTD	NPF Class B	11577	SEA THIEF	B7
AUSTRAL FISHERIES PTY LTD	NPF Class B	11576	OCEAN THIEF	B169
AUSTRAL FISHERIES PTY LTD	NPF Class B	11951	KFV SHEARWATER	F555
AUSTRAL FISHERIES PTY LTD	NPF Class B	11246	COMAC ENTERPRISE	F871
AUSTRAL FISHERIES PTY LTD	NPF Class B	11247	NEWFISH I	F015
AUSTRAL FISHERIES PTY LTD	NPF Class B	11434	GNARALOO	FPKN
BRAMPTON FISHING CO. PTY LTD	NPF Class B			
BRAMPTON FISHING CO. PTY LTD	NPF Class B			
COLIN M JAMES	NPF Class B	11683	WARLOCK	O519
DUJOUR PTY LTD	NPF Class B	12487	OCEAN MISS	HSJ
HENCHMAN FISHING COMPANY PTY LTD	NPF Class B	11230	BRAHMAN	B285
HENCHMAN FISHING COMPANY PTY LTD & WILLMAY (QLD) PTY LTD	NPF Class B	9989	ADVANTAGE	FXSD
IRENE A AND BRIAN T BIENKE	NPF Class B			
JOHN E THOMAS	NPF Class B	11324	BEACHLANDS	B53
JOHN J JARRETT (JNR)	NPF Class B	12173	JALaura	FVKB
JUARA FISHING COMPANY PTY. LIMITED	NPF Class B			
K J LOCK INVESTMENTS PTY LTD	NPF Class B			
MADANG CONTRACTORS (QLD.) PTY. LTD.	NPF Class B	4068	EMSERVE	FVEY

MADANG CONTRACTORS (QLD.) PTY. LTD.	NPF Class B	11250	FV CAPE YORK	K6D
RAPTIS FISHING LICENCES PTY LTD	NPF Class B	11349	ADELAIDE PEARL	O572
RAPTIS FISHING LICENCES PTY LTD	NPF Class B	11280	DOLPHIN PEARL	O573
RAPTIS FISHING LICENCES PTY LTD	NPF Class B	11288	EYLANDT PEARL	O585
RAPTIS FISHING LICENCES PTY LTD	NPF Class B	11277	RAPTIS PEARL	O575
RAPTIS FISHING LICENCES PTY LTD	NPF Class B	11435	NORTHERN PEARL	O574
RAPTIS FISHING LICENCES PTY LTD	NPF Class B	11574	KFV SANDPIPER	PS17
RAPTIS FISHING LICENCES PTY LTD	NPF Class B	11278	KARUMBA PEARL	O579
RAPTIS FISHING LICENCES PTY LTD	NPF Class B	11913	ANNA PEARL	V06
RAPTIS FISHING LICENCES PTY LTD	NPF Class B	11279	ARNHEM PEARL	O581
RAPTIS FISHING LICENCES PTY LTD	NPF Class B	11289	BRISBANE PEARL	O520
RAPTIS FISHING LICENCES PTY LTD	NPF Class B	11175	FLINDERS PEARL	O580
RAPTIS FISHING LICENCES PTY LTD	NPF Class B	3748	TERRITORY PEARL	O582
RAPTIS FISHING LICENCES PTY LTD	NPF Class B	11348	AUSTRALIAN PEARL	O576
RONALD S & RACHELLE L EARLE	NPF Class B	11728	GULF BOUNTY	FVNV
RONALD S & RACHELLE L EARLE	NPF Class B	11421	CENATOR	B103
RONALD S & RACHELLE L EARLE	NPF Class B	12040	XANADU 1	F630
RONBRIDGE PTY. LTD.	NPF Class B	11882	OCEAN WILD	B229
RUBY MARINE ENGINEERING PTY. LTD.	NPF Class B	11152	BOUNTIFUL LADY	B26
RUBY MARINE ENGINEERING PTY. LTD.	NPF Class B	12105	RUBY ENTERPRISE	B146
SAMSON SEAFOODS PTY LTD	NPF Class B	9558	SOUTH PASSAGE	J001
SAMSON SEAFOODS PTY LTD	NPF Class B			
W.A. SEAFOOD EXPORTERS PTY LTD	NPF Class B	9681	OCEAN PRODUCER	P245
W.A. SEAFOOD EXPORTERS PTY LTD	NPF Class B	9682	OCEAN EXPORTER	P246
W.A. SEAFOOD EXPORTERS PTY LTD	NPF Class B	11892	SENHORA DE FATIMA	F258

Source: <http://www.afma.gov.au/fisheries-services/concession-holders-conditions/>

3.2 Overview of the fishery

The NPF comprises three distinct sub-fisheries: the tiger prawn multispecies subfishery (catching predominantly Brown tiger prawn (*Penaeus esculentus*), grooved tiger prawn (*P. semisulcatus*), blue endeavour prawn (*Metapenaeus endeavouri*); and red endeavour prawn (*M. ensis*); the white banana prawn (*Fenneropenaeus merguiensis*) trawl subfishery; and the JBG red-legged banana prawn (*Fenneropenaeus indicus*) subfishery. All subfisheries target prawns using twin, triple and quad otter trawls. The NPF is managed through a series of input controls, including limited entry to the fishery, gear restrictions, bycatch restrictions and system of seasonal, spatial and temporal closures.

Prawn trawling is an active fishing method which involves towing a conical-shaped net spread open by two or four steel or timber otter boards over the seabed, commonly called otter trawling. Ground chains are also used on the nets to stimulate prawns from the substrate into the trawl mouth. Vessels in the NPF may tow a range of nets in a variety of configurations. These are regulated by the *Northern Prawn Fishery Management Plan 1995* (the Management Plan). In addition to the main nets, a small “try-net” is also used to test the potential catches for a given area. All trawl nets (other than try-nets) in the NPF are required to be fitted with approved Turtle Excluder Devices (TEDs) and Bycatch Reduction Devices (BRDs).

Most of the vessels in the NPF are purpose built steel boats and range in length from 17 m to 28 m. All NPF boats have modern, sophisticated catch handling, packing and freezing capabilities as well as wet (brine) holding facilities. All vessels use electronic aids such as colour echo sounders and Global Positioning Systems (GPS) and plotters. Satellite phones and fax equipment are used by most vessels and many have introduced on-board computing facilities, as well as electronic logbooks. All vessels are required by legislation to have an operational Vessel Monitoring System (VMS).

Prawns account for >95% of the landed catch in the three subfisheries combined. Landings of banana prawn (white and red-legged), ranged from 3050 tonnes to 5359 tonnes in the years 2012-2015 (Laird 2016). The catch of red-legged banana prawns in JBG is usually a relatively small component of the total banana prawn catch. Catch was 886 t in 2014, the highest since 1997, but dropped substantially in 2015 to 56 t with low effort in the region (Larcombe *et al.*, 2016). Catches of the two tiger prawns (brown and grooved) over the period ranged from 1203 to 3295 t. Endeavour prawn catches (blue and red endeavour) ranged from 487 to 675 t.

Other retained prawn species catches in 2015 amounted to 35.8 t of king prawns and 3.4 t mixed prawns in the tiger prawn subfishery, and 9.5 t of black tiger prawn and 2 t of mixed prawn species in white banana subfishery. In red-legged banana prawn subfishery, prawn catches other than targets were insignificant (18 kg). In 2015, the tiger prawn subfishery also landed 69 t of bugs, 24.7 t of squid, 5.9 t of cuttlefish 0.71 t of scallops, and smaller quantities of other retained species contributing 87% of the byproduct quantities. In the white banana subfishery catches of bugs for 2015 were 7.5t while all the other byproduct species catch were under 1 t. Red-legged banana prawn subfishery's contribution to the byproduct catch in 2015 was extremely low (under 100 kg) (NPFI, 2016, unpublished data).

The banana prawn subfishery operates from 1 April to mid-June each year. White banana prawns are caught mainly during the day in the Gulf of Carpentaria east of Arnhem Land and on isolated grounds along the Arnhem Land coast in < 20 m depth (Figure 1). The white banana prawns form dense aggregations (‘boils’) that may be located by spotters in planes, who direct the trawlers to them. The highest catches are taken in areas offshore from the nursery areas based around the mangrove forests. Trawl times are considerably shorter than in the tiger prawn subfishery, lasting from 20 to 30 minutes.

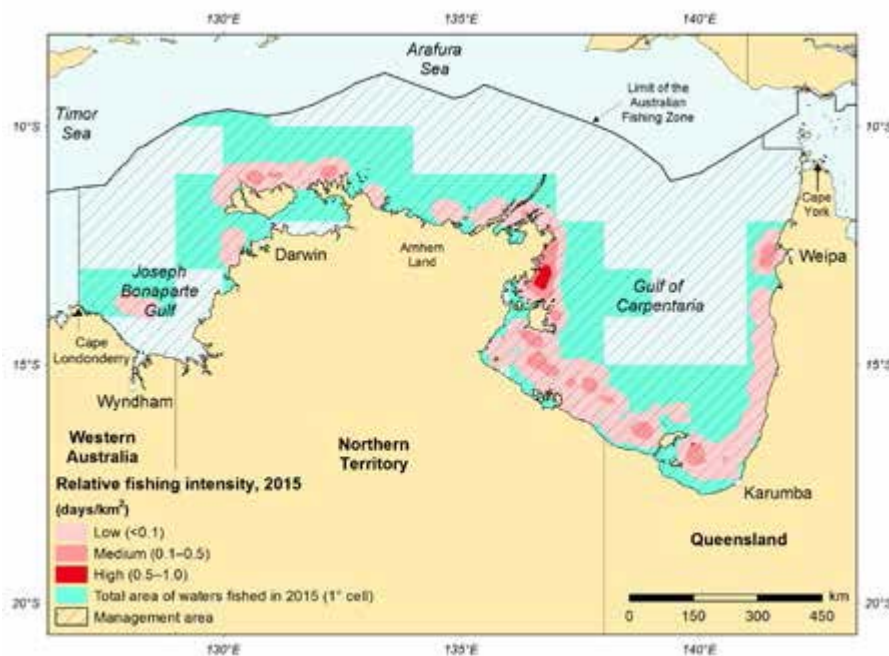
Tiger prawns are taken mainly at night in the southern and western Gulf of Carpentaria and along the Arnhem Land coast. The tiger prawn fishing grounds are often close to those of banana prawns, but the highest catches are in areas near coastal seagrass beds, the nursery habitat for tiger prawns. Endeavour prawns and king prawns are mainly caught as a byproduct of the tiger prawn subfishery. A daylight trawl ban is in place during the season for the tiger prawn subfishery. Trawl times in the tiger prawn subfishery may be up to 3 hours.

Red-legged banana prawns are caught in deeper waters of the JBG, typically 45-85 m. The subfishery takes place during neap tides with fishing only occurring for up to 14 days a month (on average). Catches are usually higher from August to November (tiger prawn season) but the fishery operates during both, banana and tiger season.

There are two closed seasons each year at which time there is no fishing throughout the area. These are: 1st December to 1st April, and 15th June to 1st August.

A maximum of 52 vessels fished during 2016. All NPF-licensed vessels are entitled to fish in the JBG subfishery. Only 5 vessels have operated in the JBG subfishery in recent years, fishing for around 280 vessel days per year, however, only 79 vessel days were fished in 2015.

Figure 1: Relative fishing intensity in the Northern Prawn Fishery, 2015 (Source: Patterson *et al.*, 2016)



3.2.1 History of the Fishery

Year	Description
1966	Two vessels operating
1970	200 vessels operating
1971	Seasonal closure for banana prawns introduced
1974	Banana prawn catch peaked at 12,712 t. Total prawn catch 13,815 t
1977	First management plan in place with limited entry licensing at 302 vessels
1977 and 1980	Controls on vessel replacement
1983	Tiger prawn catch peaked at 5751 t
1984	Unitisation introduced in response to fishing overcapacity and overcapitalization. Adoption of A-units as a measure of vessel size and power. B-units introduced and served as a right to fish. NORMAC formed.
Mid-1980s	Mid-1980s buy back scheme aimed at reducing A-units to 70,000 by 1990. Voluntary buyback extended to B-units.
1987	Mid-season closure (15 th June to 1 st August) introduced to reduce effort on tiger prawns before they spawn, in response to a decline in tiger prawn recruitment. Daylight trawling during the tiger prawn season ban introduced. Vessels restricted to towing two nets.
1988	Fishery became solely managed by the Commonwealth under the Offshore Constitutional Settlements arrangements.
1990	Buyback scheme refinanced, with amended target of 53,844 A-units by early 1993.
1993	License numbers reduced from 216 to 132 from 1990 to 1993 through voluntary sales to the buy back and compulsory surrender of 30.33%. The target was met in April 1993.
1995	A new Management plan and SFRs introduced under the Australian Fisheries Management Act 1992, based on existing effort units in the fishery, to replace class A and B units. A & B Class units rolled into A & B Statutory Fishing Rights (SFRs)
1998	Northern Prawn Resource Assessment Group advise that effective effort directed at tiger prawns was well above MSY and should be reduced by 25-30%. Bycatch Action Plan developed and implemented.
2000	Fishery moved to gear based management units using headrope length. Gear SFRs replaced A SFRs. B (boat) SFRs remain in place.
2001	AFMA commissioned an international expert review, which confirmed that tiger prawns were overfished and levels of fishing effort were too high to promote recovery. NORMAC established a target SMSY (spawner biomass that produced MSY) by 2006, with 70% uncertainty.
2002	40% effort reduction target met through 25% reduction in total allowable headrope length and shortening of season (to 134 total days in 2002, 2003 and 2004).
2002	Design, trial and implementation of an integrated, long-term bycatch monitoring program – road tested in the NPF
2003	Assessment and improvement of TEDs and BRDs in the NPF: a co-operative approach by fishers, scientists, fisheries technologists, economists and conservationists. Final Report on FRDC Project 2000/173.
2004	NORMAC established MEY as the overall management objective of the fishery. Smsy redefined as limit reference point. NORMAC recommended 25% reduction in the operational value of gear SFRs.
2005	25% reduction in total allowable headrope length. Second tiger prawn season lengthened, with additional measures to minimize tiger prawn catch in the first banana prawn season.
2005	Effects of trawling on the benthos and biodiversity: development and delivery of a spatially-explicit management framework for the NPF
2006	NPF management Plan 1995, amended to allow for the use of different gear types (including quad gear) and provide for the collection of prawn broodstock.
2006	Structural adjustment package removed 43 class B SFRs and 18365 gear SFRs (45% and 34% reductions, respectively).
2007	NPF Harvest Strategy Under Input Controls introduced, which aims to pursue MEY and maximize profit by changing effort levels using the results of a bioeconomic assessment of the tiger prawn fishery. Harvest Strategy includes catch trigger limits and decision rules for banana and tiger prawn fisheries.
2007	Developing a management strategy for by-product species in the NPF, ABC limits
2008	Agreement to allow a 33% increase in total gear in the fishery, resulting in an increase in the operational value of each gear SFR from 0.5625 cm to 0.7481 cm.
2008	Research undertaken to assess the advantages and disadvantages of effort control and catch control management options for the NPF.

2008	Bycatch Action Plans (BAP) were replaced by Bycatch and Discarding Workplans developed by Bycatch Subcommittee
2009	In 2009, the available tiger prawn season was increased by four weeks based on the outputs of the 2008 tiger prawn stock assessment, resulting in a season commencing 25 July and closing 19 December. The application of catch trigger limits and decision rules resulted in an early closure of the fishery on 4 th December.
2010	In 2010, the banana season commenced 31 March at 2200 UTC, and concluded on 10 June at 0200 UTC, extending for 10 weeks. The tiger season commenced on 1 August at 0830 UTC and concluded 29 November at 2230 UTC, extending for 17 weeks.
2011	Harvest strategy and controls rules drafted for red-legged banana prawns, waiting for final approval by the AFMA Commission for implementation in 2012.
2012	New arrangements were introduced in 2012 to allow continued fishing for tiger prawns if banana prawn catch trigger limits are not met, including through a daylight trawl ban.
2012	Northern Prawn Fishery Bycatch Reduction Device Assessment
2014	Revised NPF harvest strategy.
2014	Northern Prawn Fishery Bycatch and Discarding Workplan 2014-2016
2015	NPF Bycatch Strategy 2015-2018 (30% bycatch reduction by July 2018)
2017	Breakthrough achievement in BRD design and performance: Kon's Covered Fisheyes: 36.7% bycatch reduction and 0.5% increase in target catch.

3.2.2 Fishing Gear and Methods

In the fishery, there are currently: 52 boat fishing rights (maximum number of vessels active at one time) and 35,479 gear fishing rights. All NPF operators require a class B statutory fishing right (SFR) and a number of gear SFRs to fish (Section 1.6, NPF Directions and Closures, 2016, AFMA 2016a). A class B SFR is required to be nominated to a boat to enable it to operate within the NPF. This SFR lists several conditions which an operator must abide by when operating in the NPF, such as: landing and processing obligations, carriage of AFMA observers and the use of a vessel monitoring system (VMS). ^[1]_{SFR} Gear SFRs entitle the holder to use a net with a certain headrope and footrope length, each boat is required to have a minimum of 100 gear SFRs nominated to it. Gear SFRs have a different value depending on the configuration of nets an operator uses. Operators can use a configuration of two, three or four nets, with the use of the twin-tongue method also permitted. A gear SFR for operators using twin gear is currently worth 9 cm of headrope length. A gear SFR for operators using triple quad or twin tongue gear, has a value of 8.1 cm per SFR. ^[1]_{SFR}

3.2.3 Fishery Management

The Northern Prawn Fishery is managed through a combination of controls detailed in the annual *NPF Directions and Closures* report (AFMA 2016a). Measures include:

- a limit on the amount of net that can be used;
- a limit on the number of boats allowed to fish;
- requirements to use turtle excluding devices and bycatch reduction devices;
- seasonal and area closures.

3.3 Principle One (P1): Target stock status and harvest strategy

There are important differences in the biological characteristics and harvesting of the three species groups targeted in the sub-fisheries. Common or white banana prawns are short-lived and their abundance is largely environmentally driven (Vance *et al.*, 1985), whereas tiger and endeavour prawns are longer-lived (a maximum age of about 2 years) and appear to exhibit a

relationship between stock size and subsequent recruitment (which implies that they can be recruitment overfished). Red-legged banana prawns have less variable recruitment and lower natural mortality than common banana prawns, but are shorter-lived and more variable than tiger prawns.

The commercial penaeid prawns of northern Australia have been studied using electrophoretic techniques to determine the extent of geographic differentiation throughout their ranges in Australian waters. Genetic differences were detected among widely separated populations of *Metapenaeus endeavouri*, but *P. esculentus*, *M. ensis*, *P. semisulcatus* and *Fenneropenaeus merguensis* showed no evidence of genetic differentiation (Mulley & Latter, 1981). In *M. endeavouri* the most marked differences were detected between the samples from the Gulf of Carpentaria and Western Australia. *F. indicus* is widely distributed across the Indo-West Pacific, but the species range is found in a restricted range in Australian waters, predominantly in the JBG (Patterson *et al.*, 2016).

Die *et al.* (2001) suggested that there are several distinct stocks of tiger prawns in the NPF and suggested that assessments should be applied at a finer scale than that of a single stock. They based this conclusion on a simulation model of the currents in the Gulf of Carpentaria and the behaviour of larval prawns that was used to predict the offshore spawning regions from which tiger prawn larvae could be expected to reach the seagrass nursery areas along the coast. The model shows that there are large gaps between these effective spawning areas and this suggests limited mixing of tiger prawn larvae within the Gulf of Carpentaria (GoC). However, both larvae (Rothlisberg *et al.*, 1983) and adult prawns (Somers & Kirkwood, 1984) can migrate relatively long distances within the GoC and it appears that considerable mixing might also occur.

A harvest strategy for the NPF has been developed in line with Australia's Commonwealth Fisheries Harvest Strategy Policy (DAFF, 2007) which has the objective to ensure that key commercial fish species are managed for long-term biological sustainability and economic profitability. The NPF harvest strategy (described at Section 4.2) has been tested using management strategy evaluation (MSE) (Dichmont *et al.*, 2006a, Dichmont *et al.*, 2014). As part of the MSE, a multi-stock tiger/endeavour prawn assessment was developed for and compared that with single stock assessment and concluded that the single stock assessment was more robust and produced the most reliable result. Modelling also tested the most conservative case, which is that each stock in the operating model of the MSE was totally independent of each other and the intermediate case that there were correlations between stocks. In both cases, the single stock assessment was more robust and would lead to better management of the prawns in the NPF.

All P1 species are assessed at the fishery level. Separate assessments are undertaken for the three sub-fisheries. The tiger prawn subfishery stock assessment uses a multispecies (covering brown and grooved tiger prawns), weekly, sex- and size-structured population model, combined with a Bayesian hierarchical production model for blue endeavour prawn. An integrated economic model is used for these three species that calculates maximum economic yield (MEY). The assessments for this subfishery are conducted every two years, most recently in 2016 with data to the end of 2015 (Buckworth, 2016). White banana prawn abundance is highly variable, driven by environmental factors. It has not been feasible to develop a stock assessment model for the stock as has been developed for the tiger prawn fishery. The harvest strategy for the stock is based on closing the season when catch rates fall below a trigger level associated with allowing sufficient escapement to ensure subsequent recruitment (as well as incorporating an economic objective to stop fishing when catch rates fall to uneconomic levels). A stock assessment model has been developed for red-legged banana prawns using quarterly time steps

of catch and effort. The most recent assessment was undertaken in 2015 incorporating data to the end of 2014 (Buckworth *et al.*, 2015b).

3.3.1 Stock status and reference points (PI 1.1.1/2)

The total fishing effort in the NPF has declined significantly as a result of management measures (Figure 3). At its peak in 1981, there were 286 vessels fishing with a total of 43,419 nominal vessel days. In 2010, 52 vessels fished the NPF for 8044 days; 3146 vessel days fished during the banana prawn season and 4898 vessel days during the tiger prawn season. Fishing effort from 2012 to 2015 averaged 2457 days in the banana season and 5628 days in the tiger fishery season. Catches for the UoAs being assessed from 2000 to 2015 are given in Figure 4.

Figure 2: Catch in the banana and tiger prawn fisheries between 1970 and 2015. Source: Laird 2016¹.

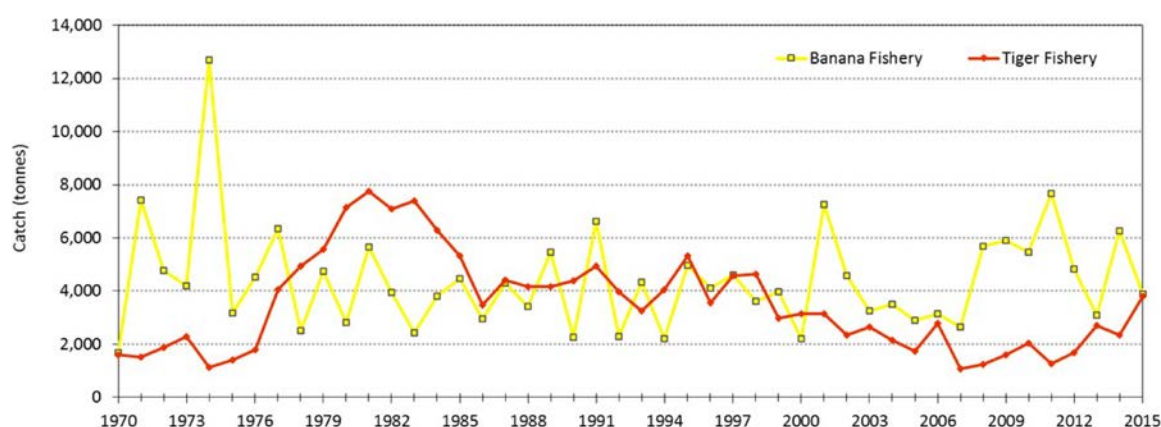
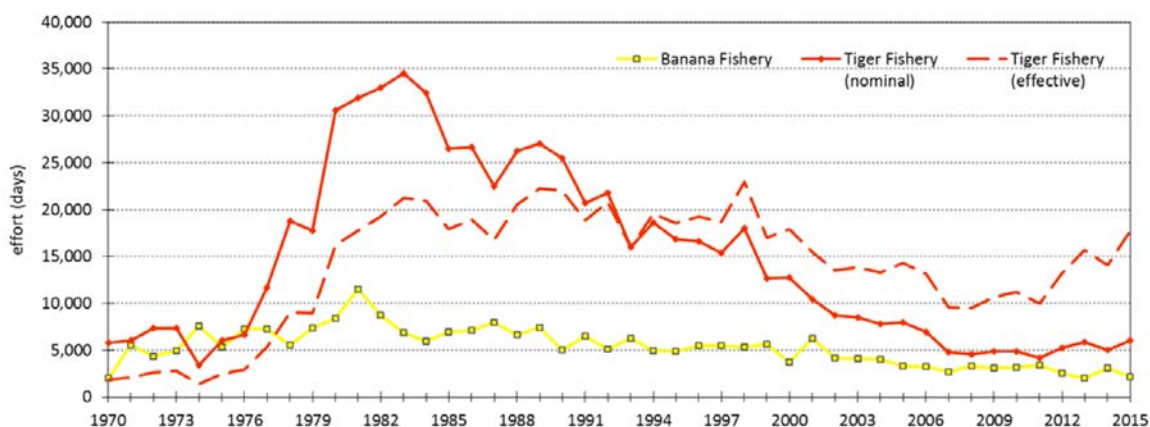


Figure 3: Effort in the banana and tiger prawn fisheries between 1970 and 2015.



Nominal effort is the number of days recorded by skippers in their logbooks. Effective effort applies only to the tiger prawn fishery and is based on the assumption that there has been an

¹ the split into banana and tiger prawn fishery components is based on the composition of the catch in logbook records. If half or more of a vessel's daily catch was banana prawns or there was no prawn catch and the vessel was fishing, the vessel was defined as operating in the banana prawn fishery on that day; otherwise it was defined as operating in the tiger prawn fishery. Banana prawn fishery catch is the catch of all prawn species (bananas + tigers + endeavours + kings) when a vessel is defined as fishing in the banana prawn fishery. Tiger prawn fishery catch is the catch of all species when a vessel is defined as operating in the tiger prawn fishery.

‘effort creep’ (an increase in effectiveness of the gear utilised and fishing operations). A number of different approaches are being used by the Northern Prawn Fishery Resource Assessment Group (NPRAG) to account for effort creep.

In many management systems, the standard or default target reference point (TRP) is based on the biomass that provides for maximum sustainable yield (B_{MSY}), and the MSC uses B_{MSY} as a default target reference point (TRP). The management system may choose to increase the biomass TRP for biological or economic reasons. Recognition of uncertainty, biological features, and/or ecological role (e.g. forage species) are biological justifications for TRP higher than B_{MSY} . On the other hand, an increase in economic benefits, such as managing for maximum economic yield (B_{MEY}), is a non-biological reason for TRP higher than B_{MSY} .

Because MEY occurs at a fishing mortality less than the fishing mortality of MSY, the B_{MEY} is typically greater than B_{MSY} . Compared to B_{MSY} , attaining B_{MEY} adds a layer of precaution because the risk of reducing the biomass to a level below the actual B_{MSY} is reduced. This reduces the risk of recruitment impairment, but the use of B_{MEY} is primarily an economic decision.

The most recent assessments of the main species taken in the tiger prawn subfishery (brown tiger prawn, grooved tiger prawn and blue endeavour prawn) are described Buckworth (2016). Two different groups of stock assessment models were applied: a) the Base Case, comprised of size-structured models (for the two tiger prawn species), as well as a Bayesian hierarchical biomass dynamic model (for blue endeavour prawns); and, b) Deriso models for each of the three species. The Base Case provides outputs relative to reference levels and are discussed below.

The bioeconomic analysis provides estimates of optimal effort levels for the tiger prawn subfishery. The 2014 assessment (Buckworth *et al.*, 2015a) predicted optimal effort levels of 3868 boat days for grooved tiger prawns and 2777 boat days for brown tiger prawns (a total of 6645 boat days). The optimal total effort estimated in the various sensitivity tests ranged from 5902 to 7128 boat days. The 2016 assessment (Base Case) predicted 2016 optimal effort levels of 3024 boat days for grooved tiger prawns and 5281 boat days for brown tiger prawns, a total of 8305 boat days (Buckworth *et al.*, 2016). The optimal total effort estimated in the various sensitivity tests ranged from 6861 to 8493 boat days. This equates to an increase in total effort of 37.5% over 2015 effort, and is calculated to be equivalent to a potential gear increase of 224%.

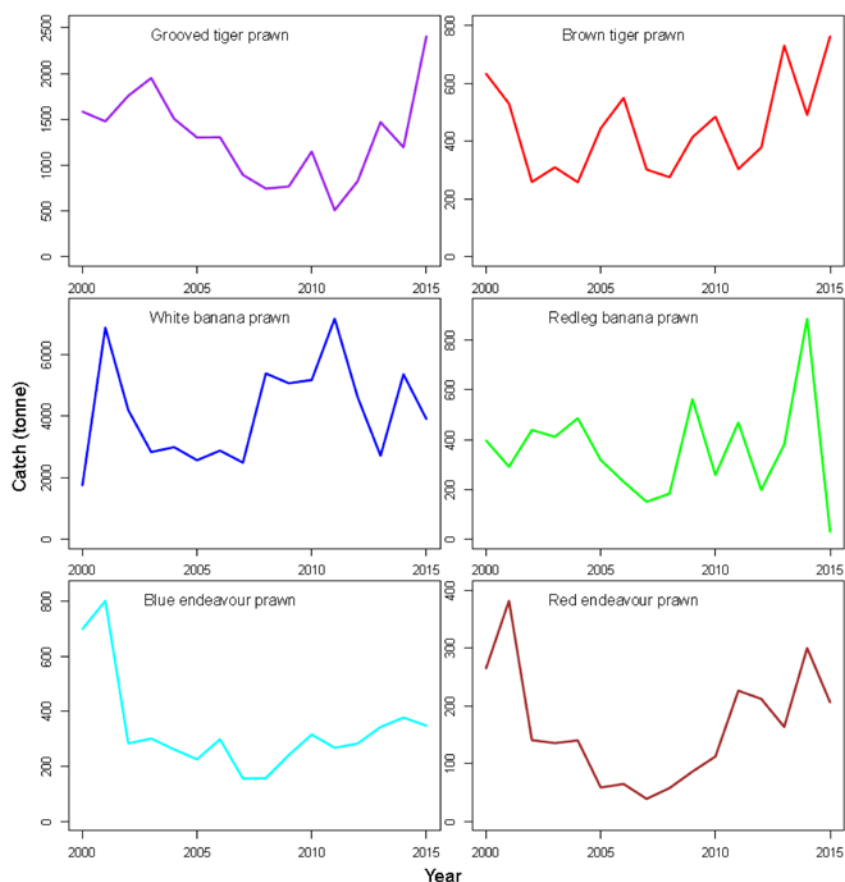


Figure 4: Estimated annual catches (tonnes) by species, 2000-2015 (NPRAG 2016a).

3.3.2 Brown tiger prawn (*Penaeus esculentus*)

Stock status

The catch of brown tiger prawns in 2015 was 763 t (Figure 4), an increase over 2014 and similar to 2013 catch levels. The most recent assessment of the status of brown tiger prawn (Buckworth *et al.*, 2016) estimates a number of parameters in relation to the agreed reference points (see below for definition of reference points). The stock status of *P. esculentus*, is based on a size-structured population model that uses size data obtained from real-time surveys in the GoC (Punt *et al.*, 2010). The method is described at Section 4.5. Stock assessments for the tiger prawn subfishery have two components: (i) the stock assessment of the two tiger prawns plus blue endeavour prawns, and (ii) the bio-economic assessment (Dichmont *et al.*, 2008, Punt *et al.*, 2011, Deng *et al.*, 2015). Buckworth *et al.*, 2016) provides an overview of approaches taken in providing the most recent assessment advice for the fishery. Two different groups of stock assessment models were applied: a) the Base Case, comprised of size-structured models (for two tiger prawn species), as well as a Bayesian hierarchical biomass dynamic model (blue endeavour prawns); and, b) Deriso models for each of the three species (Dichmont *et al.*, 2003) as sensitivity test cases of the Base Case option. Outcomes are provided below.

Table 3: Relevant management measures and parameter estimates for the Base Case for *Penaeus esculentus* (Buckworth *et al.*, 2016).

Indicator	Current value (2015)
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	(range across sensitivities)
S_{2015}/S_{MEY} (target reference point S_{MEY})	162% (136-166)
5-year av. $S_{2011-2015}/S_{MSY}$ (limit reference point $0.5S_{MSY}$)	122% (106-137%)
S_{2015}/S_{MSY}	175% (151-196)
E_{2015}/E_{MSY} (standardised effort)	35% (31-35%)
E_{2015}/E_{MEY} (standardised effort)	34% (31-42%)

E_{MSY} is the effort level (expressed in terms of 2015 days) at which MSY is achieved and S_{MSY} is the spawner stock index at which the (deterministic) MSY is achieved

Following a period of overfishing in the late 1990s to the whole tiger prawn subfishery and a rebuilding strategy from 2002 to 2006, the stock is now above the MSC target biomass target reference point (TRP) of B_{MSY} (as well as above the NPF TRP of S_{MEY}) and well above the biomass limit reference point (LRP). Effort levels are also well below the target level the brown tiger prawn stock is not overfished and not subject to overfishing (Table 3 and Figure 5). The stock is at a level which maintains high productivity and has a low probability of recruitment overfishing.

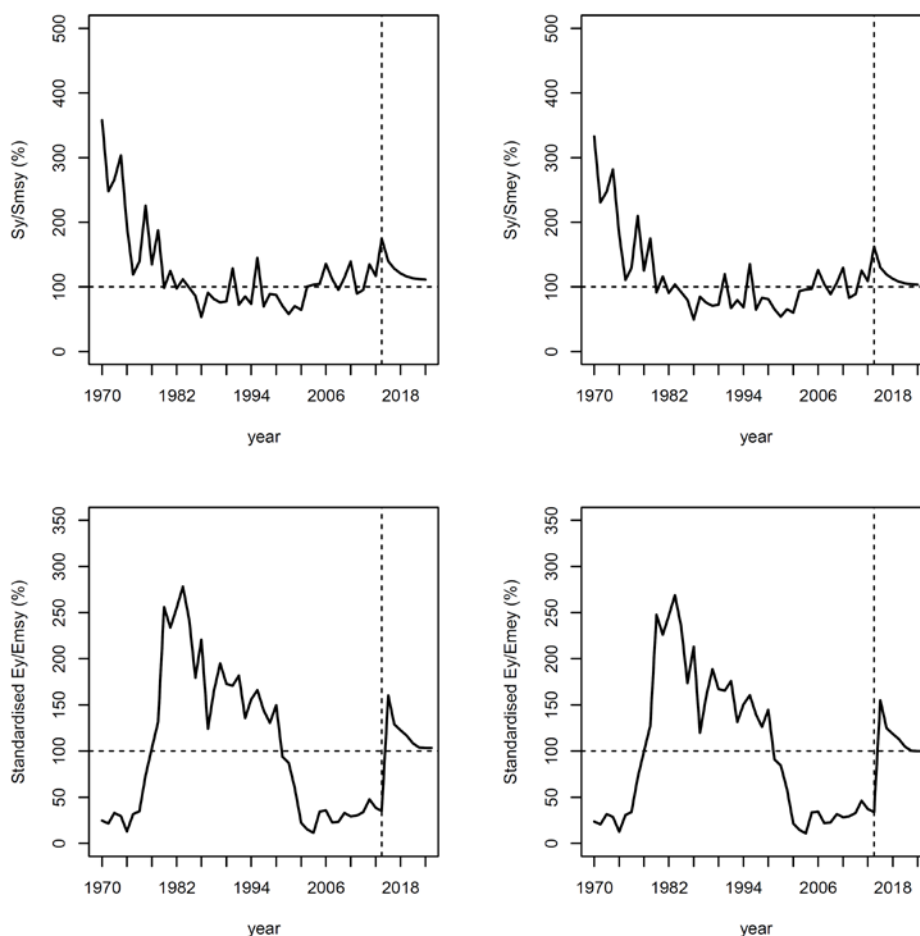


Figure 5: Status of the stock and effort relative to reference points for brown tiger prawns for the Base Case. 1) Spawning stock size (S_Y) relative to the spawning stock size at MSY (S_{MSY}) (top left), 2) spawning stock size in a year relative to the spawning stock size at MEY (S_{MEY}) (top right), 3) standardised effort in a year (E_Y) relative to the effort at MSY (E_{MSY}) (bottom left) and 4) standardised effort in a year (E_Y) relative to the effort at MEY (E_{MEY}) (bottom right). Source: Buckworth *et al.*, 2016.

Reference points

Biomass reference points

The choice of reference points to meet the Commonwealth of Australia's Legislative requirements and is aimed at realizing the objectives of the NPF Management Plan 1995 that includes "Ensure the utilization of the fishery resources is consistent with the principles of ecologically sustainable development and the exercise of the precautionary principle." More details concerning the reference points can be found at Section 4.3.

Target: S_{MEY} (Spawning biomass at maximum economic yield)

Limit: Moving average of S_Y/S_{MSY} over 5 most recent years = 0.5

There is also a 350kg/day trigger in place, which if met, results in closure of the fishery during the second season (an early closure will take place if the average prawn catch per boat (all prawn species) fishing in the NPF per night is less than 350kg for the 12th and 13th week of the season"; AFMA 2016).

S_{MEY} is a conservative target reference point that aims for economic efficiency while still maintaining the stock above S_{MSY} . Similarly, S_y/S_{MSY} is a conservative limit reference point that takes 50% of S_{MSY} as a state that is undesirable. A moving average is used to account for year-to-year variability in abundance that could cause rapid changes in management responses.

Effort reference points

The bioeconomic model predicts optimal levels of effort for the tiger prawn subfishery but also separately for brown and grooved tiger prawns based on effort patterns over the previous two years. The relevance of these predictions can be impacted by the outcomes of the white banana prawn season. Predicted MEY effort levels have been higher than actual levels to date.

Target: E_{MEY} (Effort at maximum economic yield) 1.e. $E_y/E_{MEY} = 1$.

P. esculentus is a scavenger that feeds on a wide variety of detritus, small animals and plants (e.g., foraminifera). It comprises only a very small proportion of many species of penaeid, carid and sergestid shrimps that occupy similar feeding niches in the food web of the NPF, and it is not considered a low trophic level (LTL) species.

Conclusion: Limit and target reference points are appropriate for the stock.

3.3.3 Grooved tiger prawn (*Penaeus semisulcatus*)

Stock Status

The catch of grooved tiger prawn in 2015 was 2405 t, a substantial increase from the 2014 catch of 1196 t and the highest catch of this species since the early 1980s. The most recent assessment of the status of grooved tiger prawn (Buckworth *et al.*, 2016) estimates a number of parameters in relation to the agreed reference points (see below for definition of reference points). The stock status of *P. semisulcatus*, is based on a size-structured population model that uses size data obtained from real-time surveys in the GoC (Punt *et al.*, 2010). The method is described in detail at Section 4.5.

Following a period of overfishing in the late 1990s to the whole tiger prawn subfishery and a rebuilding strategy from 2002 to 2006, the stock is now above the MSC default biomass TRP of B_{MSY} (Table 4 and Figure 5). Effort in 2015 was below that at E_{MSY} , well below that at the limit reference point. The five-year average abundances were all above 100% of S_{MSY} , and thus well above the reference point, 0.5 S_{MSY} . Grooved tiger prawns are therefore considered not overfished, and overfishing is not occurring (Buckworth *et al.*, 2016).

Table 4: Current status of *Penaeus semisulcatus* against reference points

Indicator	Current value (2015) (range across sensitivities)
S_{2015}/S_{MEY} (target reference point S_{MEY})	171% (152-196)
5-year av. $S_{2011-2015}/S_{MSY}$ (limit reference point 0.5 S_{MSY})	114% (103-145%)
S_{2015}/S_{MEY}	185%

	(164-235)
E_{2015}/E_{MSY} (standardised effort)	82% (49-110%)
E_{2015}/E_{MEY} (standardised effort)	99% (96-114%)

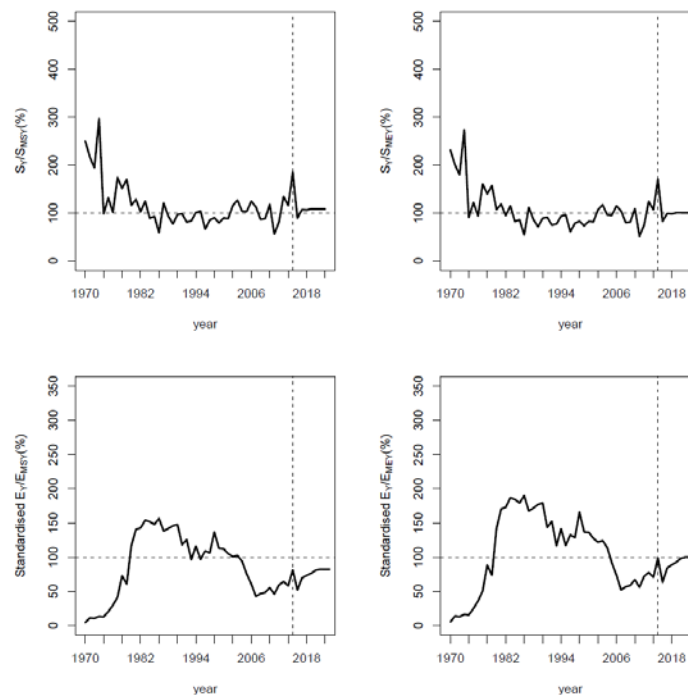


Figure 6: Status of the stock and effort relative to reference points for grooved tiger prawns for the Base Case. 1) Spawning stock size (S_Y) relative to the spawning stock size at MSY (S_{MSY}) (top left), 2) spawning stock size in a year relative to the spawning stock size at MEY (S_{MEY}) (top right), 3) standardised effort in a year (E_Y) relative to the effort at MSY (E_{MSY}) (bottom left) and 4) standardised effort in a year (E_Y) relative to the effort at MEY (E_{MEY}) (bottom right). Source: Buckworth *et al.*, 2016.

The stock status is assessed based on sophisticated modelling techniques and excellent data inputs. It can be stated with confidence that the stock is at a level which maintains high productivity and has a low probability of recruitment overfishing. The biomass is above B_{MSY} close to the TRP of B_{MEY} .

Reference points

Biomass reference points

The choice of reference points to meet the Commonwealth of Australia's Legislative requirements and is aimed at realizing the objectives of the NPF Management Plan 1995 that includes "Ensure the utilization of the fishery resources is consistent with the principles of

ecologically sustainable development and the exercise of the precautionary principle.” More details concerning the reference points can be found at Section 4.3.

Target: S_{MEY} (Spawning biomass at maximum economic yield)

Limit: Moving average of S_Y/S_{MSY} over 5 most recent years = 0.5

There is also a 350kg/day trigger in place, which if met, results in closure of the fishery during the second season (an early closure will take place if the average prawn catch per boat (all prawn species) fishing in the NPF per night is less than 350kg for the 12th and 13th week of the season”; AFMA 2016).

S_{MEY} is a conservative target reference point that aims for economic efficiency while still maintaining the stock above S_{MSY} . S_Y/S_{MSY} is a conservative limit reference point that takes 50% of S_{MSY} as a state that is undesirable. A moving average used to account for year-to-year variability in abundance that could cause rapid changes in management responses.

Effort reference points

The bioeconomic model predicts optimal levels of effort for the tiger prawn subfishery but also separately for brown and grooved tiger prawns based on effort patterns over the previous two years. The relevance of these predictions can be impacted by the outcomes of the white banana prawn season. Predicted MEY effort levels have been higher than actual levels to date.

Target: E_{MEY} (Effort at maximum economic yield) i.e. $E_Y/E_{MEY} = 1$.

P. semisulcatus is a scavenger that feeds on a wide variety of detritus, small animals and plants (e.g. foraminifera). It comprises only a very small proportion of many species of penaeid, carid and sergistid shrimps that occupy similar feeding niches in the food web of the NPF, and it is not considered a LTL species.

Conclusion: Limit and target reference points are appropriate for the stock.

3.3.4 Blue endeavour prawn (*Metapenaeus endeavouri*)

Stock Status

Since 2002, annual catches of blue endeavour prawns have averaged around 300 t. The 2015 catch was 348 t (Figure 4). The most recent assessment of the status of the blue endeavour prawn (Buckworth *et al.*, 2016) estimates a number of parameters in relation to the agreed reference points (see below for definition of reference points). The stock status of *M. endeavouri*, is based on a size-structured population model that uses size data obtained from real-time surveys in the GoC (Punt *et al.*, 2010). The method is described in detail at Section 4.5.

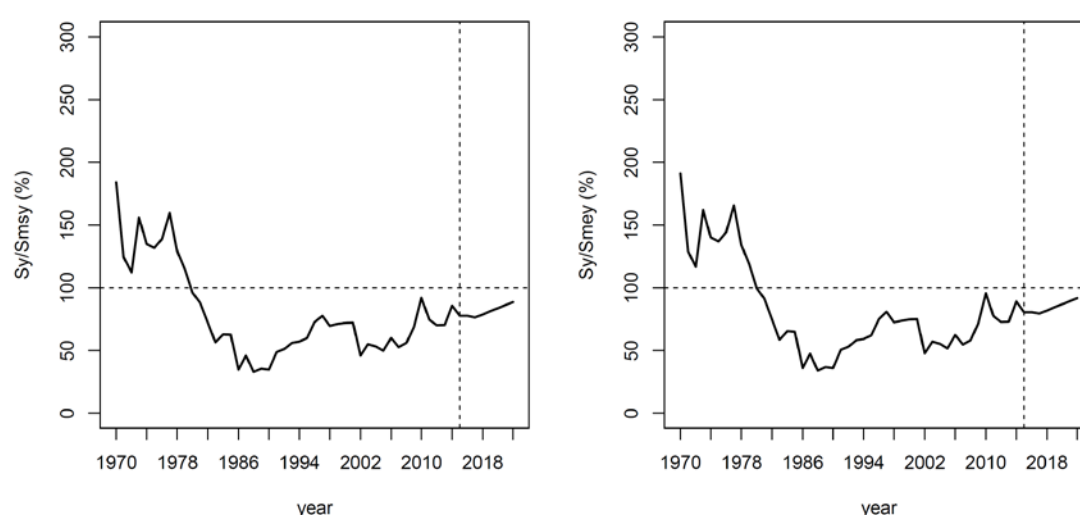
Table 5: Current status of *Metapenaeus endeavouri* against reference points

Indicator	Current value (2015) (range across sensitivities)
S_{2015}/S_{MEY} (target reference point S_{MEY})	80% (77-84)
5-year av. $S_{2011-2015}/S_{MSY}$ (limit reference point $0.5S_{MSY}$)	76% (75-94%)

S_{2015}/S_{MSY}	77% (77-97)
--------------------	----------------

Blue endeavour prawns are considered a byproduct of the tiger prawn subfishery. The species is not considered to be over-fished relative to the target reference point of $0.5 S_{MSY}$ (based on a 5-year moving average). In all the scenarios tested, the stock abundance was close to S_{MSY} at the end of 2015 (77% to 97 %). The five-year average abundance estimate ranged from 75% to 94% of S_{MSY} (Table 5 and Figure 7).

Figure 7: Ratio of spawning stock size of *Metapenaeus endeavouri* to S_{MSY} (left) and ratio of spawning stock size to S_{MEY} (right) for the Base Case. Source: Buckworth *et al.*, 2016.



Reference points

Biomass reference points

Target: S_{MEY} (Spawning biomass at maximum economic yield)

Limit: Moving average of S_Y/S_{MSY} over 5 most recent years = 0.5

S_{MEY} is a conservative target reference point that aims for economic efficiency while still maintaining the stock above S_{MSY} . Information on blue endeavour prawns should be considered in the context of it being a component of the tiger prawn fishery for which there is an operational objective to attain long-term MEY overall of the two tiger prawn and blue endeavour prawn stocks. As a result, the blue endeavour stock is not managed to the stated target reference point, but does have explicit MSY limit reference point with requirements for management action. The stock assessment calculates S_{MSY} (and S_{MEY}) and the ratio $S_{CURRENT}/S_{MSY}$ so that management action can be taken as necessary if the stock approaches the limit and to enable monitoring of the stock status against S_{MSY} . As a species with a life span of ~18 months and a generation time of about 1 year, it is appropriate to set a management target that prevents overfishing and keeps the stock in a highly productive range (note MSC interpretation on target reference points for short lived species, MSC 2015).

S_y/S_{MSY} is a conservative limit reference point that takes 50% of S_{MSY} as a state that is undesirable. A moving average used to account for year-to-year variability in abundance that could cause rapid changes in management responses.

M. endeavouri is a scavenger that feeds on a wide variety of detritus, small animals and plants (e.g., foraminifera). It comprises only a very small proportion of many species of penaeid, carid and sergestid shrimps that occupy similar feeding niches in the food web of the NPF, and it is not considered a LTL species.

Conclusion: Limit and target reference points are appropriate for the stock.

3.3.4.1 Economic assessment of tiger prawn subfishery

The bio-economic assessment this year indicated that the ratio of S_{MEY}/S_{MSY} for grooved and brown tiger prawns was 1.083 and 1.075 for the Base Case, respectively, while for blue endeavour Prawns, it was 0.963 (Buckworth *et al.*, 2016). Target effort in 2015 on grooved tiger prawns was, at 101% of E_{MEY} , very close the level that produced MEY. However, 2015 effort on brown tiger prawns was well below E_{MEY} (35%). As blue endeavour prawns are byproduct this ratio is not calculated.

3.3.5 Red endeavour prawn (*Metapenaeus ensis*)

Stock Status

Since 1998, annual catches of red endeavour prawns have been below 400 t. The 2015 catch was 206 t (Figure 4). A map of the catch distribution over the last 10 years is provided at Section 10.2.3 in Appendix 2. Because the catches of red endeavour prawns are small and variable, red endeavour prawns are not included in the regular stock assessments carried out by the CSIRO for the other species of prawns taken in the tiger prawn subfishery. Except for 1997, red endeavour prawn catches have been lower than blue endeavour prawn catches (Figure 4).

Catches have shown similar trends to that of the blue endeavour prawn, with high catches in the 1980s followed by declines reflecting the management interventions imposed on the fishery that reduced the number of fishing vessels and the fishing effort in the fishery. Over the last five years catches of both endeavour species have increased.

The distribution of commercial prawn species in the Gulf of Carpentaria was studied in 1994 (Somers, 1994). In this study, species composition data were drawn from studies conducted in the gulf between 1977 and 1992. Somers (1994) found that the red endeavour prawn was limited in its distribution, with highest abundance in the north-eastern gulf and in the deeper parts of the western gulf (35-45 m) where the sediments were more than 60% mud.

Each year, a January/February recruitment survey is undertaken on the key fishing grounds of the Gulf of Carpentaria. A spawner survey is undertaken during the mid-season break in winter on the western grounds of the Gulf before and after major changes in the fishery. These surveys started in 2002. The surveys provide abundance indices that are incorporated into the tiger prawn stock assessment Base Case. Data is also collected for red endeavour prawns during the surveys, however, these are not used in a stock assessment for the species. Red endeavour prawns have very low abundances and high CVs. The spawning survey for 2016 was carried out from 2nd – 23rd July 2016. Two hundred and fourteen sites were trawled. Indices of prawn abundance by species (7 species; the 6 UoAs and western king prawn) have been calculated. A bubble map of red endeavour prawns from the most recent survey is presented at Figure 8.

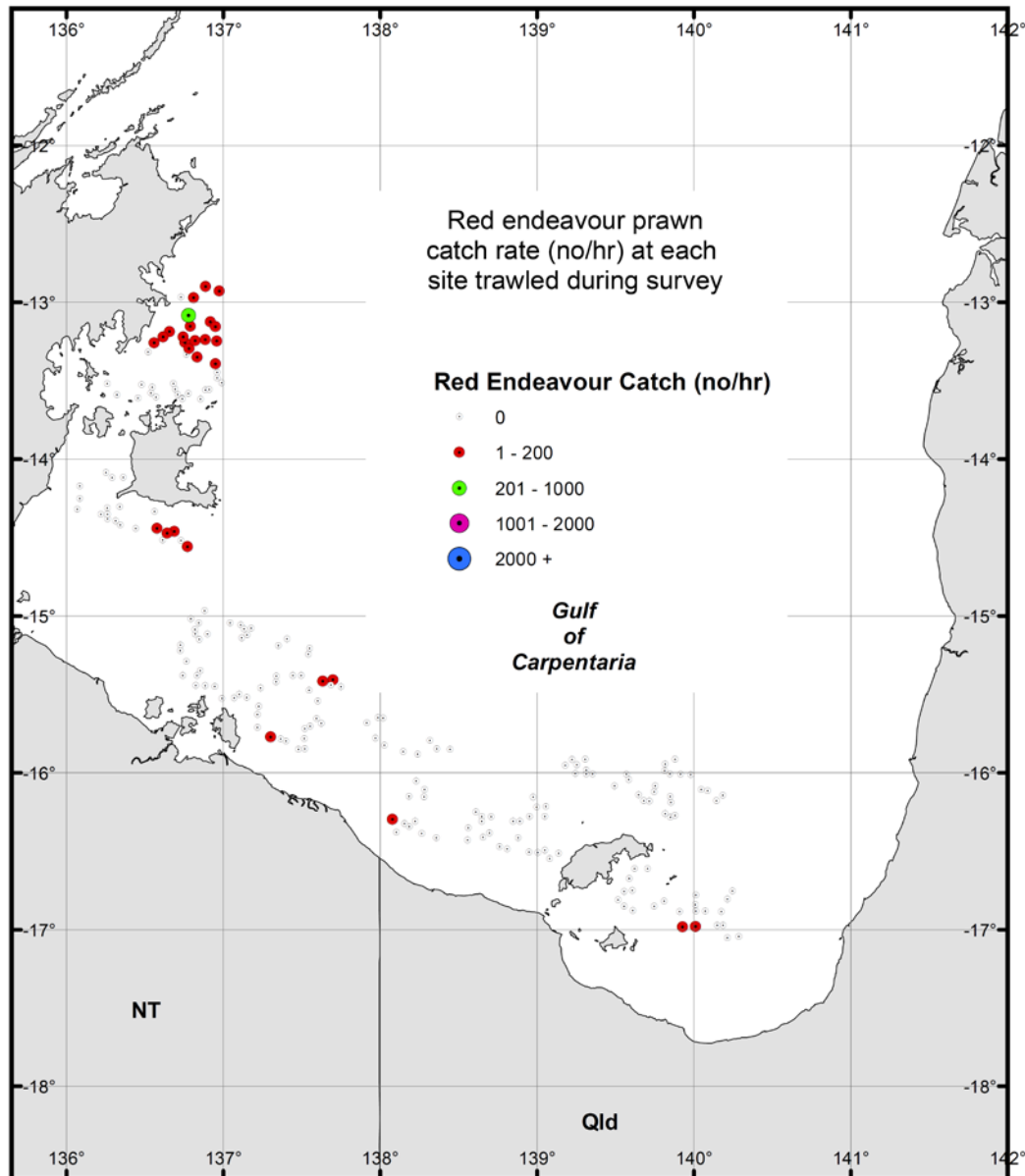


Figure 8. NPF monitoring survey of the Gulf of Carpentaria, July 2016. Source: Kenyon *et al.*, 2016.

The original MSC assessment of the NPF (MRAG, 2012) reports that the status of this stock is assessed based on logic that applies for stocks that are well managed but do not have a formal stock assessment or biomass based reference points. In this case “likely”, “highly likely” and “high degree of certainty” are interpreted both qualitatively (through analogy with similar stocks, plausible argument and risk assessments. An empirically based ‘Level 2’ analysis (PSA – Productivity Susceptibility Analysis) rated red endeavour prawns as low risk (Griffiths, S. *et al.*, 2007)). The attribute values for many of the units (e.g., age at maturity, depth range, mean trophic level, etc.) were obtained from published literature and other resources (e.g., scientific experts), and stakeholder input was provided at several points in the assessment through the NPRAG) (including fishers, managers and scientists). The red endeavour prawn was rated as “low risk”.

At the time of the 2012 MSC assessment of the NPF, both species of endeavour prawns (red and blue endeavour prawns) were included as economic bycatch in the in the bio-economic model used for the tiger prawn subfishery (MRAG, 2012) and the two species were considered together as part of the harvest strategy (AFMA, 2010). In an updated bio-economic model red endeavour prawns are not considered due to a lack of a stock assessment for the species. See discussion of the current harvest strategy below (Dichmont *et al.*, 2014).

The assessors concluded that there was insufficient information to apply the standard assessment methodology, as prescribed in the FAM V2, to assess the stock status to score PI 1.1.1 for red endeavour prawns. For this reason, the RBF was applied. A Scale Intensity Consequence Analysis (SICA) and a Productivity Susceptibility Analysis (PSA) were undertaken. The application of the RBF is described at Appendix 2.

The SICA resulted in a consequence score of 2, implying a PI 1.1.1 score of 80 (MSC CR v1.3 Table CC14). The PSA score for red endeavour prawns was 1.93, implying an MSC score of 96 (using MSC PSA worksheet for RBF).

Reference points

Biomass reference points

Whilst there is a formal harvest strategy in place for the NPF (Dichmont *et al.* 2014), there are no formal reference points for red endeavour prawns. The operational objective of the HS is to attain long-term MEY from the tiger prawn subfishery. Red endeavour prawns are not considered in the bio-economic model as no stock assessment is available for this species. Hence the reference points and control rules described for brown tiger prawn, grooved tiger prawn and blue endeavour prawn under the current HS do not strictly apply to red endeavour prawns. There is, however, an overriding TRP in the NPF HS of S_{MEY} and an overriding LRP of $0.5S_{MSY}$ (Dichmont *et al.*, 2014).

There is limited spatial separation between tiger and endeavour prawns (except for very occasional ‘spikes’ in catches of red endeavour prawns) and the correlation between tiger and endeavour prawn catches is quite high. As endeavour prawns are generally taken as an incidental part of the tiger prawn catch, effort controls described in the HS (Dichmont *et al.*, 2014) that apply to tiger prawns also apply to endeavour prawns. As described above, there is a decision rule for early closure of the second fishing season that if the average prawn catch per boat per night is less than 350kg for the 12th and 13th week of the season; then the fishery will close at the end of the 16th fishing week. A representative sample of the catch rates across the fleet is required for this measure and the catch rate estimates used include red endeavour prawns.

Conclusion:

Reference points have not been developed for red endeavour prawns. Given that the RBF was applied for this species, the reference point Performance Indicator is not scored.

3.3.6 White banana prawn (*Fenneropenaeus merguensis*)

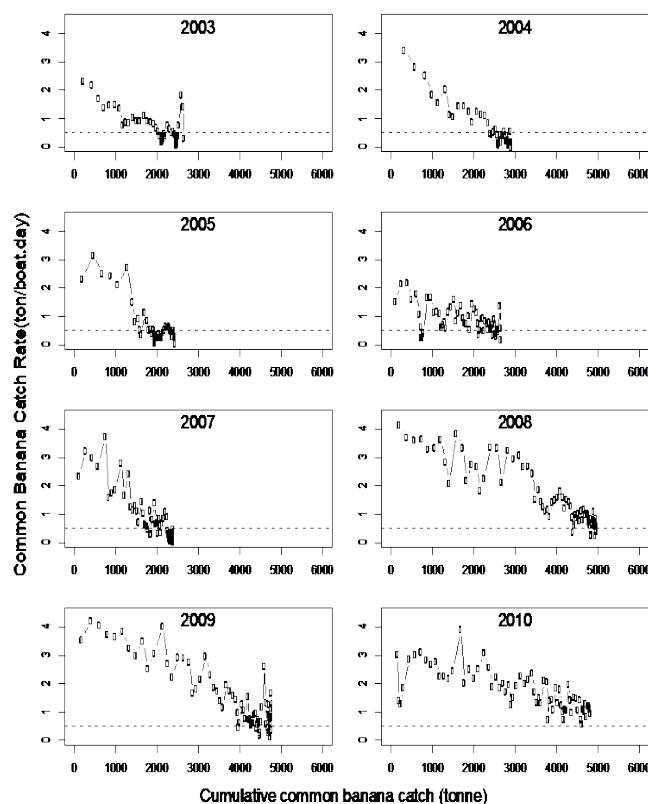
Stock Status

Because the annual recruitment of the white banana prawns is driven by environmental conditions (rainfall and catchment basin runoff) (Vance *et al.*, 1998), it is difficult to conduct stock assessments based on simple stock recruitment assumptions. However, annual catches

have been correlated with rainfall, and prediction of catches made on the basis of the rainfall preceeding the banana prawn fishing season (Venables *et al.*, 2011). Since 1970, catches, especially in the southeastern Gulf of Carpentaria, have responded more or less as expected to changes in rainfall, indicating that the stocks of banana prawns have remained at levels above those at which recruitment has been impaired. Catches have also bounced back in areas of the Gulf where there were some concerns that overfishing may have occurred. Historical records, therefore, indicate that the banana prawn subfishery is sustainable with the current short fishing season. The season can be shortened in lower catch years, based on catch rates. The harvest strategy for the stock has, inter alia, an objective to allow sufficient escapement to ensure an adequate spawning biomass and to allow subsequent recruitment. This is achieved by closing the season when catch rates fall below a trigger level associated with permitting sufficient prawns to escape to ensure an adequate spawning biomass for subsequent recruitment (based on an analysis of historical data, Dichmont *et al.*, 2012b) (see account of the HS below).

Harvest rates for white banana prawn in the fishery are understood to have been high (>90 per cent of available biomass) in some years (Buckworth *et al.*, 2013), but banana prawns are believed to be resilient to fishing pressure (Patterson *et al.*, 2016). ABARES annual fishery status reports classify the stock as not subject to overfishing and not overfished (Patterson *et al.*, 2016).

Figure 9: Annual changes in the escapement of *Fenneropenaeus merguensis* at the end of the fishing season shown by a plot of the catch rate vs the accumulative catch rate.



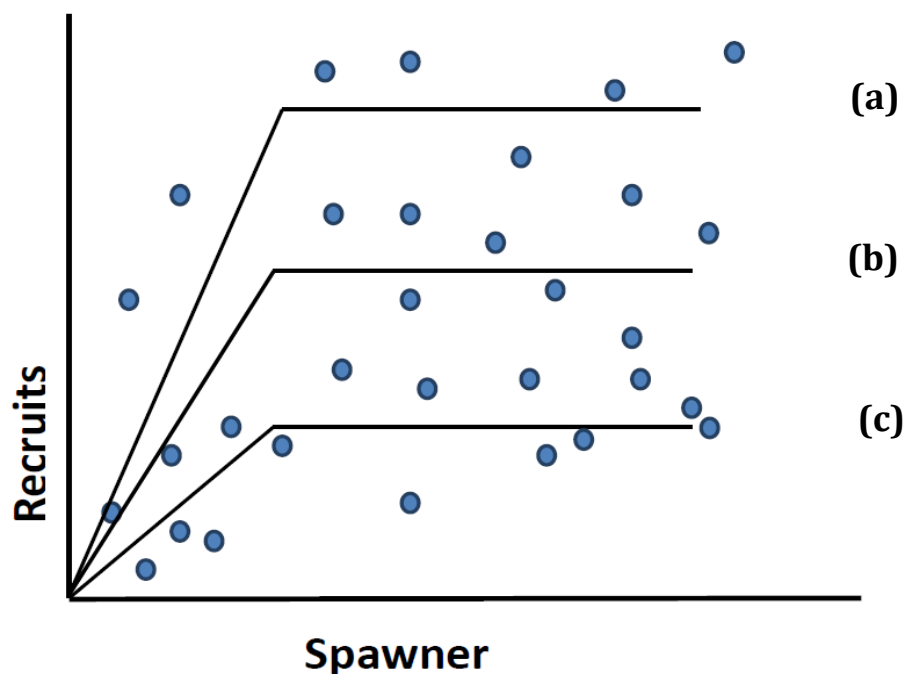
Source: Dichmont, C., CSIRO, Interview No 3 (from MRAG, 2012).

As reported in the 2012 MSC assessment (MRAG, 2012), the catch rate at the end of the season is now higher than in earlier years, providing evidence that the escapement (biomass and number

of prawns remaining at the end of the banana prawn fishing season (in April/May)) has increased in recent years (Figure 9).

A conceptual model can be used to describe the dynamics of the white banana prawn population (Figure 10). The spawning stock: recruit relationship can be shown as a series of “lines” that reflect the intensity of rainfall. “Line” (a) is high rainfall, (b) is medium rainfall and (c) is low rainfall. Each “line” shows a threshold above which there is no relationship between the spawners and subsequent recruits. Below this threshold, recruits are influenced by the size of the spawning stock and at the extreme, zero spawners results in zero recruits. The fact that residual catch, after taking into account rainfall, has not declined indicates that the stock has not dropped below the threshold, and is in fact fluctuating around an average B_{MSY} . Each year the catch is a function of the number of recruits and in some areas of the GoC, the fishing effort, which is managed through the input controls, including the length of the fishing season based on catch rates.

Figure 10: Conceptual model of white banana prawn dynamics (MRAG, 2012). (a) = high rainfall; (b) = medium rainfall; and (c) = low rainfall



Further, an empirically based Level 2 analysis (PSA – Productivity Susceptibility Analysis) rated white banana prawns as low risk (Griffiths *et al.*, 2007). The attribute values for many of the units (e.g., age at maturity, depth range, mean trophic level, etc.) were obtained from published literature and other resources (e.g., scientific experts), and stakeholder input was provided at several points in the assessment through the NPF Resource Assessment Group (NPRAG) (fishers, managers and scientists).

Based on the evidence provided it would appear that the stock has been maintained or has exceeded the biomass that produces MSY, and the stock is at a level which maintains high productivity and has a low probability of recruitment overfishing.

From 2012 to 2015, the banana prawn season operated from 1 April to 15 June with 76 fishing days available. Catches are shown in Figure 4. The 2016 season concluded on 9 June due to catch rates falling below the trigger level. See discussion below under *Harvest control rules and tools*.

Reference points

Biomass reference points

Because of the environmentally driven inter-annual variability there are no formal biomass reference points. Concepts such as a static MSY and 0.5MSY are not appropriate for this species and MSY needs to be interpreted in a more dynamic sense. The surrogate measures are that there will be a sufficient escapement from the subfishery to not jeopardize subsequent recruitment and to maximize the economic return from the fishery within the constraint of the limit. Until recently, a surrogate limit reference point was based on catch rates from the fishery (for example, a rule was in place such that the first season was closed if the average daily catch rate of banana prawns for the 4th and 5th weeks of the season was less than 500 kg/boat/day). In October 2013, the AFMA Commission adopted an MEY-based catch trigger as the new management target for the banana prawn fishery. The MEY point for the banana prawn fishery is the point such that weekly marginal revenue equals weekly marginal cost i.e. when catch rates fall to the point where revenue generated by the catch is equal to the daily costs of fishing, so that marginal profit falls to zero: the “break even” catch rate. The MEY trigger is variable and is calculated in-season, based on information on prawn prices and costs. NPF operators are to be informed of the MEY trigger value by the end of the 5th fishing week of the season. Restrictions are placed on the trigger to restrict a large change in allowable effort from the current trigger:

- Minimum MEY trigger value: 425kg/boat/day
- Maximum MEY trigger value: 575kg/boat/day

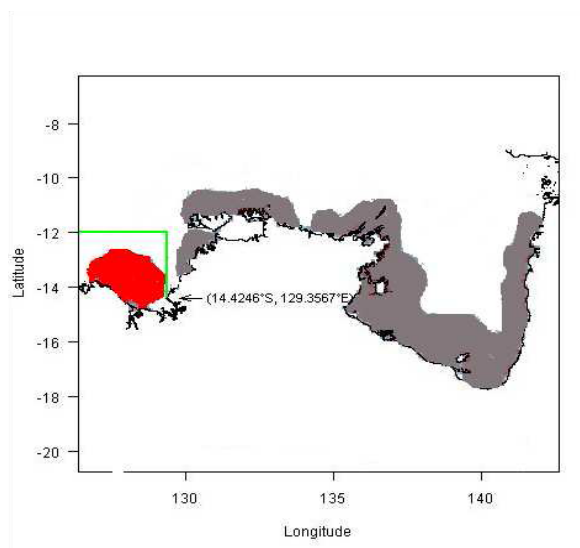
3.3.7 Red-legged banana prawn (*Fenneropenaeus indicus*)

Stock Status

Red-legged banana prawns comprise a relatively small percentage of the total prawn catch and have had less stock assessment attention than the tiger prawns. A red-legged banana prawn area has been defined within JBG, from which the bulk of their catches within their NPF are taken (Figure 11). Red-legged endeavour prawns are afforded a level of protection due to the high tidal ranges in JBG restricting fishing in the area to two weeks of each month (Dichmont *et al.*, 2012).

An assessment model is available for red-legged banana prawns in the JBG fishery. The model is a dynamic production model, in which the dynamics are represented over quarterly time steps (Plagányi *et al.*, 2010). The model is fitted to available catch and effort data. Whether or not the fishery is open for any year, and whether it is open for the first season, is determined by the status of the fishery, under the harvest strategy for the fishery (for more detail of the method see Section 3.3.12.3. For the stock assessment, the limit reference point proxy (as per the HSP) of $0.5S_{MSY}$ is used. The overfishing reference points are the corresponding fishing mortality levels that correspond to the above over the long-term. The assessment model was used to interpret the limit reference point as kilos of catch. The assessment model computed that the limit reference point of $0.5B_{MSY}$ was equal to 390 kg/day.

Figure 11: The area defined as the Joseph Bonaparte Gulf (JBG) subfishery for red-legged banana prawns. Source: Buckworth *et al.* (2016).



Buckworth *et al.* (2015b) provides an assessment of the status of red-legged banana prawn estimates the following parameters against the reference points (see below for definition of reference points). Model analyses suggest that the resource dropped below B_{MEY} between the mid-1980s to the mid-2000s, substantially so after being near B_{MEY} in 1995. Since the mid-2000s, however, spawning biomass has been near the B_{MEY} level². The spawning biomass level at the end of 2014 is estimated to have been well above B_{MSY} and B_{MEY} , by factors of 3.2 and 2.7, respectively (Table 6). This was because recruitment was much greater than average, in turn supporting a catch that was higher than would be expected at average recruitment levels. The average fishing mortality rate over the quarters (0.13), the proportion of the stock removed by fishing, was close to the target level for the year (0.15). (Buckworth *et al.*, 2015b).

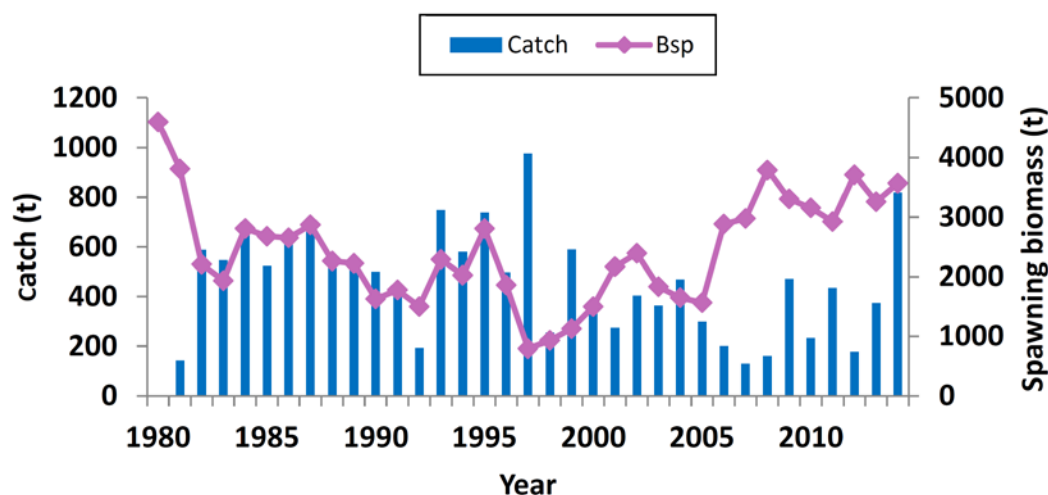
Table 6: Current status of *Fenneropenaeus indicus* against reference points (Buckworth *et al.*, 2015b)

Indicator	Current value (2014)
S_{2014}/S_{MEY} (target reference point S_{MEY})	269%
S_{2014}/S_{MSY} (limit reference point $0.5S_{MSY}$) 2 years running	323%

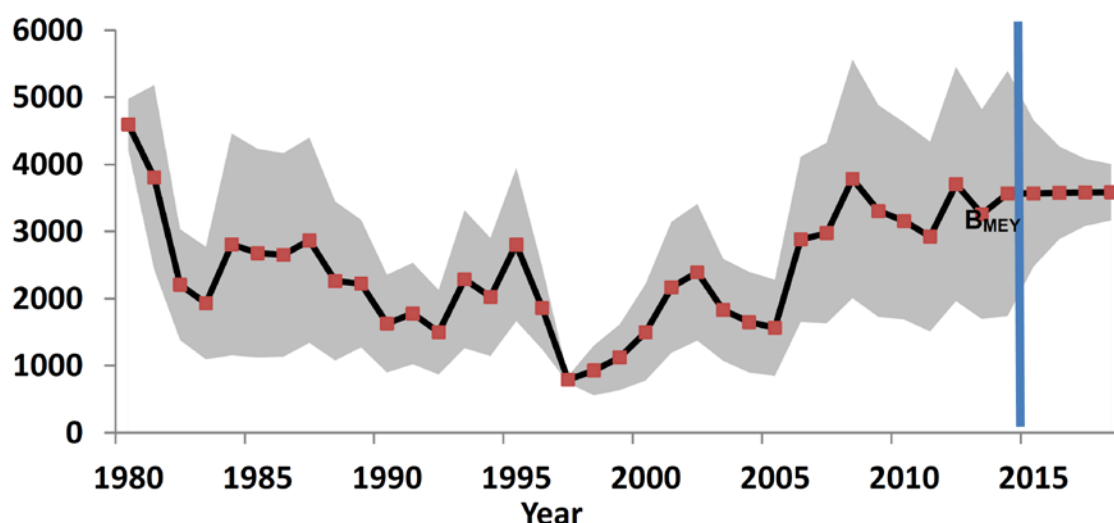
Figure 12: (a) Total annual spawning biomass trajectory using the Base Case model, with total annual catches for 1981 to 2014 plotted as bars. (b) Base Case spawning biomass estimates for the period 1980 to 2014, and projected forward to 2019. The shaded areas represent the associated Hessian-based 90% confidence intervals. Source: Buckworth *et al.*, 2015b.

² 2014 biomass estimated at 3569 t (std 1110 t); 2014 B_{MSY} 1106 t; 2014 B_{MEY} 1237 t

(a)



(b)



The red-legged banana prawn assessment is much less certain than the tiger and endeavour assessments, with wider 90% confidence intervals. Because there is no pre-season survey, the assessment relies on CPUE data only and the standardisation of these data may be less reliable than that applied to the other species which have been subject to longer and more in-depth analyses. As a result, the LRP does not align with the tiger and endeavour prawn LRP of the five-year average of the most recent consecutive year and is more conservative, namely that the LRP is implemented as soon as the stock falls below 0.5 B_{MSY} for two years in a row. Since the model relies on fisheries dependent data, some provision for collecting catch rate data may be required. For the same reason, the fishery would be re-opened after a single year's closure in order to maintain reliable data for the stock assessment.

The stock assessment for red-legged banana prawns was updated in 2016 using data to the end of 2015. Although the estimated 2015 spawning biomass was close to B_{MSY} , low catches and effort in 2015 resulted in the assessment not being able to provide reliable estimates of stock

status. Catches were again low in 2016. The November 2016 NPRAG meeting (NPRAG 2016b) discussed potential reasons for the low catch/effort in the two recent seasons. Key suggestions raised included:

- there may be a potential difference in recruitment patterns;
- there is evidence of changing currents in the region;
- prawns may have moved into different areas;
- limited rainfall;
- fishers don't steam to the JBG due to good catches in other areas.

Based on the decision rules of the HS, NPRAG recommended opening of the JBG fishery for the full fishing year in 2016 (NPRAG 2016a). NPRAG (2016a) has indicated that further consideration of the appropriateness of the HS in years of low fishing effort is needed. NPRAG (2016a) also suggested that to maintain confidence in sustainability of the fishery and to support effective management, independent or additional sources of information should be sought (these might include a recruitment survey, or monitoring of early-season CPUE trends).

Reference points

Biomass reference points

Prior to the 2012 season, the red-legged banana prawn was managed as part of a total banana prawn subfishery that includes both the white banana prawn and the red-legged banana prawn. As with white banana prawns, there were no formal biomass reference points and management was based on there being a sufficient escapement from the subfishery to not jeopardize subsequent recruitment. There was a surrogate limit reference point of a catch rate of 500kg/day, used to trigger the fishing season shortening.

However, between 2007 and 2010 inclusive, the red-legged subfishery of the JBP was not fished during the white banana prawn season and fishing occurred only during the tiger prawn season from August to November. During this period, a catch trigger of 350 kg/day applied and, if necessary, closed the subfishery. The tiger prawn catch trigger limits closed the entire fishery, including the JBG subfishery in 2009 and 2011 when the catch triggers were not met.

More recent stock assessments have considered stock status relative to HSP default reference points of $0.5B_{MSY}$ (LRP) and $1.2B_{MSY}$ (TRP). The HS for red-legged banana prawns is discussed below.

Target: S_{MEY} (Spawning biomass at maximum economic yield) defined as $1.2B_{MSY}$

Limit: S_Y/S_{MSY} over 2 most recent years = 0.5 (the assessment model computed that the LRP of $0.5B_{MSY}$ was equal to 390 kg/day).

S_{MEY} is a conservative target reference point that aims for economic efficiency while still maintaining the stock above S_{MSY} . S_Y/S_{MSY} is a conservative limit reference point that takes 50% of S_{MSY} as a state that is undesirable.

F. indicus is a scavenger that feeds on a wide variety of detritus, small animals and plants (e.g., foraminifera). It comprises only a very small proportion of many species of penaeid, carid and sergestid shrimps that occupy similar feeding niches in the food web of the NPF, and it is not considered a low trophic level (LTL) species.

Conclusion: Limit and target reference points are appropriate for the stock.

3.3.8 Harvest Strategy (PI 1.2.1)

In September 2007, the Australian Government released the Commonwealth Fisheries Harvest Strategy Policy and Guidelines for Implementation of the Strategy. The Minister subsequently required AFMA to implement harvest strategies in all relevant Commonwealth fisheries by January 2009 (DAFF, 2007). The Harvest Strategy Policy (HSP) and associated implementation Guidelines aim to ensure that key commercial fish species are managed for long-term biological sustainability and economic profitability. It also seeks to provide the fishing industry with a more certain operating environment. The HSP provides a framework that allows a strategic, science-based approach to setting total allowable catch levels in all Commonwealth fisheries on a fishery by fishery basis. The implementation guidelines provide practical advice on how to interpret and apply the HSP to Australia's fisheries and contain details of the science behind the fisheries management decisions.

The HSP was reviewed in 2012 (DAFF 2013). Overall the review found that although some aspects of the policy and guidelines could be further refined, the HSP is widely regarded as having been a very successful initiative for improving the management of Australia's Commonwealth fisheries and remains a strong foundation for Commonwealth fisheries management. The review also found that the policy and guidelines meet or exceed the standards of relevant international obligations and continue to represent best practice in most respects.

The HSP states that harvest strategies will seek to:

- maintain fish stocks, on average, at a target biomass point (B_{TARG}) equal to the stock size required to produce maximum economic yield (B_{MEY}). In cases where B_{MEY} is unknown, a proxy of $1.2B_{MSY}$ (or a level 20% higher than a given proxy for B_{MSY}) is to be used for a single species fishery and in the case of a multi-species fishery judgement needs to be exercised.
- ensure fish stocks will remain above a biomass level where the risk to the stock is regarded as too high, that is B_{LIM} (or proxy; equal to or greater than $\frac{1}{2} B_{MSY}$); and
- ensure that the stock stays above the limit biomass level at least 90% of the time.

The HSP states that for highly variable species that may naturally (i.e. in the absence of fishing) breach B_{LIM} , the harvest strategy for these species must be consistent with the intent of the Policy. The HSP also gives direction on rebuilding strategies to be employed for a stock below B_{LIM} .

The NPF harvest strategy (HS) has been developed in line with the Commonwealth HSP. The current NPF HS was approved by the AFMA Commission in 2014. The current HS is similar to that examined at the initial MSC assessment of the fishery (MRAG, 2012) though there has been further development of the strategy since then. The current NPF HS (Dichmont *et al.*, 2014) includes distinct strategies for the tiger prawn and banana prawn fisheries and is designed to operate within the current management system of input controls. The potential for moving to output controls in future is also being examined. The NPF HS has been tested using MSE to assess its performance against the HSP (Dichmont *et al.*, 2008). This evaluation showed that the harvest strategy performed well in terms of meeting the HS objectives under a number of different scenarios that included different sources of uncertainty.

In the banana prawn sub fishery, recruitment patterns of the white banana prawn have been assessed and linked to annual rainfall patterns (Venables *et al.*, 2011). The HS objective is to allow sufficient escapement from this fishery to ensure an adequate spawning biomass of banana prawns (based on historical data), and to maximize the economic return from the fishery within the above parameter. An analysis of the residual catch (catch with the effect of rainfall removed) shows no trends across the NPF, indicating that fishing has not impacted on recruitment and

that the HS is effective. The reduction in fleet size has also reduced the ability of the fleet to search for and catch white banana prawns to the same extent they have done in the past.

3.3.9 Harvest control rules and tools (PI 1.2.2)

The NPF is currently managed through a combination of input controls (limited entry, seasonal closures, permanent area closures, gear restrictions and operational controls), which are implemented under the Management Plan.

The table at Section 3.2.1 describes the evolution fleet management and harvest tools using both successive buy-back schemes (mid-1980s, 1990 and 2006) and tradeable gear Statutory Fishing Rights (SFRs), as established in 1995. The number of vessels has been reduced to the level estimated by the Australian Bureau of Agricultural and Resource Economics and Science (ABARES) needed to reach the Maximum Economic Yield (MEY) in the NPF.

The Management Plan provides for the granting of fully transferable SFRs that determine the number of trawlers that may operate (Class B SFRs) and the amount of gear (Gear SFRs) used in the Fishery. In 2001, the Management Plan was amended to allow the total gear pool to be set by a Determination. The gear SFR is set as an amount of headrope length (and corresponding footrope controls), which can be varied depending on the stock status and economic grounds.

In 2002, measures to reduce effort by 40% on tiger prawn stocks were introduced. This was achieved by shortening the seasons and a further 25% reduction in the value of a gear SFR from 24 August 2002. Internal trading amongst the fleet following this measure resulted in a reduction in Class B SFRs from 119 to 102.

In 2006, the Commonwealth Government Structural Adjustment Package removed 42 Class B SFRs and approximately 30% of the effective effort from the NPF.

In 2008, following a recommendation from the Northern Prawn Fishery Management Advisory Committee (NORMAC) there was an 8% increase in effort in the 2008 tiger prawn season. This translated into NPF gear SFRs increasing in operational value from 5.625 cm to 7.481 cm and Concessions Holders were permitted to use quad gear (with a 10% penalty applied).

In 2009, the tiger prawn season was increased by four weeks based on the outputs of the 2008 tiger prawn stock assessment, resulting in the season commencing on 25 July and closing on 19 December (Laird 2016). This was the first time since the introduction of the mid-year closure in 1987 that the tiger prawn season commenced prior to 1 August.

In 2011, the banana prawn season was extended by two weeks to enable industry to make optimal use of an expected large available biomass of banana prawns resulting from favourable environmental conditions. Due to improvements in the tiger prawn stock assessment, it was also agreed that tiger prawns could be targeted in the banana prawn season from 1 May. An on-going rule was put in place to close banana fishing west of 138°E and to prevent daylight trawling east of this location to protect banana prawns if average daily catches did not meet a trigger of 500 kg per boat/day during the two-week reporting period. The tiger prawn season commenced on 1 August and concluded one week early on 20 November due to tiger prawn catch trigger limits not being met the early tiger prawn season closure was implemented to protect stocks and prevent economic losses in the tiger prawn fishery.

In 2012, 2013 and 2014, the banana prawn season was open from 1st April to 15th June, and the tiger prawn season from 1st August to 30th November.

A Maximum Economic Yield (MEY) banana prawn catch trigger was implemented in 2014 as part of the future management regime for the banana prawn fishery. The MEY catch trigger

fishery closes the fishery west of 138°E, and prohibits daylight trawling east of 138°E if catches fall below the restricted MEY trigger of 425 kg (per boat per day) in any two week catch reporting period. The trigger is calculated in-season based on catch, cost and price information provided by industry.

2015 and 2016 operation of harvest control rules

In 2015, the banana prawn season again operated from 1 April to 15 June and the tiger prawn season operated from 01 August to 30 November (though targeting of tiger prawns was also permitted from 1 May until 15 June during the banana prawn season). As indicated in Box 2, there are three catch rate reporting periods during the banana prawn season. The average catch rate of banana prawns exceeded the minimum 425 kg per boat fishing day trigger level. At the final reporting period, the average catch rate was 789 kg, enabling the season to continue until 15 June.

The 2016 banana prawn season opened on 1 April. At the end of the 3rd reporting period for the banana prawn fishery, the average catch per boat was 420 kg, below the 425 kg trigger level. As a result, the season closed on 9 June. Tiger prawn fishing was permitted in the latter half of the banana prawn season under the decision rules.

At the end of the designated catch reporting period for the tiger prawn fishery in 2015, the average catch per boat per fishing day was 703 kg, well in excess of the 350 kg trigger limit.

At the end of the designated catch reporting period for the tiger prawn subfishery in 2016, the average catch per boat per fishing day was 330 kg, below the 350 kg trigger limit. As a result, the season closed on 20 November.

The harvest strategies operate as follows:

Box 1: Summary of the tiger prawn fishery harvest strategy (as at 2014)

Tiger Prawns

Species: Brown tiger prawn, grooved tiger prawn and blue endeavour prawn.

Target: S_{MEY} , spawning biomass at maximum economic yield.

Limit: Half of the spawning stock needed to achieve maximum sustainable yield ($0.5S_{MSY}$), calculated as the moving average over five years.

The operational objective of the HS is to attain long-term MEY from the tiger prawn species. In the context of the MEY target, endeavour prawns are treated as an economic bycatch of the tiger prawn fishery. MEY is calculated as the effort level in each year over a 7-year projection period that creates the biggest difference between the total revenue generated from tiger and endeavour prawns and the total costs of fishing for the tiger prawn subfishery as a whole. To assess whether the tiger prawn fishery has achieved the operational objective of attaining MEY, the tiger prawn fishery TRP is S_{MEY} . It is recognised, however, that the indicator S_Y/S_{MEY} will vary considerably from year to year as a result of large inter-annual variability in recruitment and in the values of economic parameters.

There is also a TRP for the economic performance of effort, $E_Y/E_{MEY} = 1$. A value greater than 1 indicates that effort for the year was in excess of that estimated to be required to produce MEY. Because of natural inter-annual variability, E_Y/E_{MEY} will exhibit considerable variability. Also, the pathway to MEY is part of the annually derived dynamic bio-economic model calculation and therefore, unlike B_{MSY} -type reference points, outputs a non-linear effort pathway to MEY. The fishery is considered to be experiencing overfishing

if E_Y is in excess of the effort that would be expected to result in a stock that is overfished, i.e. moving average of S_Y/S_{MSY} over 5 years ≤ 0.5 .

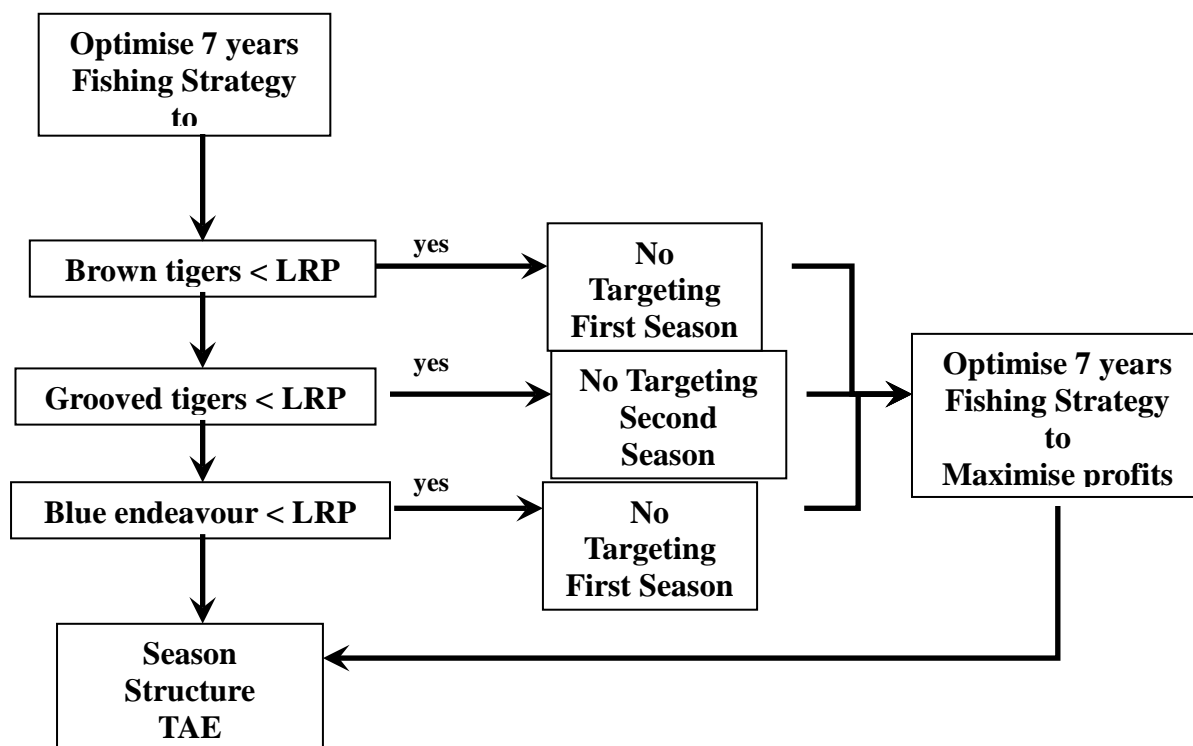
Control rules: Control rules are set for tiger prawns but also cover blue endeavours based on the conclusion that blue endeavours are taken as incidental catches and that control of tiger prawn fishing will also protect this species. There is a specific blue endeavour prawn rule when this species falls below the LRP. The flow chart for the LRPs is given in Figure 13.

The sequence in decision rules is as follows:

1. A bio-economic assessment will be undertaken every alternate year, optimising the effort over a seven-year moving window to maximise profits.
2. If the LRP is triggered, there will be no target fishing on the target species concerned. Spatial and/or temporal measures will be used to prevent target fishing on species below the limit reference point.
3. Providing the limit reference point is not exceeded, nominal effort for the fleet in any one year cannot be less than 1.08 times the nominal effort targeted at brown tiger prawns in 2007.
4. The effort in nominal days for each fleet (brown and grooved) for the first two years from the bio-economic assessment will be applied. This will be calculated as a percentage change from the previous year's actual nominal effort.
5. Effort controls will be applied through the use of spatial and temporal closures, and gear; or any combination of these inputs.
6. If effort changes are to be implemented through gear, the change in effort versus the change in gear will be calculated empirically and calculated based on the percentage gear change from the previous year's gear amount (Figure 6 of Dichmont *et al.*, 2014).

Source: NPF Harvest strategy 2014 (Dichmont *et al.*, 2014)

Figure 13: Flow chart of Limit Reference Point decision rules.



Box 2: Summary of the banana prawn fishery harvest strategy (as at 2014)

Banana Prawns

Species: White banana prawn.

Reference levels: The operational objective for the banana prawn subfishery is to allow sufficient escapement from this fishery to ensure an adequate spawning biomass of banana prawns (based on historical data), and to achieve the maximum economic yield (MEY) from the fishery.

The banana prawn season extends for 10 weeks from the start of the season, unless one of several decision rules is triggered. The following reference points are used:

- An average catch rate across the fleet of no less than the MEY catch trigger at the end of the 5th week in the banana prawn fishing season.
- A trigger limit of 6.6 t/week of tiger prawns caught at the end of the 4th week in the banana prawn fishing season.
- An average catch rate across the fleet of no less than the MEY catch trigger at the end of the 7th week of the banana prawn fishing season.
- An average catch rate across the fleet of no less than the MEY catch trigger at the end of the 9th week.

Control rules:

The banana prawn fishery is managed by a fixed length season, with some in-season management aimed primarily at allowing a maximum season length in highly productive years, and reducing the season length in years of low production. The season is closed when catch rates fall below a trigger level associated with permitting sufficient prawns to escape to ensure an adequate spawning biomass for subsequent recruitment (based on an analysis

of historical data, Dichmont *et al.*, 2012b). In addition, the trigger is designed to achieve an economic outcome by closing fishing when catch rates fall below uneconomic levels.

The MEY point for the banana prawn fishery is the point such that weekly marginal revenue equals weekly marginal cost i.e. when catch rates fall to the point where revenue generated by the catch is equal to the daily costs of fishing, so that marginal profit falls to zero: the “break even” catch rate. The MEY trigger will be variable and will be calculated in-season, based on information on prawn prices and costs.

Further details on decision rules for season closure are presented in Dichmont *et al.*, 2014.

Source: NPF Harvest strategy 2014 (Dichmont *et al.*, 2014)

Box 3: Summary of the red-legged banana prawn fishery harvest strategy (as at 2014)

Red-legged banana prawns

Species: Red-legged banana prawn.

Target: There is no specific target level for red-legged banana prawns.

Limit: No fishing if the stock falls below $0.5B_{MSY}$ for two years in a row.

(The assessment model computed that the LRP of $0.5B_{MSY}$ was equal to 390 kg/day).

Control rules:

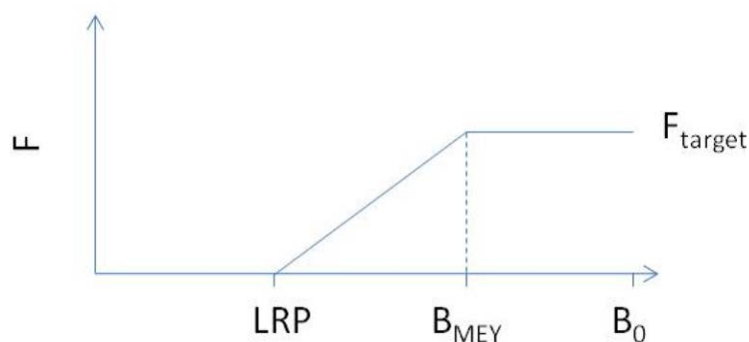
1. LRP of 390 kg CPUE.
2. Undertake the annual stock assessment using the natural mortality rate of 0.05 per week (based on tagging data from Die *et al.*, 2002) with a co-management and NPRAG-agreed season pattern and using standardised CPUE data.
3. Catch data from the JBG fishery will be analysed for the period from August, September & October inclusive at the end of each calendar year.
4. If a minimum of 100 fishing days has been achieved *and* the red-legged banana prawn stock size falls below the LRP for the two most recent consecutive years, then the TAE is zero for a year (no fishing in the following year).
5. After one year, the TAE for the subsequent year would be set at a precautionary level based on the stock assessment model-predicted TAE. The option to use research effort to maintain catch rate data for the assessment could be considered.
6. Else if the LRP is *not* triggered, then
7. Fishing **WILL** be allowed for the full two seasons in the following year provided:
 - that data has been provided for a minimum of 100 fishing days over the full fishing year *AND*
 - that the average catch per boat per fishing day in August, September & October is 390 kg or more
8. Fishing **WILL** be allowed for the full two season in the following year:
 - if data has been provided for less than 100 days of fishing during the full fishing year *AND*
 - whether or not the LRP of 390 kg per boat per fishing day in August, September & October has been triggered
9. Fishing will **NOT** be allowed in the first (banana prawn) season of the following year:

- If data has been provided for a minimum of 100 fishing days over the full fishing year *AND*
- that the average catch per boat per fishing day in August, September & October is less than 390 kg,
- however, the fishery will be re-opened to fishing in the second (tiger prawn) season of the same year

The fishery (when fishing is allowed) will open at the same time as the rest of the NPF however the fishery will close if the catch trigger limits/decisions rules in place for the common banana prawn and tiger prawn fisheries close the rest of the NPF in any given season.

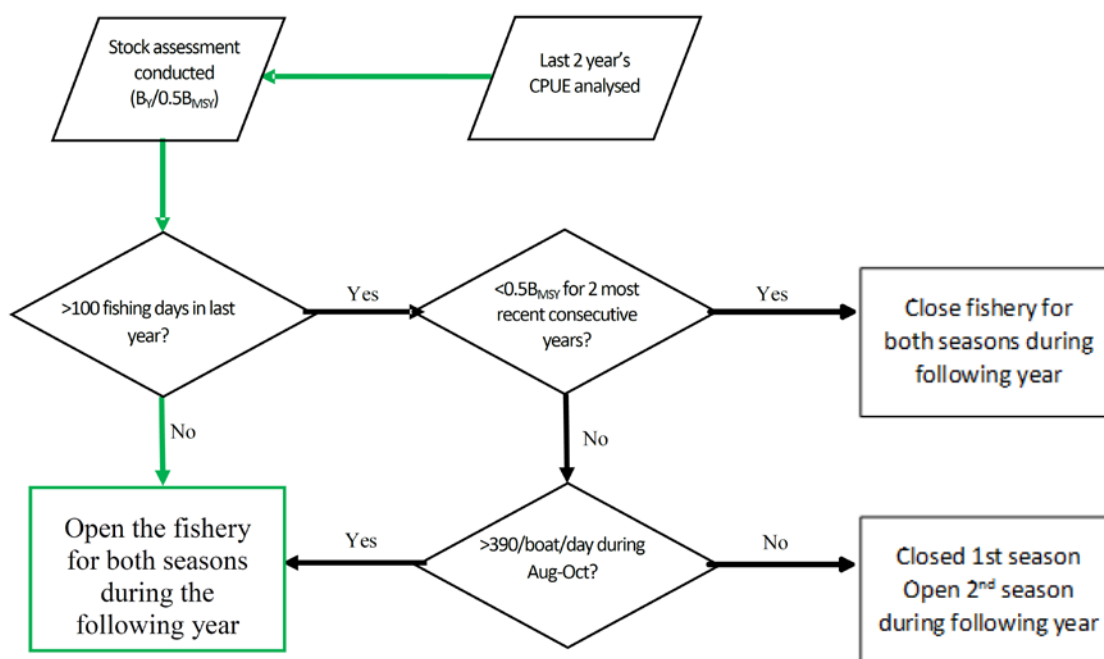
Source: NPF Harvest strategy 2014 (Dichmont *et al.*, 2014)

Figure 14: Stylised diagram showing the “hockey stick” rule as described in Box 3, above. LRP is limit reference point, F fishing mortality and F_{target} here is F_{MEY} the fishing mortality at Maximum Economic Yield (MEY). B_{MEY} is the biomass at MEY and B_0 is the unfished or virgin stock size.



Source: NPF harvest strategy, 2012, Dichmont, 2014

Figure 15: Red-legged Banana Prawn Harvest Strategy Decision Rules Flowchart (NPRAG 2016a).



Additional NPF measures

The management system is also supported by a variety of closures which have been implemented in the NPF since the fishery's development in the early 1970's. A total of 2.1% of the total managed zone of the fishery is subject to permanent closures, while 8.3% is subject to seasonal closures. (This does not include the fact the entire area of the NPF is shut for approximately 5 and a half months each year, which provides total protection to the entire area of the fishery, all bycatch and all prawns).

The closures include protected area, spatial, seasonal and daylight (seasonal) closures. Some of these closures and assigned periods have changed through the years. The primary aim of all current closures is to enhance the productivity of the NPF, usually through protecting an early stage of the life history of prawns or through reducing effort on spawners or stocks, and to protect the environmental biodiversity through defined biodiversity hot-spots, marine protected areas and conservation zones. The measures also took account of socio cultural issues including the protection of indigenous interests and reduced interactions with other fisheries (Kenyon *et al.*, 2005).

The primary aim of the establishment of most protected area closures is to protect nursery habitats of the prawn species (including seagrass and mangroves).

The closures were almost all established in the 1980s, following scientific research on two complementary topics. Firstly, the basic biology and life cycle of the species was now understood, including the habitats required by the juveniles; and secondly, scientific surveys identified the locations of the crucial inshore nursery habitats (including seagrass and mangroves). The known seagrass locations became the basis of many of the protected area closures.

The most common aim for the seasonal area closures is to protect sub-adults. Some bio-economic studies have been undertaken, which confirm the obvious economic value of protecting small prawns. Often though, few or no scientific data were available to support or verify these closures. Many of the closures have been implemented at the request of

industry, based on anecdotal advice about small prawn captures. Significantly, major issues when setting and evaluating these sorts of closures remain. For example, uncertainties exist, firstly, as a result of the high annual variability in the timing and location of the peak abundance of small prawns, and secondly, as a result of the occurrence of large and small prawns (usually of different species) together on the same grounds.

The NPF Industry Pty Ltd has implemented a process whereby if/when quantities of small prawn captures are reported, voluntary ‘move-on’ provisions (which require skippers to leave the area where there are large captures of small prawns) are implemented (NORMAC, 2007).

An AFMA sponsored Closures Review (Kenyon, *et al.*) was undertaken in 2007. The review set out criteria and protocols for the classification and review of current closures and the establishment of new closures (including an Industry workshop that reviewed proposed criteria and protocols and incorporated Industry views into the final protocols). Indigenous interests are also consulted as and when the case for closures are analysed and recommended.

3.3.10 Information (PI 1.2.3)

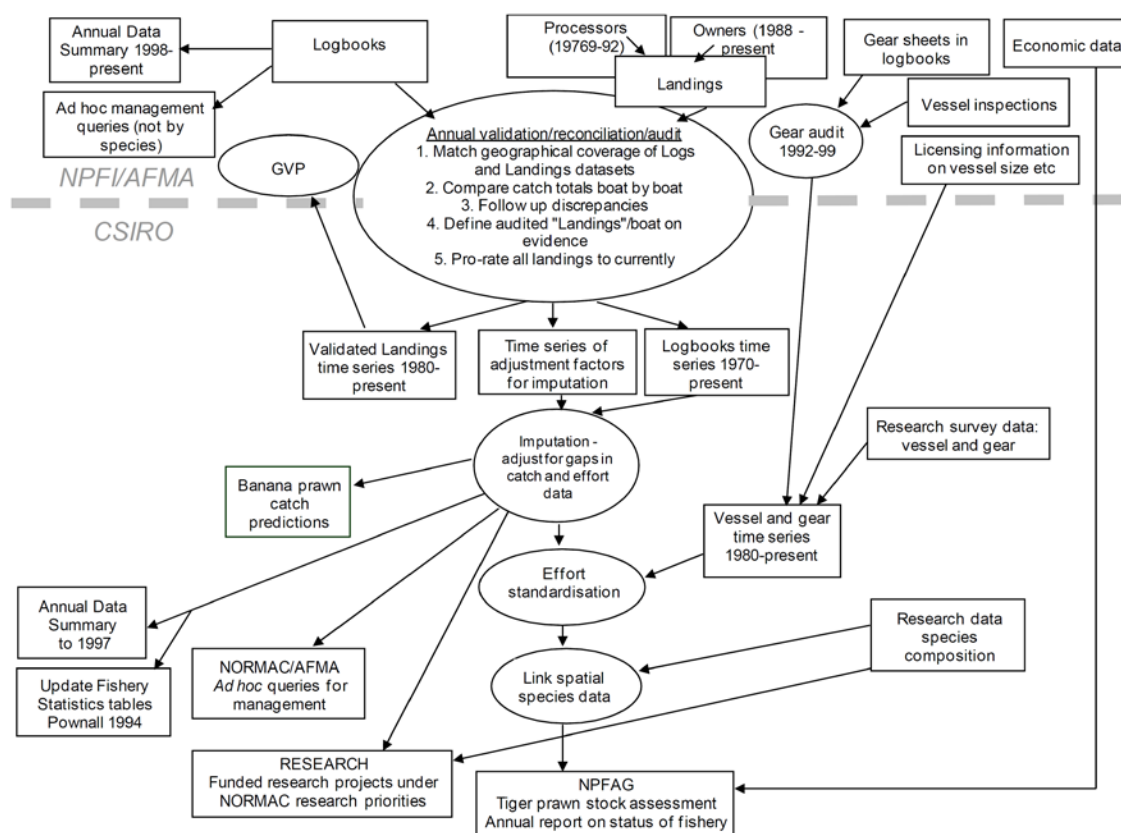
3.3.10.1 Data collection

A comprehensive data collection program has been established for the NPF to ensure reliable information is available on which to base management decisions. Information is maintained on all target prawn species taken in the NPF. The comprehensiveness of the program is a product of the high value of the fishery, the management needs of the fishery and the importance of stock assessment to determine the status of the target species.

The data collection program is based on logbooks that provide for catch and effort data to be recorded daily in logsheets. Processor records are obtained for landings data which are used to verify the logbook catch. Vessel gear details are also collected which track changes in gear and technology in the fishery. This information assists in stock assessments and research being undertaken on effort creep and fishing power studies.

These data form the basis of the NPF’s fishery dependent research program. Targeted fishery independent research, including annual fishery independent surveys for target species and bycatch are undertaken in the NPF. Each year, a recruitment survey is undertaken on the key fishing grounds of the Gulf of Carpentaria. A spawner survey is undertaken during the mid-season break in winter on the western grounds of the Gulf. These surveys started in 2002. They are a fundamental component of the tiger prawn stock assessment that is used to set the Total Allowable Effort (TAE) as they provide input to the indices of abundance for both recruits and the spawning stock to which the assessment model is fitted (as well as input data to model on the size frequency of estimated prawns).

Figure 16: Diagrammatic representation of the data and information flow for the NPF assessments and input into the HS (Source: Dichmont *et al.*, 2014).



Economic data is collected by ABARES on a regular basis to provide inputs to the NPF's bio-economic model. Figure 16 shows the flow of information and its link to stock assessments and the control rules of the HS.

Environmental information includes general climatic observations through the Australian meteorological network, oceanographic observations during past research cruises and the annual "recruitment" and "spawning" survey cruises.

3.3.10.2 Data Reliability

Bishop and Die (2001), conclude that annual landings in the NPF have been estimated reasonably accurately since 1980 by combining information from logbooks to supplement landed weights from prawn processing companies and trawler owners. Data collection since the evaluation by Bishop and Die (2001) continues to be comprehensive. Data summaries are provided on the AFMA website. There were periods during the early history of the fishery when not all operators provided logbook information but a detailed augmentation process has been used to estimate missing logbook information so that the total logbook catch corresponds to the landings. This information is needed for species specific stock assessments. The NPF has a long time series of data available for scientific analysis. CSIRO holds a copy of logbook data and annual reconciled landings since 1970. AFMA had primary responsibility for collecting, collating and verifying the logbook and vessel register data and providing this data to CSIRO. Since 2010, under co-management arrangements between AFMA and NPFI, NPFI monitors, collates and reconciles the logbook data with the seasonal landing returns and provides this to CSIRO. Dichmont *et al.* (2010) provides an extensive review of data relevant to the stock assessment.

Economic data from the NPF has been collected by the Commonwealth government's economic research agency, the Australian Bureau of Agriculture and Resource Economics (ABARES) since the 1980s (Bath & Green, 2016). Bi-annual economic surveys are carried out by ABARES, aimed at capturing financial information from approximately 40% of the fleet. The financial information is provided by NPF operators with small, medium and large trawlers on a voluntary basis. The information collected in the surveys is used by ABARES to calculate the economic performance of the fishery. ABARES survey information is also used by the Australian Government Department of Agriculture, Fisheries and Forestry (DAFF) to assess the performance of AFMA in managing fisheries. Economic data is also collected from SFR holders by the NPF annually to supplement the collection of economic information by ABARES.

3.3.11 **Fishery Monitoring**

The fishery has a number of monitoring processes in place that support the HS. These include:

(a) An annual Gulf of Carpentaria-wide independent data collection program (at sea survey) which was first undertaken in the fishery in August 2002. The survey has two modules:

- a January/February survey that provides data for a fishery independent recruitment index for banana, tiger and endeavour prawns; and
- a June/July survey that provides information to examine the spatial distribution in the fishery and attempts to quantify changes in fishing power, one of the key areas of contention with the current model.

Scientific data is collected through these surveys for all target species and a range of bycatch species.

(b) Scientific and Crew Member Observer (CMO) programs on commercial trawlers to collect data and to monitor bycatch.

(c) A fishery-wide daily catch & effort logbook program for all target and byproduct species and to record interactions with protected species. Under this program, operators are required to record the location of fishing operations (latitude/longitude) for every day they fish and/or search, regardless of whether any catch is taken; the total number of shots for each fishing day; the species/product retained and size grade information.

(d) Seasonal Landings Returns used to reconcile log book data (target and byproduct species) against commercial landings.

(e) A gear monitoring program to monitor vessel fishing power and TED/BRD configurations. Mandatory data collected through the program includes vessel length; beam; depth; engine make and model; engine power; max. trawl RPM; operating RPM; gear box reduction ratio; korth nozzle; propeller diameter and pitch; plotter make and model; sonar; max. speed; trawl speed (banana and tiger prawn fisheries); TED and BRD configurations.

(f) Annual comprehensive gear surveys to contribute to fishing power analyses and identification of new gear technologies.

(g) VMS data to monitor position of vessels especially with respect to spatial and temporal closures.

(h) Random enhanced VMS polling over a short period to monitor vessel speed.

- (i) ABARES surveys to collect economic data.

- (ii) NPFI surveys to collect economic data

3.3.12 Stock Assessment (PI 1.2.4)

3.3.12.1 Tiger and Endeavour prawns

Several different assessment techniques for the tiger prawn subfishery have been developed over time – a delay difference model (Dichmont *et al.*, 2003), Bayesian hierarchical biomass dynamic model (Zhou *et al.*, 2009), and a size-based model with which the three major species (brown and grooved tiger prawns, and the blue endeavour prawn) are assessed (Punt *et al.*, 2010). The resultant stock assessment and estimated stock-recruitment parameters are then combined with economic parameters to form the bio-economic model (Punt *et al.*, 2011). In 2011, the NPRAG agreed Base Case assessment was the size-based model for both species of tiger prawns and the biomass dynamic model for blue endeavour prawns (Zhou *et al.*, 2009). Punt *et al.*, (2011) provide a summary of the combined model used as the Base Case. The parameters of this multi-species population dynamics model, which include annual recruitment, fishery and survey selection patterns, parameters which define the size-transition matrix, and recruitment patterns, are estimated using data on catches, catch-rates, length-frequency data from surveys and the fishery, survey indices and tag release-recapture data. The model allows for the technical interaction among the three species a result of bycatch when targeting one or the other species. The results from the multi-species stock assessment form part of the basis for evaluating the time-series of catches (by species) and levels of fishing effort (by fishing strategy) which maximize net present value. The bio-economic model takes into account costs which are proportional to catches, and those which are proportional to fishing effort, as well as fixed costs. The sensitivity of the results is examined by changing the assumptions regarding the values for the economic parameters of the bio-economic model as well as those on which the assessments are based.

The advantages of the size-structured model include the greater inclusion of available data (specifically catch and survey length-frequency data as well as tagging data), and therefore less use of pre-specified parameters (for example selectivity is estimated, not knife-edge); whereas in the delay difference model this was originally not the case.

The size-structured population dynamics model also allows grade-specific prices to be considered unlike the delay-difference model which is forced to assume that price is independent of size. This has implications in terms of both optimal level of catch as well as optimal timing of catch. The model has greater flexibility in terms of fitting potential alternative effort regimes for different assumptions regarding season length. Importantly, since it still uses weekly time intervals, this model provides a useful tool for evaluation of the trade-off between TAC and season duration/timing (as recognised by the NPRAG) (by estimating the optimal fishing pattern while estimating the profit into the future.

The results of the stock assessment are reviewed by the Northern Prawn Research Advisory Group (NPRAG; comprised of scientists, economist, fishery managers, fishing representatives, and environmentalists) and in 2011 the agreed Base Case assessment was a size-based model for both species of Tiger Prawns and the biomass dynamic model for blue endeavour prawns.

An evaluation of stock assessment methods and management strategies for the Northern Prawn Fishery was carried out by Dichmont *et. al.* (2006a); Dichmont *et. al.* (2006b); Dichmont *et. al.* (2006c); and Dichmont *et. al.* (2008) using the management strategy evaluation (MSE). The MSE approach distinguishes between the true state of the resource (as represented by the

‘operating model’) and that perceived though data collection strategies and stock assessments (a component of the ‘management strategy’). The management strategy also includes decision rules that use information on the perception of the status of the system to determine management advice. The management advice determines the management actions and hence any impacts these actions have on the resource and the associated fishery. The MSE approach requires an (operating) model of the resource to act as the ‘truth’ for the analyses and the five-stock, two tiger prawn species operating model with a weekly time-step is used and conditioned using more than 30 years of logbook catch and effort data as well as the results of fishery-independent surveys. This model allows for the impact of changes over time in efficiency, a key uncertainty in the assessment of these species, and the impact of management implementation error, which has historically been substantial.

Dichmont *et al.* (2006a) showed that the stock assessment model is fairly general and can capture the dynamics of multiple stocks of several species. In Dichmont *et al.*, (2006b) three “assessment procedures” are considered (a linear regression of the log-catch rate on time, a biomass dynamic model and a delay-difference model. These assessment procedures capture a range from very simple (a linear regression of log-catch-rate on time) to fairly complicated (an age- and stock-based assessment model), and two forms of the decision rule. The performance of the management strategies is evaluated in terms of whether stocks are left at (or above) the spawning stock size at which Maximum Sustainable Yield is achieved (S_{MSY}), the long-term discounted total catch and the extent of inter-annual variation in catches. The best management strategy in terms of leaving both species close to S_{MSY} is found to be one that changes the timing of the fishing season so that effort is shifted from *P. esculentus* to *P. semisulcatus* and sets more precautionary effort targets for *P. esculentus*. Dichmont *et al.*, (2006c) management strategies are evaluated in terms of conservation- and economic-related performance measures. The factors found to have the greatest impact on the performance measures are: (a) how fishing efficiency has changed over time and whether or not the assessment is based on the correct trend in fishing efficiency, (b) the catchability coefficient used to convert from fishing effort to fishing mortality, (c) the difference between the intended fishing effort and the actual fishing effort expended (implementation error), and (d) whether recruitment is spatially correlated among stocks or not. Because the management strategies based on the delay-difference model tend to leave the spawning stock size of *P. esculentus* below the target level of S_{MSY} in median terms, a more conservative management strategy is appropriate, at least until a management strategy is identified that performs better for *P. esculentus*.

Dichmont *et al.* (2008) used an operating model similar to that in Dichmont *et al.* (2006a), but account was taken of two species of endeavour prawns (*M. endeavouri* and *M. ensis*) as well as the two species of tiger prawns and also included an effort allocation model and a benthic impacts model. Two classes of management strategy were evaluated; one class seeks to move stocks towards the target spawning stock size which is a pre-specified fraction of the spawning stock size at which Maximum Sustainable Yield (S_{MSY}) is achieved using a threshold control rule, while the other class selects time-trajectories of future effort to maximize discounted profit. Management strategies that control effort levels to maximize the total profit over the long-term outperform those which aim to move the spawning stock size toward S_{MSY} in terms of most performance measures. For example, even when the target stock size for the MSY-based management strategy is selected to be the same as that which maximizes profits, selecting effort to maximize profits leads to lower variability in catches and profits. This study also illustrated how broader ecosystem considerations can be included in MSE analyses without the need for the development and implementation of full ecosystem models and hence provides a “middle road” between single-species MSEs and full ecosystem MSEs.

The modelling is carried out by the CSIRO under contract from the AFMA. It is conducted by a team of data, information and stock assessment specialists including part-time input from a world-renowned expert from the University of Washington. Modelling results are then reviewed by the NPRAG. Peer-group review of the actual assessments is provided by two independent stock assessment experts. The methods and results of the assessments are also published in peer-reviewed scientific journals. The assessment was externally peer-reviewed in 2002 by an independent stock assessment expert (Deriso, 2001) who concluded that the assessment was world-class but also recommended the inclusion of fishery dependent data; a recommendation that has since been followed.

Red endeavour prawns have been considered as part of the economic bycatch in the bio-economic modelling of the fishery (Dichmont *et al.*, 2008, Punt *et al.*, 2010, Kompas *et al.*, 2010). However, the most recent bioeconomic modelling excludes red endeavours due to the lack of a stock assessment of the species (Dichmont *et al.*, 2014).

Buckworth *et al.* (2016) provides an overview of recent developments with the tiger prawn subfishery assessment. Various model improvements have been made based on a retrospective study of model performance (Deng *et al.*, 2015). The improvements and updates include:

- An alternative statistical method to analyse fishery-independent survey length frequency information was applied
- Length frequency information from the most recent recruitment survey is not included in the analysis, to avoid data conflicts (recruitment abundance is included);
- Gamma functions replaced logistic functions as descriptions of fishing selectivity for recruitment survey data;
- Sensitivity tests, which include using variations to the amount of effort change permitted between years, variations to the lower effort threshold, and alternative fishing power levels, model structures, and predicted fishing patterns; and,
- A fishing pattern for the projections based on the average of the last two years' actual fishing patterns, as recommended by Deng *et al.*, (2015). The model encountered optimisation difficulties with this pattern in the assessment conducted in 2014. This was addressed by first adopting the previous two years' mean fishing pattern then applying the algorithm described in Buckworth *et al.*, (2015a), to distribute available fishing effort; and,
- A "species-split" model, to allocate logbook catches and effort by species of Tiger and Endeavour Prawns (Venables *et al.*, 2006), was applied to the updated fishery catch and effort data;
- Two updated (April 2016) fishing power models were applied as separate scenarios – the "low" model (used in the Base Case) and the "mid-high" model (Bishop *et al.*, 2008, and Nov 2009 and May 2010 NPRAG meetings).

Scenario testing focuses mainly on assessing the sensitivity of the outputs to assumptions regarding the factorial components of the model: fishing effort pattern, fishing power estimates, model type, the NPRAG-specified fishing pattern, constraining (year-on-year) effort change during a seven-year projection period, the lower effort threshold in the bio-economic mode. Furthermore, there are concerns of the possibility of changes in natural mortality due to environmental factors and to address these concerns, two more sensitivity runs have been provided in the recent assessment (Buckworth *et al.*, 2016). One run sets natural mortality at half of present value and the other at 1.5 times the value.

3.3.12.2 White banana prawns

The stock assessment process for white banana prawns does not follow the traditional pattern for a prawn stock (e.g., for the tiger prawn species). Because of the inter-annual variability driven mainly by the environment, regular stock assessments have not been carried out, but the status of the stock is assessed through historic catch data and with reference to a proxy limit point. There has been extensive research on the causes of stock fluctuations, the most recent being that of Venables *et al* (2011) who modelled the effect of fishing effort and rainfall on the annual season catches in different areas of the NPF.

In a detailed study into the causes of the decline in catches in the Weipa area in the period following 2000, a stock assessment method was trialled. Estimates of daily catch per unit of effort (CPUE) for the banana prawn stock at Weipa were calculated from logbook data. The daily catch data for each year were subjected to virtual population analysis (VPA), and a tuned VPA, with both catchability and terminal biomass being estimated as parameters of the model. The resulting estimates of recruitment and spawning biomass were used, in combination with time series of rainfall, temperature and wind data, to explore whether recruitment was affected by spawning biomass and the effects of the environmental variables. In addition, a depletion analysis based on similar assumptions to the tuned VPA was fitted simultaneously to the daily CPUE data for all years. However, there was insufficient information in the data to demonstrate a relationship between recruitment and spawning biomass and/or the environmental variables. It was concluded that imprecision of the CPUE data for banana prawns is likely to mask any signal of such relationships in the data.

The fishery is managed by a combination of spatial and temporal closures and a fixed season length with in-season management aimed at potentially closing the season earlier to increase the economic return to the fishery in less productive years. Historical records indicate that the banana prawn fishery is sustainable with an annual six-week fishing season. The high variability and environmental dependency of this species results in significant variations in catch from year to year, and even in the years where there have been very poor catches in some areas, the rebound in the stocks would indicate that the banana prawn fishery is resilient. Management in recent years under the HS has included a catch rate trigger, based on catch rate information for specified reference periods, wherein the average is calculated.

3.3.12.3 Red-legged banana prawns

Red-legged banana prawns are assessed using a quarterly “age-based” biological model with no economic content internal to the model (Plagányi *et al.*, 2010). The model is fitted to available catch and effort data. Weekly catch and effort data are available from 1970, but given the almost negligible catches during the 1970s, the assessment starts in 1980. These data were analysed per week, per month, per quarter and per year and it was considered that the most sensible aggregation would be by quarter, with four quarters defined as corresponding to the four quarters of a calendar year respectively, i.e. Quarter 1 = January – March; 2 = April – June; 3 = July – September and 4 = October – December. A historic catch series per quarter was constructed using all available catch information. The model is sensitive to CPUE interpretations, made more difficult by recent changes in fishing in the Joseph Bonaparte Gulf, where most of the fishing occurs.

The most recent accepted assessment for the stock was undertaken in 2015 (Buckworth *et al.* 2015b), and includes data up to and including 2014. The assessment model uses quarterly time steps of catch and effort. As a result, outputs from the model depend on the distribution of effort across fishing seasons, and sensitivity to this aspect has been explored. Effort data are

standardised using the fishing power series derived for the species. An updated assessment was attempted using data updated from 2015 (Plagányi *et al.*, 2016). The fishing power series for red-legged banana prawns was preliminarily updated based on available 2015 data (including catch and effort data, vessel and gear characteristics from 21 vessels, and environmental descriptors such depth and lunar phase). However, the stock assessment model relies on sufficient quarterly data and there were insufficient data available for 2015 to reliably fit the model. Sufficient data were only available for quarter two in the model. Levels of effort and catch in JBG in 2015 were very low. The total number of boat days fished (in JBG) in 2015 was 79, which was less than the trigger amount used in the harvest strategy. The harvest strategy states that with < 100 boat-days effort in 2015 the fishery opens 1 April, unless the 2016 assessment indicates $B_{sp} < 0.5 B_{MSY}$ for the last two years in that assessment. Plagányi *et al.* (2016) examines tidal and oceanographic data, as well as feedback from industry on their successful 2015 tiger prawn season, in order to generate hypotheses as to why 2015 was an anomalous year in terms of fishing effort and catch of red-legged banana prawns.

A possible explanation for the low levels of catch and effort in 2015 is the more favourable tiger prawn fishing in the Gulf of Carpentaria where there were unusually high catch rates in 2015—this explanation was accepted by the NPRAG as a contributing factor. Another explanation is that recruitment or availability was lower in 2015 as a result of anomalous environmental factors, including strong El Niño conditions and considerably reduced tidal flows. Under the harvest strategy, when effort is below 100 days in one year, the fishery remains open in both seasons of the following year. However, given the uncertainties around status, NPRAG agreed to additional data collection and analysis during the first season of 2016, to provide early indications of stock status before an assessment update is undertaken in early 2017.

3.4 Principle Two (P2): Ecosystem Background

The NPF grounds cover an extensive area of 771,000 km² off the northern coast of Australia, from the Cape York Peninsula to Cape Londonderry in Western Australia, and from the low water mark to the outer edge of the Australian Fishing Zone (Figure 1). The managed area comprises tropical marine environments with a wide range of geomorphological and oceanographic conditions that support a variety of marine communities. The ecosystem is characterised by high productivity with high seasonal variations, depending on the rainfall regime and nutrient input (Pitcher *et al.*, 2016). Prawn trawling impacts are mainly associated with benthic and demersal communities through physical disturbance, changes in the trophic structure, removals (organisms caught) and additions (discards). Because fishing occurs in areas with high variability and high natural disturbance (see Pitcher *et al.*, 2015), it is difficult to differentiate NPF's impacts from the effects of natural processes. All high intensity fishing effort is concentrated on small areas, mainly in the western half of the GoC. These high intensity fishing areas are mainly fishing grounds for the tiger prawn subfishery, while for the white banana prawn subfishery fishing effort is less intense and more evenly distributed. The red-legged banana prawn subfishery operates in the Joseph Bonaparte Gulf and it is a lower intensity fishery. About 19.6% of the NPF area (0-150 m) is closed in Commonwealth Marine Reserves (CMRs), ~0.2% in Marine Protected Areas (MPAs) and ~0.7% under fishery regulation. The current annual footprint of the NPF trawl fishery (i.e. area trawled/managed area) is estimated to be 1.6% overall (Pitcher *et al.*, 2016).

AFMA is making progress towards an ecosystem-based approach in managing the NPF. The outcome of this approach is a broader environmental sustainability, including retained and discarded species, habitat and communities (Pitcher *et al.*, 2016). The NPF Management Plan

1995 (last revision in 2012, AFMA, 2012a) sets out to achieve the objectives of the Fisheries Management Act 1991 (FMA). Policy drivers addressed include:

- the National Strategy for Ecologically Sustainable Development (ESD) (DoE, 1992a),
- the precautionary principle, as set out in the Intergovernmental Agreement on the Environment (DoE, 1992b),
- the EPBC Act 1999 (DoE, 1999), and
- Commonwealth Policy on Fisheries Bycatch (DAWR, 2000).

Under this legislation framework fisheries are required to ensure: (i) information is gathered about the impact of the fishery on target, byproduct and bycatch species; (ii) bycatch is reduced to, or kept at, a minimum and below a level that might threaten bycatch species; (iii) all reasonable steps are taken to minimise interactions with species listed under Part 13 of the EPBC Act (Endangered, Threatened and Protected Species -ETPs), which include seabirds, marine reptiles, marine mammals and some sharks and bony fish; and (iv) the ecological impacts of fishing operations on habitats in the area of the fishery are minimised and kept below an acceptable level (AFMA, 2008a).

The outcomes of these management measures for each ecosystem component (retained species, bycatch, ETPs, habitat and ecosystem overall) will be assessed based on all information available about the fishery and/or the species, habitats, or ecosystems involved.

Sources of information:

(i) fishery-dependent, provided by AFMA and NPFI:

- logbook data on target and byproduct catch and on ETPs interactions;
- observer data from CMOs on “at risk” bycatch and ETPs;

(ii) fishery-independent from

- research surveys undertaken by CSIRO,
- observer data from AFMA's scientific observer program (AFMA SOs);
- AFMA-CSIRO ecological risk assessments (ERAs) for each component of the ecosystem.

Fishery-dependent datasets, i.e. the CMO and logbook data, lack taxonomic detail, particularly for retained and bycatch species (Fry & Miller, 2016). Fishery independent datasets do not duplicate commercial trawl operations and have considerably smaller spatial and temporal coverage. Despite these limitations, research surveys identify all sampled individuals to species (as much as possible) and thus provide the best available information on the actual taxonomic composition of the catch (Fry & Miller, 2016).

Data on the retained catch are derived from daily logbook records by skippers and from seasonal landing returns submitted by statutory fishing rights holders. Data on ETP species are also available from daily logbooks. These data are submitted to AFMA but the NPFI is responsible to reconcile logbook data with observer data and fishing effort and provide data summaries to AFMA, NORMAC, NPRAG, CSIRO and other approved stakeholders, under a co-management arrangement (AFMA, 2017).

As logbooks only record retained and ETP species, data on bycatch (non ETP discards) is only available from observer programs and specific research projects. The NPF's CMO Program began in 2003 and over time has expanded to collect data on ETPs and “at risk” species (Fry *et al.*, 2015). Data collected through the CMO Program has continued to improve in terms of volume and quality. Since 2008 the number of trawls monitored by CMO's has increased by

611%, and the program is now providing data in excess of the minimum required coverage (2350 shots) (AFMA, 2017). The observer bycatch data is supplemented by independent surveys data which, together, were used as input for the NPF ecological risk assessments (in Griffiths *et al.*, 2007) as well as baseline for subsequent NPF-specific surveys and studies. Research studies have been undertaken to narrow the knowledge gaps about the fishery's impacts on bycatch (e.g. Ramm *et al.*, 1990; Pender *et al.*, 1993; Stobutzki *et al.*, 1999, 2001a, 2001b; Dell *et al.*, 2009; Tonks *et al.*, 2008) byproduct (Milton *et al.*, 2010), and habitats and ecosystem (Hill *et al.*, 2002, Haywood *et al.*, 2005, Przeslawski *et al.*, 2011, Bustamante *et al.*, 2010). Ecological risk assessments (ERAs) from the NPF activities have been applied to all ecosystem components (byproduct, bycatch, ETPs, habitats and communities) and support the implementation of an ecological risk management framework (ERM) (AFMA, 2012b).

3.4.1 Retained species (P 2.1)

Retained species are species other than the target, that are caught in a Unit of Assessment (UoA) and are retained due to their commercial value. For each UoA considered in this assessment, the retained species include the other NPF target species and the byproduct species. MSC terminology defines “main” retained species as those species that are caught by the fishery and not discarded, if they represent over 5% of the total catch biomass or, for vulnerable species, over 2%. Species with lower percentage contributions are considered “minor” (MSC, 2013). Also, because catch composition in prawn trawl fishery is very complex, including a high number of species with very low contributions, it was assumed that the impact from the UoAs was minimal when species contributions to total catch were under 0.5% (*de minimis* impact).

According to section 14A, para 4, of the NPF's Management Plan (AFMA, 2012a), fishers may engage in commercial fishing in the Northern Prawn Fishery area for: (a) any species of prawns (including penaeid and carid prawns), scampi, bugs or scallops; and (b) any species of squid, using a prawn trawl apparatus. Also, the fishers may engage in commercial fishing in the area for any other species of fish only if the fish is taken as an incidental part of fishing for the fish mentioned above (AFMA, 2012a, p.10). This means that, besides target species, a large number of species can potentially be retained. In fact, byproduct species retained in each NPF subfishery, belong to a few groups, each with a limited number of species. Most byproduct species have been identified to species level from logbook data (NPFI, 2016, unpublished), byproduct study (Milton *et al.*, 2010), catch data from ABARES reports and discussions with CSIRO scientist Gary Fry. Only a few groups with retained catches under 1t, (e. g. mixed prawns, whiting) could not be identified to species level. Scampi catch data may appear in some catch datasets, however, fishing for scampi does not take place during the prawn fishing operations and fishing grounds do not overlap, thus scampi are not part of this assessment.

Table 7 presents catch data from 2012-2015 in each subfishery, with species with percentage contributions over 5% in bold. The tiger prawn subfishery includes four UoAs with total overlap. Each UoA is defined by one target species (in bold), while fishing method/gear and management framework, are identical. White banana subfishery and red-legged banana subfishery include only one UoA each, with targets white banana prawn and red-legged banana prawn respectively. The majority of the retained component in these subfisheries comprises species that are managed as target in the NPF, while the retained byproduct is extremely low. NPF target species catch data are estimations from subfishery data provided by NPFI, with tiger prawns, endeavour prawns and banana prawns respectively grouped together; and ABARES reports where catch data is reported per species but not per subfishery. To calculate percentage contributions, total catch was estimated from AFMA SO datasets from Fry & Miller (2016).

Table 7. Retained species (target and non-target) in each subfishery from 2012 to 2015. Greyed species/groups are <0.5% total catch for which the impact was considered *de*

minimis. Note: catches of target species are best estimations using various sources available. All values rounded to the nearest ton.

Species	2012 catch (t)	2013 catch (t)	2014 catch (t)	2015 catch (t)	2012- 2014 average	% contri bution
Tiger Prawn Subfishery						
Grooved Tiger Prawn	812	1446	1176	2365	1450	18.03
Brown Tiger Prawn	373	719	484	750	582	7.23
Blue Endeavour Prawn	270	327	359	331	322	4.00
Red Endeavour Prawn	202	156	286	196	210	2.61
Red-Legged Banana	67	133	310	20	133	1.65
Bug - <i>Thenus</i> sp.	62	103	55	69	72	0.90
White Banana Prawn	41	24	47	34	37	0.45
King Prawn	11	27	21	35	24	0.29
Squid	11	14	9	25	15	0.18
Scallop	11	2	5	1	5	0.06
Cuttlefish	4	5	4	6	5	0.06
Other	2	2	3	5	3	0.04
Bycatch estimate (2:1)	3396	5295	4704	7356	5188	64.50
<i>Total Catch Subfishery</i>	<i>5262</i>	<i>8253</i>	<i>7463</i>	<i>11193</i>	<i>8043</i>	<i>100.00</i>
White Banana Prawn Subfishery						
White Banana Prawn	4528	2614	5163	3867	4,043.00	57.57
Groove Tiger Prawn	13	23	18	37	22.75	0.32
Blue Endeavour Prawn	8	10	11	10	9.75	0.14
Brown Tiger Prawn	6	11	8	12	9.25	0.13
Red Endeavour Prawn	6	5	9	6	6.50	0.09
Bugs	3	5	3	7	4.50	0.06
Black Tiger Prawn	1	1	3	10	3.75	0.05
Other	1	1	1	4	1.75	0.02
Bycatch estimate (0.8:1)	3702	2237	4415	3070	3,356.00	47.79
<i>Total Catch Subfishery</i>	<i>8268</i>	<i>4907</i>	<i>9631</i>	<i>7023</i>	<i>7457.25</i>	<i>100.00</i>
Red-Legged Banana Prawn Subfishery						
Red-Legged Banana	124	248	576	36	246	24.63
White Banana Prawn	131	75	149	108	116	11.59
Blue Endeavour Prawn	5	6	7	6	6	0.60
Red Endeavour Prawn	4	3	5	4	4	0.40
Groove Tiger Prawn	1	2	1	3	2	0.18
Brown Tiger Prawn	0	1	1	1	1	0.08
Other	0	1	1	0	1	0.05
Bycatch estimate (1.4:1)	370	468	1034	221	624	62.48

<i>Total Catch Subfishery</i>	635	804	1774	379	999	100.00
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(Source: data compiled from NPMI unpublished logbook data, NPF Data Summaries 2011-2015, ABARES 2012-2016, and AFMA observer datasets, Fry & Miller, 2016)

3.4.2 Retained Species Outcome (PI 2.1.1)

Under scoring guidepost P 2.1.1 the status of each retained species/group of species stock is assessed against biologically based limits (BBLs). MSC defines “biologically based limits” for P2 species as their stocks being above the limit where serious or irreversible harm can occur (i.e. point of recruitment impairment) (CB3.2.4, FCR v1.3). For a score of 100, this should be demonstrated with a high degree of certainty. For P2 retained species, the MSC definition for “high degree of certainty” means there is a probability greater than or equal to 80% that the statement is true, compared to 95% required for P1 species (CB 3.2.3.3, FCR v1.3). If the degree of confidence is lower than 80% but higher than 70% the fishery still achieves a score of 80 (unconditional pass) for the respective scoring element (e.g. species or group of species). The stock outcome for each species managed as target in the NPF is detailed under P1 section of this report. This section focusses on potential impacts from each UoA on its retained species.

3.4.2.1 Main Retained Species

Tiger Prawn Subfishery: (4 UoAs: brown tiger prawn, grooved tiger prawn, blue endeavour prawn, red endeavour prawn)

Grooved tiger prawn (*Penaeus semisulcatus*) (2011-2015 average = 18%) is a main retained species in the tiger prawn subfishery and assessed as such within brown tiger prawn (*P. esculentus*), blue endeavour prawn (*Metapenaeus endeavouri*) and red endeavour prawn (*M. ensis*) UoAs. Grooved tiger prawn is a target species in the NPF and managed under the NPF harvest strategy. The outcome for the grooved tiger prawn stock in tiger prawn subfishery is detailed under P1 section of this report. The most recent assessment of the status of grooved tiger prawn (Buckworth *et al.*, 2016) shows that stock status is above the limit reference point or LRP (S2011-2015/SMSY=114%) and, above the target reference point or TRP (S2015/SMEY=171%). Effort in 2015 was close to the effort at maximum economic yield, EMEY (99%) and to the effort at maximum sustainable yield EMSY (82%) indicating that overfishing is not occurring (Table 4). There is a high degree of certainty that the grooved tiger prawn stock is within its BBLs and above its TRPs and brown tiger prawn, blue endeavour prawn and red endeavour prawn UoAs do not cause serious or irreversible harm.

Brown tiger prawn (*P. esculentus*) (2012-2015 average = 7.2 %) is a main retained species in grooved tiger prawn, blue endeavour prawn and red endeavour prawn UoAs and it is also a target species in tiger prawn subfishery. The most recent assessment of the status of brown tiger prawn (Buckworth *et al.*, 2016) shows that stock status is above the LRP (S2011-2015/SMSY=122%) and above the TRP (S2015/SMEY=162%). Effort in 2015 was well below that at EMSY indicating that overfishing is not occurring (Table 3). There is a high degree of certainty that the brown tiger prawn stock is within biologically based limits and fluctuating around its target reference point, and the grooved tiger prawn, blue endeavour prawn and red endeavour prawn UoAs do not cause serious or irreversible harm.

White Banana Prawn Subfishery (one UoA: white banana prawn)

There were no main retained species in this subfishery.

Red-Legged Banana Prawn Subfishery (one UoA: red-legged banana prawn)

White banana prawn (*F. merguensis*) (2012-2015 average = 11.6%) is a main retained species in the red-legged banana prawn subfishery. White banana prawn catch in the red-legged

banana subfishery is very low compared to the catch when the species is targeted, the overlap between the two banana prawn species distributions being low (Loneragan *et al.*, 2002). White banana prawn is managed as target species in the NPF and its outcome is known and understood. The recruitment of white banana prawns is strongly driven by environmental conditions (rainfall and catchment basin runoff) (Vance *et al.*, 1998). Consequently, it has not been possible to develop a stock assessment model for white banana prawn.

Since 1970, catches, have responded as expected to the changes in rainfall, indicating that the stocks of banana prawns have remained at levels above those at which recruitment would be impaired. There is evidence that the escapement (biomass and number of prawns remaining at the end of the banana prawn fishing season (in May/June)) has increased in recent years (MRAG, 2012). Catches, have fluctuated around a long-term average with no conclusive evidence of long-term positive or negative trends in overall trends. Based on a consideration of the dynamics of white banana prawns (Figure 10) the stock has fluctuated over the history of the fishery around a highly productive level consistent with B_{MSY} or better.

There is a high degree of certainty that white banana prawn is within its biologically based limits and above target reference points and the red-legged banana prawn UoA does not pose a risk of serious or irreversible harm.

3.4.2.2 Minor Retained Species

Tiger Prawn Subfishery (four UoAs: brown tiger prawn, grooved tiger prawn, blue endeavour prawn, red endeavour prawn)

Blue endeavour prawn (*M. endeavouri*) (2012-2015 average = 4%) is a minor retained species in brown tiger prawn, groove tiger prawn and red endeavour prawn UoAs. The most recent stock assessment (Buckworth *et al.*, 2016) showed that blue endeavour prawn was above the LRP (S2011-2015/SMSY=76%, LRP = 50%SMSY) but below the TRP (S2015/SMEY=80%, TRP = SMEY). The stock was depleted for several years in the early 2000s but has been rebuilding since (Figure 4). The stock was close to the LRP in 2002. The species has shown that it can recover from these levels and the current assessment indicates that the HS is working to allow rebuilding to target levels. There is a high degree of certainty that at the current levels of fishing effort this species is within biologically based limits and fluctuating around its target reference point, and none of the three UoAs cause serious or irreversible harm.

Red endeavour prawn (*M. ensis*) (2012-2015 average = 2.6%) is a minor retained species in brown tiger prawn, grooved tiger prawn and blue endeavour prawn UoAs. No recent stock assessment is available for this species and no TRPs are defined. At ERA for target species red endeavour prawn scored low risk (PSA=1.93) from tiger prawn subfishery. The species has a wide Indo-Pacific distribution and prefers deeper habitats (over 35m, in Crocos *et al.*, 2001), suggesting a limited overlap with the tiger prawn subfishery. The species is protected through harvest controls applied to the other targets in the tiger prawn subfishery and it is monitored within NPF prawn monitoring surveys undertaken annually by CSIRO. There is a high degree of certainty that red endeavour prawn stock is within its biologically based limits but no target points have been defined, thus it cannot be stated that the species fluctuates around its target reference point.

Red-legged banana prawn (*Fenneropenaeus indicus*) is a minor species in the tiger prawn subfishery (2011-2015 average contribution= 1.6%). The most recent stock assessment was undertaken in 2015 (Buckworth *et al.*, 2015b), and includes data up to and including 2014. The estimate of spawning stock biomass in 2014 was approximately 2.7 times the SMEY, i.e. well above the TRP at SMEY. It was also approximately 3.2 times the SMSY, i.e. well above the LRP of 0.5 SMSY. Low catches and effort in 2015 resulted in the 2016 update of the assessment

not being able to provide reliable estimates of stock status (Plagányi *et al.*, 2016). Despite this, the previous assessment suggests that it is highly likely that the stock is above the point where recruitment would be impaired. Most red-legged banana prawn is caught in Joseph Bonaparte Gulf, where this species is targeted, while fishing effort in tiger prawn subfishery occurs in the Gulf of Carpentaria and north or Arnhem Land, thus the overlap is low. There is a high degree of certainty that tiger prawn subfishery does not pose a risk of serious or irreversible harm to red-legged banana prawn stock and the stock is within BBLs and above its TRP.

Bugs (*Thenus parindicus* and *T. australiensis*) (2011-2015 average = 0.9%) are minor species in the tiger prawn subfishery. Milton *et al.* (2010) estimated the Acceptable Biological Catch (ABC), consistent with an exploitation rate at MSY. For bugs, this was 1887 t (95%CI lower bound 1716, upper bound 2057). In estimating the ABC, the discarded portion of the catch was taken into consideration. For bugs, the discarded catch was estimated as all bugs smaller than 75 mm carapace width (CW) and all berried females (which are legally protected). Discarded bugs usually survive, thus the discarded catch does not substantially contribute to the fishing mortality. The retained catch in the NPF tiger prawn subfishery is much lower than the ABC. The ABC refers to the species of bugs combined. This is sufficient to sustainably manage all bugs because the species composition was predicted to be stable in the catch over the years (Milton *et al.*, 2010). Data about bug species abundance and distribution continue to be collected during the NPF prawn monitoring surveys and an eventual increase in risk can be identified early enough to inform and adjust the management strategy. At ERA *T. parindicus* and *T. australiensis* were assessed as low risk from the NPF tiger prawn subfishery (Griffiths *et al.*, 2007). The highest level of assessment for byproduct species was level 2 PSA.

There is a high degree of certainty that *Thenus spp.* stock is within its biologically based limits and the tiger prawn UoAs do not pose a risk of serious or irreversible harm. No target points have been defined, thus it cannot be stated that the stock fluctuates around TRPs.

Other Byproduct (2012-2015 average = 0.6%). Over 85% of the NPF byproduct derives from the tiger prawn subfishery, i.e. four UoAs: brown tiger prawn, groove tiger prawn, blue endeavour prawn and red endeavour prawn. Each of the byproduct species other than bugs had very low contributions to the catch (<0.5%) and the impact of the tiger prawn subfishery is *de minimis*. All byproduct species are widely distributed outside the NPF fishing grounds and have low overlap of their stocks with the fished area.

Other byproduct species with the most important catches belong to 4 groups: prawns (other than target: *Melicertus latisulcatus*, *M. longistylus*), squid (*Uroteuthis sp.* 3 and 4), cuttlefish (*S. elliptica* and *S. smithi*) and scallop (*Amusium pleuronectes*). The remaining byproduct catch consists of octopus, rock lobsters, and some teleost fish in very low quantities (NPFI, 2016, unpublished data).

CSIRO undertook a byproduct research study using data collected from five regions within the GoC between 2002 and 2008, during NPF prawn monitoring surveys (FRDC Project 2006/008, Milton *et al.*, 2010). All high intensity fishing grounds are located in the GoC and most of the byproduct biomass is caught there (Milton *et al.*, 2010). Squid, cuttlefish and scallop, which represented over 90% of the byproduct retained in the tiger prawn subfishery, have been assessed, and Acceptable Biological Catch (ABC) limits have been estimated. The retained catch for these groups is well under these limits. Data about byproduct continue to be collected from the NPF prawn monitoring surveys and the abundance and the distribution of the byproduct species in the GoC are assessed and reported regularly within the Integrated Monitoring Program reports (Projects AFMA R2009/0863; AFMA R2010/0822; AFMA 2011/0811).

All species identified as potentially retained in the NPF (135 species) have been subject to Ecological Risk Assessment (ERA, AFMA R04/1072) and are managed within an Ecological Risk Management Framework (ERM, AFMA, 2012). Two potentially retained mantis shrimp species, *Dictyosquilla tuberculata* and *Harpisquilla stephensoni* were assessed as high risk from tiger prawn subfishery, due to their rarity and insufficient data on their distribution and their life histories. These species are listed on the NPF priority list and are closely monitored within Crew Member and AFMA Scientific Observer programs, as well as within the CSIRO's NPF prawn monitoring surveys. However, these species have never been recorded as retained byproduct. There is a high degree of certainty that all byproduct species are within their BBLs and the tiger prawn subfishery does not pose a risk of serious or irreversible harm.

White Banana Prawn Subfishery (one UoA: white banana prawn)

Due to highly targeted fishing method in this subfishery white banana prawn makes up most of the catch, while the retained species component is very low: 0.6% other NPF target species and 0.07% byproduct species, with no species with percentage contributions over 0.5%. The impact of white banana prawn UoA on minor retained species is *de minimis*.

Red-Legged Banana Prawn Subfishery (one UoA: red-legged banana prawn)

All minor retained species in red-legged banana prawn UoA contributed in 2012-2015 about 1.2% annual average, with most catch consisting in other NPF targets. Only blue endeavour prawn had a percentage contribution of 0.6%. Blue endeavour prawn is managed sustainably as a target species in the tiger prawn subfishery and the outcome is known and understood. A very small part of the catch is being taken from JBG in red-legged banana prawn subfishery. All the other minor retained species had percentage contributions under 0.5% and the impact from the red-legged banana was considered *de minimis*.

3.4.3 Retained Species Management (PI 2.1.2)

The NPF Management Plan 1995 (last revision in 2012) includes long-term management objectives referring to the protection of retained species (Dichmont *et al.*, 2014):

- Objective 1. Ensure the utilisation of the fishery resources within the Northern Prawn Fishery is consistent with the principles of ecologically sustainable development and the exercise of the precautionary principle;

and

- Objective 5. Ensure that the incidental catch of non-target commercial and other species in the NPF is reduced to a minimum.

3.4.3.1 Main Retained Species

Tiger Prawn Subfishery (four UoAs: brown tiger prawn, grooved tiger prawn, blue endeavour prawn, red endeavour prawn)

The main retained species, **grooved tiger prawn** and **brown tiger prawn**, are managed under the NPF Harvest Strategy (HS) for tiger prawn subfishery (Dichmont *et al.*, 2014) and their management is detailed in P1 section of this report. A summary of these management measures is presented below.

There is a strategy to manage brown tiger prawn and grooved tiger prawn based on input controls. The strategy is compliant with Objective 1 of the management plan (Dichmont *et al.*, 2014). The operational objective of the HS is to attain long-term maximum economic yield (MEY) from the tiger prawn subfishery. MEY is calculated as the effort level in each year over a 7-year projection period that creates the biggest difference between the total revenue generated

from tiger and endeavour prawns and the total costs of fishing for the tiger prawn fishery as a whole. The harvest strategy for tiger prawns includes: (i) indicators (data from the fishery), (ii) monitoring (agreed protocols to get data), (iii) reference points (target and limit) and (iv) decision rules (agreed rules for setting input controls). The harvest strategy contains a comprehensive set of control rules that feed into HS actions, including no fishing for this species if the LRP is triggered as well as changes to fishing effort to achieve MEY through the use of spatial and temporal closures and gear modifications. There is also a 350kg per boat and per night trigger in place, which if not met during 12th and 13th week of the season, results in early closure of the fishery (20 November instead of 30 November). This trigger applies to all target species in the tiger prawn subfishery together. The trigger is set at the break-even point, where costs equal revenue.

The HS is designed to be responsive to the state of the stock and achieve objectives reflected in the target and limit reference points. The HS has been tested using the NPF Management Strategy Evaluation (Dichmont *et al.*, 2006a, Dichmont *et al.*, 2006b, Dichmont *et al.*, 2006c, Dichmont *et al.*, 2008, and Dichmont *et al.*, 2012a). Regular assessments provide evidence that the HS is achieving its objectives and maintaining the stock at target levels. A comprehensive data collection and validation, gear monitoring and VMS data to monitor the position of the vessels especially with respect to spatial and temporal closures, as well as compliance monitoring ensure the strategy is implemented successfully.

White Banana Prawn Subfishery (one UoA: white banana prawn)

There are no main retained species in this subfishery.

Red-Legged Banana Subfishery (one UoA: red-legged banana prawn)

There is a harvest strategy to manage **white banana prawn** during the banana season and this covers the management of white banana prawn caught in red-legged banana subfishery during the first fishing season. The operational objective is to allow sufficient escapement from the fishery to ensure an adequate spawning biomass of banana prawns (based on historical data) and, within this parameter, maximise the economic return from the fishery, and minimise the catch of tiger prawns in the first four weeks of the banana prawn season. The HS is based on: (i) banana prawn catch and catch per unit effort, (ii) reported industry data on catches for weeks 4 & 5; 6 & 7; 8 & 9 of the first fishing season (iii) tiger prawn incidental catch trigger of 6 tonnes/week 5. An on-going rule was to close banana fishing west of 138° and to prevent daylight trawling east of this location, if average daily catches did not meet the 500kg/day during the two-week reporting period. The trigger refers to catches of both white banana and red-legged banana prawns. Since October 2013 the 500kg trigger was replaced with an MEY which is variable and calculated in season (AFMA, 2016). If the MEY is not met and the decision rule is triggered, red-legged banana subfishery as well as white banana subfishery close in order to protect spawning biomass of banana prawns.

3.4.3.2 Minor Retained Species Management

Minor retained species that are target species in the NPF (brown tiger prawn, blue endeavour prawn, red endeavour prawn, red-legged banana prawn) are managed under the NPF HS (Dichmont *et al.*, 2014) and their management is detailed in P1 section of this report.

Tiger Prawn Subfishery (four UoAs: brown tiger prawn, grooved tiger prawn, blue endeavour prawn, red endeavour prawn)

Blue endeavour prawn and **red endeavour prawn** are minor retained species in the tiger prawn subfishery.

Endeavour prawns, are managed together with the tiger prawn species under the tiger prawn HS. The harvest strategies contain comprehensive sets of control rules that feed into HS actions, including species specific, as no fishing if the LRP for brown tiger prawn, grooved tiger prawn or blue endeavour prawn is triggered, as well as changes to fishing effort to achieve MEY through the use of spatial and temporal closures and gear modifications. There is also the 350kg/night per boat trigger in place, which if not met, results in early closure of the fishery. This trigger applies to all target species of the tiger prawn subfishery together. The trigger is set at the break-even point, where costs equal revenue.

The overall NPF HS is designed to be responsive to the state of the stocks and achieve objectives reflected in the target and limit reference points. The HS has been tested using the NPF Management Strategy Evaluation (Dichmont *et al.*, 2008 and Dichmont *et al.*, 2012b, and Dichmont *et al.*, 2014). Regular assessments provide evidence that the HS is achieving its objectives and maintaining the stocks at target levels. A comprehensive data collection and validation, gear surveys and VMS data to monitor the position of the vessels especially with respect to spatial and temporal closures, as well as compliance monitoring ensure the strategy is implemented successfully.

There are no specific measures for red endeavour prawns, however, the harvest strategy that is in place for tiger prawn species and blue endeavour prawn is highly likely to benefit this species and to maintain the species within its biologically based limits.

Red-legged banana prawn is caught in small quantities in tiger prawn subfishery. A harvest strategy for red-legged banana prawn subfishery operating during the tiger prawn fishing season is in place. If a minimum of 100 fishing days has been achieved and the red-legged banana prawn stock size falls below the LRP (390kg/boat per fishing day in August, September and October) for the two most recent consecutive years, then the total allowable effort (TAE) is zero for a year (no fishing in the following year). The HS for red-legged banana has been tested using the NPF Management Strategy Evaluation (Dichmont *et al.*, 2014). The 2015 assessment indicated increasing spawning biomass levels in recent years, suggesting the strategy is working (Buckworth *et al.*, 2015b). This strategy applies to boats fishing in the JBG but is sufficient to maintain red-legged banana prawn stock overall in the NPF. Catch rates in 2015 and 2016 were low and require further investigation to determine whether the tools in place are effective in achieving appropriate exploitation levels, although red-legged banana prawn abundance in the JBG is highly dependent on the environmental conditions. The uncertainty relates more to the exploitation rates in the red-legged banana subfishery where most of the red-legged banana prawn is caught. Gear restrictions and closures that are in place to protect tiger and endeavour prawns also protect red-legged banana prawns. A comprehensive data collection and validation, gear surveys and VMS data to monitor the position of the vessels, as well as compliance monitoring ensure the strategy is implemented successfully.

Byproduct Species are minor retained species in the four UoAs in tiger prawn subfishery. These species are managed through species specific measures, as well as general measures that reduce incidental catch and increase post-capture survival. Measures to minimise incidental catch in general (including catch of byproduct species) are: fishing effort control, permanent and temporal closed areas and activities that reduce the impacts of fishing (e.g. compliance monitoring, CMO and Scientific Observer programs).

Tiger prawn subfishery operates only for about four months of the year (usually 1 August- 30 November) and only at night time (see Direction No. 171, AFMA, 2016). NPF vessels use trawls which may increase survivability of the discarded portion for some retained species such as bugs and scallops.

There are also specific measures (harvest controls) for byproduct species as set in the NPF Harvest Strategy, presented in Table 8 (Dichmont *et al.*, 2014). These measures and trigger limits apply for the NPF overall and not just for tiger prawn subfishery.

Table 8. Byproduct limits and measures. Source: NPF Harvest Strategy (Dichmont *et al.*, 2014)

Species	Possession Limit
Shark, Skates & Rays -(all species)	No part of these species to be retained, including: fins, teeth, skin and saw shark beaks
Saddle Tailed snapper (<i>Lutjanus malabaricus</i>) Red Snapper (<i>Lutjanus erythropterus</i>) Red Emperor (<i>Lutjanus sebae</i>)	(a) a total of 550 kg whole weight, 211 kg fillet weight, 500 kg gilled & gutted weight or 393 kg headed & gutted weight during the period beginning on 1 March in any year and ending on 30 June the same year (b) a total of 55 kg whole weight, 22 kg fillet weight, 50 kg gilled & gutted weight or 40 kg headed & gutted weight during the period beginning on 1 July in any year and ending on 28 February in the same year.
Mud Crab (<i>Scylla</i> sp.)	10 per trip
Broad Barred Spanish Mackerel (<i>Scomberomorus semifasciatus</i>), Narrow barred Spanish Mackerel (<i>Scomberomorus commerson</i>), Longtail Tuna (<i>Thunnus tonggol</i>), Gold Band Snapper (<i>Pristipomoides multidens</i>), Coral Trouts, Rock Cods, Sea Breams etc (Serranidae family) and Sweet Lips (Lethrinidae family)	10 whole fish per trip
Rock Lobster (<i>Panulirus ornatus</i>), also known as painted crayfish	6 lobsters or lobster tails per trip in total
Barramundi (<i>Lates calcarifer</i>), Threadfin Salmon (<i>Polydactylus sheridani</i>), Blue Salmon (<i>Eleutheronema tetradactylum</i>), Black Jewfish (<i>Protonidea diacanthus</i>), Jewfish or Yellow Jew (<i>Nibea squamosa</i>), Spotted Grunter-bream (<i>Pomadasys kaakan</i>), Queenfish (<i>Scomberoides lysan</i>) (<i>S. commersonianus</i>), Pearl Shell (<i>Pinctada</i> spp.), Trochus (Class Trochidae), Trepang (Class Holothuroidea), Coral	NIL catch
Bugs (<i>Thenus indicus</i> , <i>Thenus orientalis</i>)	60 mm minimum carapace; no berried female bugs; all bugs retained whole; no removal by any method (including chemical) of eggs from egg-bearing females; and 100 t trigger limit to review survey and logbook data

Squid	500 tonne catch trigger limit; Review event at 300 tonnes; Appropriate management measures to be developed and implemented if catch trigger is reached
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In the NPF tiger prawn subfishery the majority of the byproduct is represented by bugs, prawns and squid (89% average for 2011-2015). One species from each group for bugs, *Thenus parindicus* (mud bug), and prawns, *Melicertus latisulcatus* (western king prawn) and two species of squid, *Uroteuthis* sp. 3 and 4, dominate the retained byproduct (Milton *et al.*, 2010).

As specific measures for mud bugs, individuals smaller than the current minimum legal size (60 mm CW) and egg-bearing females are returned to the water alive. Also, the removal of eggs from females by any method is prohibited. A maximum catch limit of 100t was introduced as a trigger to review the available data and appropriate measures. This limit is very conservative compared to the Acceptable Biological Catch (ABC) of 1716t (Milton *et al.*, 2010). The retained quantity of bugs has been maintained under the 100 t limit since this limit was introduced.

A 500 t trigger limit for squid was set in 2006 and still applies. If the trigger is reached, appropriate management measures are to be developed and implemented. Since 2014, at the last revision of the NPF Harvest Strategy, a 300 t limit was set to trigger a review of the management measures. The estimated ABC for squid was between 300 t and 400 t, but the authors admit that this limit may be underestimated. Based on the results of the byproduct study (Milton *et al.*, 2010), squid are less vulnerable to night prawn trawling because they migrate in the water column for feeding.

NPF Harvest Strategy lists western king prawn and red-spot king prawn as target species but they are caught incidentally during tiger prawn fishing activities. Levels of catch for these prawn species are very low compared to target prawn species. There are no specific management measures, however, these species are generally protected by the management measures adopted for the tiger prawn resource, as well as through spatial and temporal closures. Closures in the fishery include permanent closures (Direction No. 169, AFMA, 2016) of seagrass beds and other sensitive habitats and seasonal closures of juvenile prawn stock habitat, which are designed to coincide with recruitment phases, and to protect pre-spawning prawns. Seasonal closures (Direction No. 171, AFMA, 2016) are in place to protect small prawns, as well as to protect spawning individuals. The daylight trawl closure during the tiger prawn fishing season reduces the capture of spawning tiger and king prawns. Spawning index and its recruitment index are assessed annually, to ensure the populations are maintained above their BBL (Dichmont *et al.*, 2014).

Catch information about all retained species is collected in fishery logbooks and validated through seasonal landing returns. Overall, there is a strategy to manage all byproduct species in the NPF tiger prawn subfishery. Since 2002, an integrated monitoring program collects data on the key byproduct species together with data on target species from the GoC. Abundance and distribution maps are produced and reported in an Integrated Monitoring Report. Testing the byproduct management strategy and adjusting it, is an ongoing process. Based on the information directly about the fishery and the species involved, there is high degree of confidence that the strategy will work. No significant changes in catch rates, abundance and distribution of the byproduct species have been identified so far, however, ongoing monitoring ensures that any warning signs are recognised and investigated / addressed in their early stages (see Kenyon *et al.*, 2015). In addition, key byproduct catches are maintained bellow the ABC

levels (NPFI, 2016, unpublished data). In consequence, there is some evidence that the strategy is achieving its overall goal.

Some of the same processes that are in place to ensure that harvest strategy for target species is implemented successfully are valid for byproduct species as well. A comprehensive data collection and validation, gear monitoring and VMS data to monitor the position of the vessels especially with respect to spatial and temporal closures, as well as compliance monitoring ensure the strategy is implemented successfully.

White Banana Prawn Subfishery (one UoA: white banana prawn)

There are some differences in how white banana prawn subfishery operates, as compared with tiger prawn subfishery. The white banana prawn subfishery operates mainly during the first fishing season of the year for 6 to 12 weeks starting on 1 April, without the daylight ban. This subfishery is more selective and the incidental catch is much lower than in the tiger prawn subfishery, with the retained species (other than white banana prawn) contributing less than 1% of the catch biomass in 2011-2015.

During the banana season, **brown tiger, groove tiger, blue endeavour and red endeavour prawns** are likely to be retained in white banana trawls. A decision rule to protect spawning individuals from these species is closure of the fishery west of 138° and daylight ban for fishing east of 138° if the pro-rata total tiger prawn catch for the first 4 weeks is more than 24 tonnes. The daylight ban is mainly to protect spawning tiger prawns but the other species are likely to be protected as well. Early closure of the banana season to allow tiger prawns targeting, ensures that the retained quantities of tiger and endeavour prawns in white banana UoA are minimal.

During the first fishing season (banana season), **red-legged banana prawn** which may be caught in small quantities when fishing for white banana prawn is counted towards the total NPF catch triggers for white banana, i.e. MEY trigger in banana season, which if not met, the fishery closes. This is sufficient for the white banana subfishery to achieve the required outcome for red-legged banana prawns (not lead to recruitment impairment) with a high degree of certainty, especially considering the low susceptibility for red-legged banana to be caught using the fishing method for white banana. Improved observer coverage in banana prawn fishing season since 2011 (Fry *et al.*, 2011), plus gear surveys, VMS (Dichmont *et al.*, 2014) ensure the strategy is implemented successfully.

Other minor retained species. Each of the minor retained species in white banana prawn subfishery contributed less than 0.5% and the impact is considered *de minimis*. However, all the general measures to reduce incidental catch such as effort control, spatial and temporal closures (specific for this subfishery), catch limits and prohibitions apply as described for the tiger prawn subfishery. Comprehensive monitoring programs ensures the strategy for retained species is implemented successfully. The abundance and distribution of the byproduct species are monitored annually (NPF prawn monitoring program) and reported periodically (Kenyon *et al.*, 2011, 2016). No significant changes identified over the years (since 2002) suggest that the strategy is working.

Red-Legged Banana Prawn Subfishery (one UoC: red-legged banana prawn)

The red-legged banana prawn subfishery operates in both seasons, from the 1 April to 15 June and from the 1 August to 30 November, usually only 14 days per month. This fishery does not operate if the other fisheries close. The fishing effort in the red-legged banana subfishery is much lower than in the other two subfisheries (e.g. 254 boat-days in 2006, and much lower in 2015, 76 boat-days) and fishing occurs in deeper waters at 45-90m. The retained species component in this subfishery consists in white banana prawn (2011-2015 average = 11%,

assessed as main) and other NPF target species in very low quantities (2011-2015 average = 1.5% collectively), each species contribution being 0.5% or under. Management strategies specific for tiger prawn and banana prawn seasons apply in red-legged prawn subfishery, as well as the byproduct limits.

3.4.4 Retained Species Information (PI 2.1.3)

A comprehensive data collection program (Figure 16) has been established for the NPF to ensure reliable information is available on which to base management decisions. Accurate information is collected and maintained on all retained species (target and non-target), through fishery dependent and independent programs. Currently, fishery independent data collection for retained species is in place only in the Gulf of Carpentaria region but not in Joseph Bonaparte Gulf, thus fishery independent information on retained species in the red-legged banana subfishery is lacking. However, the retained species in this subfishery are retained in the other two subfisheries and most of these species catch is from the GoC. Most information about the stock of the species that are retained in the three subfisheries is verifiable through fishery independent data. All logbook retained catch data is verifiable through seasonal landing returns data (PI 2.1.3a). This information is sufficient to quantitatively assess the consequences for the status of the affected populations with high degree of certainty (PI 2.1.3b). Information on byproduct species is also available from a byproduct study. The consequences for the retained species populations were assessed in ecological risk assessments which, together with the byproduct study results support the implementation of a management strategy for retained species (PI 2.1.3c). Independent surveys data on the distribution and abundance of the retained species, analysed and reported in Integrated Monitoring Reports is adequate to evaluate with high degree of certainty whether the strategy is achieving its objective (PI 2.1.3c). Monitoring of retained species is conducted in sufficient detail to assess ongoing mortalities to all retained species. Catch data reported in logbooks and verified by seasonal landing returns can be used together with the catch rate data from independent surveys to assess ongoing mortalities for all retained species (PI 2.1.3d). More information about the monitoring programs, surveys, research and ecological risk assessments (ERAs) is presented in the following sections.

Fishery dependent information

The fishery dependent data collection program is based on a fishery-wide Daily Catch & Effort logbook program for all target and byproduct species. Under this program, operators are required to record the location of fishing operations (latitude/longitude) for every day they fish and/or search, regardless of whether any catch is taken; the total number of shots for each fishing day; the species/product retained and size grade information. Processor records are obtained for landings data which are used to verify the logbook catch. AFMA scientific observer and CMO programs are also in place to collect data on commercial trawlers, although these programs collect data mainly on ETPs and bycatch. Vessel gear details are also collected which track changes in gear and technology in the fishery. This information assists in stock assessments and research being undertaken on effort creep and fishing power studies (Dichmont *et al.*, 2014). These data form the basis of the NPF's fishery dependent research program.

Fishery independent information

Fishery independent information, including annual fishery independent surveys for target species (brown tiger prawn, grooved tiger prawn, blue endeavour prawn, red endeavour prawn, king prawn, white banana prawn) and byproduct (bugs, squid, cuttlefish, scallop), is collected in the NPF. A major source of ongoing information about retained species is the Prawn Monitoring Survey Program in the NPF which began in August 2002. Each year, a recruitment survey has been undertaken on the key fishing grounds of the Gulf of Carpentaria. A spawner

survey is undertaken during the mid-season break in winter on the western grounds of the Gulf. These surveys are a fundamental component of the tiger prawn stock assessment that is used to set the Total Allowable Effort (TAE) as they provide input to estimating the indices of abundance for both recruits and the spawning stock to which the assessment model is fitted (as well as input data to model on the size frequency of prawns) (Dichmont *et al.*, 2014).

In addition to target species, the NPF prawn monitoring program includes the most important byproduct species (bugs, squid, cuttlefish, scallop). The data has been used in the development of innovative new models to support the assessment byproduct (i.e. to estimate the ABCs) and to produce distribution maps for byproduct catch rates.

The NPF prawn monitoring program produced an integrated monitoring survey design; defining the objectives, scale, frequency and costs of the surveys which will be used in the future. The implementation of the monitoring program allowed quantitative descriptions of the spatial distribution and temporal variation of the populations of all commercial prawn and byproduct species (Kenyon *et al.*, 2011, 2016). These fishery independent surveys were designed to generate a long-term set of data capable of providing key parameters to support the sustainable management of the Northern Prawn Fishery (Kenyon *et al.*, 2016).

Sampling. According to Kenyon *et al.* (2011) a major issue for long-term research surveys is to use standard sampling gear so that the fishing power of the survey vessel can be kept as constant as possible over many years. To ensure standardisation, all these surveys have used approximately the same number of sites from each region and very similar NPF-based commercial vessels as a survey platform.

In most cases, all commercial species of prawns (including king prawn), bugs and scallops were identified to species and total weights and numbers were recorded for each net. Up to 2007, all squid and cuttlefish had been frozen and later transported to CSIRO, Cleveland, for identification and further processing. Commencing in 2008, all squid and cuttlefish were counted and weighed, but not kept. Currently, the cephalopods are not differentiated to species level because the data accumulated from 2002 to 2007 provided enough information on cephalopod species distribution. Up to 100 individuals of each species of prawn, bugs and scallops (50 individuals for scallops) were measured to provide information on population structure (Kenyon 2011).

The results of these independent surveys are reported in the Integrated Monitoring Program reports for the NPF (Milton *et al.* 2008a; Ye *et al.* 2006, Kenyon *et al.*, 2011, 2016) but they are also used in fishery-independent studies such as the byproduct study, and in ecological risk assessments.

Byproduct Study (Source: Milton *et al.*, 2010)

The objectives of and the methodologies used in the byproduct study were:

Objective 1. To identify, collate and analyse all available data on the distribution, biology, population dynamics and catches of byproduct species (or at least species groups) in the NPF in order to identify knowledge gaps and provide critical life-history parameters for modelling byproduct populations.

Method: The life-history characteristics of the species from the key four byproduct categories (90% of the byproduct catch), six species of squid, five species of cuttlefish, two bug and two scallop species, were examined from samples collected by the AFMA-funded NPF prawn monitoring surveys in 2002-2008.

Objective 2. To investigate the feasibility of dividing the byproduct groups recorded in NPF commercial logbooks into individual component species on the basis of available research data.

Method: The species composition of subsamples of the byproduct catch from the NPF prawn monitoring surveys were used to develop statistical models to predict the species composition of logbook byproduct records. Two types of models were developed – a two-species model for bugs, and separate multi-species models for squid and cuttlefish. A range of temporal, spatial and environmental predictors were used in the analyses. The models explained > 60% of the variation in the proportion of each species within a byproduct group. The sample species composition confirmed the predictions made by the statistical model and suggests that the data may be useful for byproduct stock assessments.

Objective 3. To develop models of impacts on byproduct species with the purpose of (a) assessing the sensitivity of results to uncertainty in the biological parameters with a view to determining minimum data requirements and (b) assessing the relative effect on population size of each byproduct species (or group) under alternative prawn management scenarios.

Method: Due to the low catch level, evaluating management strategies for byproduct species in fisheries is challenging. This issue has been addressed by estimating a biologically-sustainable total annual catch for each of the four main byproduct groups and by undertaking a management scenario evaluation of the current bug regulations. Both methods required developing new approaches to the problem. They each rely on fishery independent estimates of abundance obtained from the NPF prawn monitoring surveys.

The maximum biologically-sustainable total annual catch (acceptable biological catch or ABC, Figure 9) was calculated from the biomass estimates based on the NPF prawn monitoring surveys and life-history characteristics of each group.

Table 9. Mean potentially acceptable biological catch (ABC, in tonnes) and its 95% confidence interval of each byproduct group in the Gulf of Carpentaria based on 2005 – 2007 NPF prawn monitoring survey data.

Group	Mean	L95%CI	U95%CI
Scallop	186	159	213
Bugs	1887	1716	2057
Cuttlefish	282	258	306
Squid	306	267	344

Ecological Risk Assessments (Source: Griffiths *et al.*, 2007)

The initial assessment of the ecological impacts of the NPF was undertaken using the ERAEF method version 9.2. ERAEF stands for “Ecological Risk Assessment for Effect of Fishing”, and was developed jointly by CSIRO, and the AFMA. ERAEF provides a hierarchical framework for a comprehensive assessment of the ecological risks arising from fishing, with impacts assessed against five ecological components – target species; byproduct and bycatch species; endangered, threatened and protected (ETP) species; habitats; and ecological communities. ERAEF proceeds through four stages of analysis: scoping; an expert judgement based Level 1 analysis (SICA – Scale Intensity Consequence Analysis); an empirically based Level 2 analysis (PSA – Productivity Susceptibility Analysis); and a model based Level 3 analysis. This hierarchical approach provides a cost-efficient way of screening hazards, with increasing time

and attention paid only to those hazards that are not eliminated at lower levels in the analysis. Risk management responses may be identified at any level in the analysis.

The application of the ERAEF method to a fishery can be thought of as a set of screening or prioritization steps that work towards a full quantitative ecological risk assessment. At the start of the process, all components are assumed to be at high risk. Each step, or Level, potentially screens out issues that are of low concern. The Scoping stage screens out activities that do not occur in the fishery. Level 1 screens out activities that are judged to have low impact, and potentially screens out whole ecological components as well. Level 2 is a screening or prioritization process for individual species, habitats and communities at risk from direct impacts of fishing. The Level 2 methods do not provide absolute measures of risk. Instead they combine information on productivity and exposure to fishing to assess potential risk. Because of the precautionary approach to uncertainty, there will be more false positives than false negatives at Level 2, and the list of high risk species or habitats should not be interpreted as all being at high risk from fishing. Level 2 is a screening process to identify species or habitats that require further investigation. Some of these may require only a little further investigation to identify them as a false positive; for some of them managers and industry may decide to implement a management response; others will require further analysis using Level 3 methods, which do assess absolute levels of risk.

Target and byproduct species have been assessed at SICA using a "plausible worst case scenario", that means by considering the most vulnerable sub-component and the most vulnerable unit of analysis (e.g. species, habitat type or community with highest risk). All target, and byproduct species were then assessed at Level 2, PSA (Griffiths *et al.*, 2007). The PSA approach is based on the assumption that the risk to an ecological component will depend on two characteristics of the component units: (1) the extent of the impact due to the fishing activity, which will be determined by the susceptibility of the unit to the fishing activities (Susceptibility) and (2) the productivity of the unit (Productivity), which will determine the rate at which the unit can recover after potential depletion or damage by the fishing. Full details of the methods are described in Hobday *et al.* (2007). A list with species potentially at risk from the NPF fishery (priority list) is regularly updated when new information about the species becomes available or when changes in management occur. All species on the priority list are closely monitored within the CMO program. Currently no species that were recorded as retained are on the priority list.

MSC RBF assessment uses SICA and PSA methodologies which are based on the ones developed by CSIRO, but modified to be applied to any fishery and not only to Australian fisheries, thus these methodologies are considered sound (<https://www.msc.org/about-us/standards/fisheries-standard/msc-risk-based-framework>). AFMA's ERAs are scheduled to be updated in 2017.

3.4.5 Bycatch species (P 2.2)

In MSC definition, bycatch comprises organisms that have been taken incidentally and are not retained (usually because they have no commercial value) (Table AA1, FCR v2.0, p.39, MSC, 2013). The bycatch of tropical prawn trawl fisheries is highly diverse, and usually dominated by teleosts (Hall, 1999 in Stobutzki *et al.*, 2001a). The bycatch quantity and species composition varies based on the gear deployed, the fishing grounds and the time of day (Dell *et al.*, 2009). In the Gulf of Carpentaria (GoC), bycatch composition can be broadly grouped into northern and southern regions separated at 14°S (near Groote Eylandt) (Dell *et al.*, 2009), while in the JBG, the bycatch composition differs, although most species can be found in both, GoC and

JBG. Stobutzki *et al.*, 2001a found that over 400 teleost species contributed 73% of the NPF bycatch weight. This diversity and the lack of historical and biological information prevent the use of quantitative stock assessments to determine the population status of each species (Stobutzki *et al.*, 2001b). NPF pioneered bycatch research (e.g. Ramm *et al.*, 1990; Blaber *et al.*, 1990, Pender *et al.*, 1993, Dell *et al.*, 2009, Tonks *et al.*, 2008), bycatch sustainability assessments and monitoring programs in fisheries (Stobutzki *et al.*, 1999, 2001a, 2001b; Zhou & Griffiths, 2008; Zhou *et al.*, 2007, 2009, 2011, 2015; Fry *et al.*, 2015; Brewer *et al.*, 2007) as well as the development of Bycatch Reduction Devices or BRDs (e.g. Brewer *et al.*, 1998, 2006).

3.4.5.1 Bycatch Species Outcome (PI 2.2.1)

Under scoring guidepost P 2.2.1 the status of the stock of each bycatch species or group of species is assessed against biologically based limits (BBLs). MSC defines “biologically based limits” for P2 species as their stocks being above the limit where serious or irreversible harm can occur (i.e. point of recruitment impairment) (CB3.2.4, FCR v1.3). MSC terminology defines “main” bycatch as those species that are incidentally caught by the fishery and not retained, if they represent over 5% of the total catch biomass, or, for vulnerable species, over 2%. Otherwise, they are considered “minor” species. The NPI and the AFMA requested CSIRO to undertake a data assessment of the observer bycatch data sets for the purpose of supplying a summarised dataset for this MSC recertification assessment. This data includes bycatch species percentage contributions in surveyed trawls within the tiger, white banana and red-legged banana sub-fisheries. The AFMA Scientific Observer dataset is the most representative dataset for the commercial catch, however, it often lacks taxonomic detail. To compensate for this limitation, the AFMA dataset was used in combination with extensive datasets on bycatch from CSIRO surveys, where whole catch or subsamples of catch were sorted and identified to species level (Fry & Miller, 2016).

Table 10 presents the total numbers of species or species groups for elasmobranchs, teleosts and invertebrates from the filtered AFMA dataset that was used to identify “main” bycatch species in each subfishery. The mean percentage weight contribution of each species/ group is presented in Table 11.

Table 10. Summary of total numbers of species or species groups recorded during the AFMA scientific observer and CSIRO scientific survey trawls in each subfishery. (Source: Fry & Miller, 2016)

Dataset	AFMA			CSIRO	
Subfishery	Red-Leg	Banana	Tiger	Banana	Tiger
All Species/Groups	317	525	602	668	991
Elasmobranchs	32	44	60	23	33
Teleosts	211	391	450	410	435
Invertebrates	61	65	68	225	523

Table 11. Summary of the mean percentage weight contribution of each species or species groups at 2% or above in each subfishery for the AFMA scientific observer dataset from 2013 to 2015. (Source: Fry & Miller, 2016) (main species greyed)

Red-legged Banana Prawn Subfishery

Scientific Name	Species Code	Percent Average
Sciaenidae - undifferentiated	37354000	8.13931
<i>Setipinna tenuifilis</i>	37086008	3.93824
<i>Polydactylus nigripinnis</i>	37383001	3.18022
<i>Harpadon translucens</i>	37119001	2.52390
<i>Neotrygon annotata</i>	37035012	2.09961
White Banana Prawn Subfishery		
Scientific Name	Species Code	Percent Average
Sciaenidae - undifferentiated	37354000	4.06209
<i>Setipinna tenuifilis</i>	37086008	3.64880
<i>Carcharhinus, Loxodon and Rhizoprionodon</i> spp	37018901	3.06139
<i>Polydactylus nigripinnis</i>	37383001	2.12277
<i>Harpadon translucens</i>	37119001	2.00291
Tiger		
Scientific Name	Species Code	Percent Average
Leiognathidae - undifferentiated	37341000	6.72016
Mullidae - undifferentiated	37355000	5.39104
Bathysauridae, Synodontidae - undifferentiated	37118000	4.29888
Sillaginidae - undifferentiated	37330000	3.19425
<i>Nemipterus</i> spp	37347901	3.11481
<i>Polydactylus multiradiatus</i>	37383002	2.67985

As Table 11 shows, percentage contributions over 5% are reported for groups of species. For a conservative approach, we considered all species from those groups as "main". The lists of species for each group were identified from CSIRO Surveys dataset (Fry & Miller, 2016) and species list used for ERAEF (Griffiths *et al.*, 2007). The outcome for these species will be discussed per subfishery, in the following sections.

Tiger Prawn Subfishery (*brown tiger prawn, grooved tiger prawn, blue endeavour prawn and red endeavour prawn UoAs*)

Tiger prawn trawling generally occurs close to the substratum and as a result selectivity of prawns is low and bycatch is high. The trawl gear in the tiger prawn fishery is generally lowered over suitable prawn habitat to fish as close as possible to the seabed. The gear is towed at an average of 3.2 knots for periods of 3-4 hours. Trawling only takes place at night (Griffiths *et al.*, 2007). Dell *et al.* (2009) estimated the bycatch volume for the tiger prawn subfishery as 20,073 t yr⁻¹ ±568 SE, with a bycatch to prawn ratio of 8:1. According to recent data from AFMA Scientific Observer Program compiled by Fry & Miller (2016, Annex), bycatch in the tiger prawn subfishery accounted for 65%, with a bycatch to prawn ratio was 1.9:1. This drastically reduced bycatch ratio is reasonable, considering the improved performance of BRDs achieved since the data used by Dell *et al* was sampled (without BRDs).

From AFMA SO datasets from 2007-2015, teleosts and elasmobranchs contributed an average of 47% total catch weight while invertebrates contributed about 15%. This is much lower than findings from Stobutzki *et al.*, 2001a. As survey trawls did not use BRDs or TEDs, the lower catch of teleosts and elasmobranchs is most likely due to the use of these devices.

Fry & Miller (2016), compiled a list of 602 species occurring in the NPF Tiger Prawn Subfishery bycatch. Two families, Leiognathidae (ponyfishes) and Mullidae (mullets), contributed each over 5% total catch biomass. All the species from these families were considered as "main" bycatch. These species are presented in the table below:

Table 12. Bycatch species with potential percentage contribution over 5% in biomass in the NPF Tiger Prawn Subfishery. Source Fry and Miller, 2016; Griffiths *et al.*, 2007)

Family Leiognathidae	Family Mullidae
<i>Photopectoralis bindus</i>	<i>Upeneus moluccensis</i>
<i>Leiognathus</i> sp. [in Sainsbury <i>et al.</i> , 1985]	<i>Parupeneus heptacanthus</i>
<i>Aurigequula longispina</i>	<i>Parupeneus indicus</i>
<i>Equulites leuciscus</i>	<i>Upeneus sulphureus</i>
<i>Secutor insidiator</i>	<i>Upeneus guttatus</i>
<i>Gazza minuta</i>	<i>Upeneus luzonius</i>
<i>Aurigequula fasciata</i>	<i>Upeneus asymmetricus</i>
<i>Eubleekeria splendens</i>	<i>Upeneus sundaicus</i>
<i>Equulites elongatus</i>	<i>Upeneus tragula</i>
<i>Equulites moretoniensis</i>	<i>Parupeneus chrysopleuron</i>
<i>Nuchequula glensae</i>	<i>Upeneichthys stotti</i>
<i>Leiognathus equulus</i>	
<i>Leiognathus ruconius</i>	
<i>Nuchequula gerreoides</i>	
<i>Photopectoralis aureus</i>	

All the main bycatch species have been subject of a new quantitative ecological risk assessment, the Sustainability Assessment for Fishing Effects (SAFE), in 2007, and re-assessed in 2010 using updated fishery data (Zhou, 2011). The method used for this assessment will be discussed in section 5.2.3, Bycatch Information. All these species scored low risk from the tiger prawn subfishery.

No species with percentage contributions between 2% and 5% catch biomass were found to be vulnerable, mainly because they are species with highly productive, small sized individuals and are widely distributed outside the tiger prawn fishing grounds. Thus, they do not classify as main. All species in this category (*Polydactylus multiradiatus* -a threadfin salmon, *Nemipterus* spp. - threadfin breams, Bathysauridae and Synodontidae -lizardfishes, and Sillaginidae whiting) were assessed at ERA Level 2.5 (SAFE) and scored low risk from the fishery. In conclusion, there is a high degree of certainty that main bycatch species are within biologically based limits and the tiger prawn subfishery does not pose a risk of serious and irreversible harm.

In addition, all species of teleosts and elasmobranchs identified as potential bycatch were SAFE assessed (Zhou & Griffiths, 2008; Zhou *et al.*, 2009). While risk assessments for bycatch focused on teleosts and elasmobranchs, many invertebrate species that are discarded were assessed at PSA under ERA for byproduct (Griffiths *et al.*, 2007). Not all species of invertebrates have been risk assessed, although most of these had exceptionally low percentage contributions to the catch weight, <0.5%, and the impact of the tiger prawn subfishery on their populations is considered *de minimis*. Only one group, undifferentiated crabs (Infraorder Brachyura-undifferentiated), contributed 1.05% of catch weight. It is likely that none of the

species included in this group had individual percentage contributions over 0.5%. The sustainability of the invertebrate species caught in prawn trawls in the NPF has been assessed in studies of benthic biodiversity which informed the NPF management (Hill *et al.*, 2002, Haywood *et al.*, 2005, Bustamante *et al.*, 2011). Crab species that have the highest susceptibility to be caught are portunid crabs which were found to be one of the most sustainable groups with the highest recoverability rates (Hill *et al.*, 2002).

The initial SAFE assessments in 2006 and 2007, identified several potentially ‘at risk’ species: three elasmobranchs *Orectolobus ornatus*, *Taeniura meyeni* and *Urogymnus asperrimus*, and two teleosts: *Dendrochirus brachypterus* and *Scorpaenopsis venosa*. These were added on a priority species list and were object of monitoring by the crew-member observers and the fishery independent NPF prawn monitoring surveys since 2007 (Fry *et al.*, 2015).

Since the initial ERAs, the fishery has experienced changes in the fleet structure, fishing pattern, and fishing effort (see Figure 17), which deemed a new SAFE necessary (Zhou, 2011). In 2010 AFMA requested an updated SAFE using more recent fishery data. The method used for the first assessment did not differentiate between high and low intensity fishing areas, leading to higher fishing mortalities. The updated SAFE used the actual fishing effort for a more accurate estimation of fishing mortality and a more accurate estimate of the risk (Zhou, 2011). The uncertainty was also considered (Zhou, 2011).

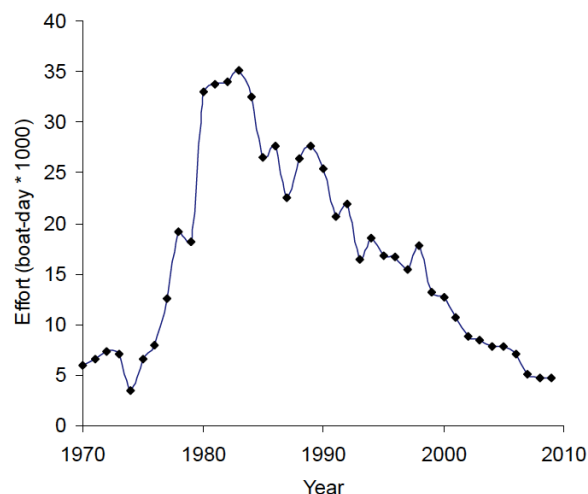


Figure 17. Change of tiger prawn fishing effort in the NPF between 1970 and 2009. Source: Zhou, 2011

SAFE for teleosts and elasmobranchs were done separately because of the differences in life history. Out of the 478 species of teleosts initially thought of as potentially encountering with the tiger prawn fishing area, 50 species have never been caught in surveys so only the remaining 428 species were assessed at the second SAFE. No teleosts were found at medium risk (did not have estimated fishing mortality greater than their maximum sustainable fishing mortality (F_{msm})). There were also no species at high risk from the NPF fishery (with fishing mortality higher than the unsustainable fishing mortality ($F_{2007-2009} > F_{crash}$)) even when uncertainty was taken into consideration.

Out of two teleost species previously assessed as potentially at risk of overfishing: *Dendrochirus brachypterus* and *Scorpaenopsis venosa*, the latter was based on only one detection from a scientific survey in fished area (Brewer *et al.*, 2007). In this updated report, neither had estimated fishing mortality greater than their maximum unsustainable mortality even when uncertainty was taken into consideration. It was concluded that these species were not at risk

from tiger prawn subfishery and they should be removed from the priority list (Fry *et al.* 2009; Zhou, 2011). Furthermore, eight teleost species, *Pterygotrigla hemisticta*, *Lepidotrigla* sp C, *Lepidotrigla spiloptera*, *Lepidotrigla kishinoyi*, *Lepidotrigla* sp 2, *Lepidotrigla spinosa*, *Lepidotrigla argus*, *Lepidotrigla* sp A., were assessed as having a 'precautionary medium risk' score. These species were then assessed by key biological researchers using the expert opinion method and only two of these species (*Lepidotrigla spinosa* and *Lepidotrigla* sp A) were regarded as potentially 'at risk' to trawling and subsequently included in the NPF priority list for future monitoring (Fry *et al.*, 2015).

SAFE for elasmobranchs did not identify any species at medium risk ($F_{msm} \leq F_{2007-2009} < F_{crash}$). When uncertainty was taken into consideration, 9 species were at precautionary medium risk (had upper bound 90%CI fishing mortality greater than their maximum unsustainable fishing mortality or fishing mortality greater than lower bound 90%CI maximum sustainable mortality) (Zhou *et al.*, 2011). However, due to the wide distribution of these species and the fact that most of them are large animals and excluded by TEDs none of these species were considered as being "at risk" of overfishing by the NPF tiger prawn fishery and in need for close monitoring (Zhou, 2011).

Two species of elasmobranchs, *Taeniura meyeni* and *Urogymnus asperrimus*, were considered at risk in the previous assessment (Brewer *et al.* 2007; Zhou and Griffiths 2008). In the updated assessment with new data, *Taeniura meyeni* had a small $F_{2007-2009}$, mainly due to its low occurrence in the fished area. The estimated fishing mortality was smaller than its F_{msm} , even when uncertainty was taken into account. For *Urogymnus asperrimus*, although its mean $F_{2007-2009}$ was smaller than its F_{msm} , its $F_{2007-2009} + 90\%CI$ was slightly larger than its F_{msm} (precautionary medium risk, Zhou, 2011).

A summary of the logbook and observer data on discarded bycatch species collected since the 2007 ERA, found that neither of the two teleosts initially considered "at risk" (*Dendrochirus brachypterus* and *Scorpaenopsis venosa*) had been recorded by any of the monitoring programs. Similarly, there were no observer records of the two "at risk" elasmobranch species (*Taeniura meyeni* and *Urogymnus asperrimus*) (Fry *et al.*, 2009). The latest version of the NPF priority species list still contains the porcupine ray (*Urogymnus asperrimus*) (AFMA, 2012b).

The current NPF priority list includes the following bycatch species: *Urogymnus asperrimus* (elasmobranch), *Lepidotrigla spinosa* and *Lepidotrigla* sp A, (teleosts). *Urogymnus asperrimus* has never been recorded in the tiger prawn subfishery bycatch in the last 10 years while *Lepidotrigla* species had percentage contributions less than 0.01% catch biomass (Fry & Miller, 2016, Annex).

Some minor bycatch species were found at higher risk at SAFE, mainly based on higher uncertainty of their abundance and distribution and exceptionally low weight percentage contributions (<0.01%). However, because of such low levels of catch, the impact of the tiger prawn subfishery on their populations is *de minimis*. There is a high degree of certainty that minor bycatch species are within biologically based limits and the tiger prawn subfishery does not pose a risk of serious or irreversible harm.

White Banana Prawn Subfishery (white banana prawn UoA)

In the white banana prawn subfishery trawling is more selective than in the tiger prawn subfishery. The trawl gear is generally only deployed once a prawn aggregation or "mark" is located on the echo sounder. The gear operates within about 5m from the seabed, towed at an average of 3.2 knots and the trawl duration is less than 1 hour (Griffiths *et al.*, 2007). Dell *et al.* (2009) estimated the bycatch volume for the white banana prawn subfishery as $1502 \text{ t yr}^{-1} \pm 288$

SE and a bycatch to prawn ratio of 0.8:1. The same ratio was estimated from recent data (2007-2015) from Fry & Miller (2016).

According to Fry & Miller (2016) over 525 species (Table 10) have been identified in the NPF White Banana Prawn Subfishery bycatch. No individual species or group of species contributed a percentage average higher or equal to 5% of total catch biomass (see Table 11). From the species/ groups with percentage contributions >2% but <5% (*Sciaenidae* or jewfishes, *Carcharhinus*, *Loxodon* and *Rhizoprionodon* spp., *Polydactylus nigripinnis* and *Harpadon translucens*) no species was deemed as vulnerable and none of these species are on the NPF priority list (Zhou, 2011, AFMA, 2012b), thus they do not classify as "main".

In a study that compared white banana prawn and tiger prawn subfisheries bycatch, the bycatch catch rate in banana prawn subfishery was higher than in tiger prawn subfishery, however, due to the short trawl duration and shorter fishing season and much higher catch rate for the target species in white banana subfishery, the bycatch to prawn ratio was much lower, and the total bycatch was lower. Compared to tiger prawn subfishery, the bycatch in the white banana subfishery contained more teleost species and less invertebrates (Dell *et al.*, 2009).

Besides the differences in fishing operations between the two subfisheries, depth and sediment type are also likely to contribute to differences in the bycatch assemblages. The white banana prawn subfishery operates in shallower waters (<20 m), while tiger prawn fishery generally operates further offshore due to different habitat preferences of the targeted species. The distribution of some bycatch species is affected in the same way. Ramm *et al.* (1990) described different bycatch teleost assemblages between trawls <30 and >30 m in the western Gulf of Carpentaria. They also found that some species were distributed widely, regardless of depth. This concurs with the commonality of many species in the bycatch of both subfisheries in the Gulf of Carpentaria (e.g. carangids, leiognathids and mullids) (Dell *et al.*, 2009).

Bycatch in the White Banana Prawn Subfishery can also vary depending on fisher behaviour, which influences the bycatch composition and catch rates. Dell *et al.* (2009) bycatch study in the GoC assessed how fishers' behaviour influences bycatch composition in the NPF white banana subfishery. According to these authors, three main types of trawling based on fishing behaviour are potentially employed in this subfishery:

- The prawn school trawl has a short duration (10–30 min) when a school of banana prawns is located using an echo-sounder, visual observations of the sea surface, radio contact with a spotter plane (as per Die & Ellis 1999, in Dell *et al.*, 2009), or activity of other trawlers (the dominant fishing behaviour).
- The fish school trawl (10–30 min) is either schooling fish species mistaken for banana prawns or occasional trawls (for prawns) near fish schools, as fishers sometimes associate these with the presence of prawns. The fish school trawls are usually dominated by unwanted bycatch.
- The dispersed prawn fishing behaviour is undertaken when sparsely distributed banana prawns are targeted. This is typically due to the prawns being dispersed from previous trawling activity or occasionally much smaller schools of prawns spread over a large area. These trawls can be either short or long in duration (20 min–2 h) and may sweep a larger area than the other trawl types (Dell, 2009).

The proportion of bycatch in prawn school trawls (when prawn aggregations are targeted) was significantly lower than in the other types of fishing behaviour and this is used for most trawls in the white banana subfishery. Fish school trawls usually contain the largest quantities of schooling bycatch species (e.g. Leiognathids) caught in a short period of time (<30 min) (Dell *et al.*, 2009).

Throughout the banana season (first season of the year), the decision on where to trawl is weighed up after considering the benefits of staying in a particular area or not (e.g. yield from trawls, operating expenses or search time). Die & Ellis (1999, in Dell *et al.*, 2009) found that the number of *P. merguensis* aggregations in the Gulf of Carpentaria decreased by as much as 83% in the first three weeks of the season. As the season progresses, large schools of banana prawns become difficult to locate, resulting in the increased likelihood of fish school and dispersed prawn trawls (and potential increased bycatch). Also, search time can increase significantly. These factors affect the level of bycatch throughout the season (including the bycatch-to-prawn ratio) and, consequently, the strategies required for monitoring bycatch in a variable fishing environment (Dell *et al.*, 2009). Minimising the use of non-efficient fishing behaviours is achieved through the new arrangements to close white banana fishing and allow tiger prawn fishing in the first fishing season of the year (banana season) (AFMA, 2016a).

All teleost and elasmobranch species were SAFE assessed cumulatively with the tiger prawn fishery and all species that scored high and medium risk were reviewed by the NORMAC Bycatch Subcommittee after more information became available from research. All teleost and elasmobranch species found at the bycatch survey have been included in the SAFE risk assessments (Zhou & Griffiths, 2008, Zhou *et al.*, 2009, Zhou, 2011). Bycatch species that remained on the NPF priority list (*Urogymnus asperrimus* (elasmobranch), *Lepidotrigla spinosa* and *Lepidotrigla* sp A, (teleosts)) have not been recorded in the white banana subfishery in the last 10 years. Many invertebrate species have been assessed as byproduct because although usually discarded, the fishers are allowed to retain them. Except for *Brachyura* undifferentiated group (0.6%), no invertebrates from white banana prawn subfishery bycatch had percentage contribution higher than 0.5%, thus the impact of this subfishery was considered *de minimis*. There is a high degree of certainty that bycatch species are within biologically based limits and white banana prawn unit of assessment does not pose a risk of serious or irreversible harm to these species.

Red-Legged Banana Prawn Subfishery (red-legged banana prawn subfishery)

Red-legged banana prawn subfishery operates in Joseph Bonaparte Gulf. Fishing for the red-legged banana prawn is permitted day and night in both NPF fishing seasons: autumn (April to mid-June) and spring (August to November). Fishing takes place in waters 35–70m deep, with most fishing effort between 50 and 60 m. Inter-annual trends in fishing effort in the JBG subfishery showed a steady spatial contraction from ~8% of the available nm² grids fished in 1999 to ~1.5% of grids fished in 2012. The trend was similar for the fishing intensity per grid with the proportion fished at >10 hours x nm² declining from ~3% to ~0.5%. (Jarret *et al.*, 2015). The trawling regime for this species is similar to the tiger prawn subfishery in other regions of the NPF, where the total duration of individual trawls is usually long (~ 3 h) (Tonks *et al.*, 2008). The estimated bycatch volume for the red-legged banana prawn subfishery was 4934 t yr⁻¹ with a bycatch to prawn ratio 13:1 (Tonks *et al.*, 2008). From recent AFMA SOs data (Fry & Miller, 2016, Appendix) bycatch contributed approximately 57%, with a bycatch to prawn ratio of 1.3:1.

According to Fry & Miller (2016), over 317 species (Table 10) have been identified in the NPF Red-Legged Banana Prawn Subfishery bycatch. This is the number of species recorded from the JBG since 1993 when CSIRO surveys started but the current number is lower because the fished area is much lower than the entire gulf. Tonks *et al.* (2008) found at the 2000-2004 survey 195 taxa from 85 families; 117 teleost taxa contributing 90.9% of the total bycatch biomass, 68 invertebrate taxa (7.7% of biomass), six species of elasmobranchs (1.3% of biomass).

In 2013-2015 period, one family, Sciaenidae, had percentage contribution to total catch biomass higher than 5% (Fry & Miller, 2016). It is possible that no individual species had contributions

over 5%, however, we considered all the species in this family as "main". These species are presented in Table 13. These species also ranked high as mean biomass per hectare during the bycatch survey (Tonks *et al.*, 2008). No vulnerable species have been identified among the species or groups with percentage contribution over 2% but less than 5%, thus none of these classifies as "main".

Table 13. Bycatch species with potential percentage contribution over 5% to total catch biomass in the NPF Tiger Prawn Subfishery. Source Fry & Miller, 2016; Zhou *et al.*, 2015).

Sciaenidae	
<i>Protonibea diacanthus</i>	<i>Austronibea oedogenys</i>
<i>Johnius laevis</i>	<i>Atrobucca brevis</i>
<i>Otolithes ruber</i>	<i>Johnius australis</i>
<i>Johnius borneensis</i>	<i>Larimichthys pamoides</i>

Zhou *et al.*, (2015) applied SAFE to 150 species of teleosts (including all "main" species) and elasmobranchs identified as occurring in the area, to assess the fishing impact from 2010-2013. To calculate fishing mortalities, the methodology had to be changed compared to the one used for tiger prawn subfishery because the information on species composition for bycatch in recent years is limited. In this approach, current fishing effort and area fished were used. More about SAFE methodologies applied for red-legged banana subfishery, will be discussed in Bycatch Information section. The conclusion of this SAFE assessment was:

"Nevertheless, the three alternative approaches fail to detect any species that is potentially at risk of overfishing. We conclude that the impacts of fishing on the species examined, expressed as instantaneous fishing mortality rates, are less than the maximum rates that would be sustainable. Clearly, a key explanation of these findings is that a low proportion of the species' distribution ranges is being trawled as a result of low fishing effort." (Zhou *et al.*, 2015)

Most invertebrate species with important contributions to the catch and some teleosts have been assessed at level 2 PSA, as byproduct, cumulatively with the white banana and tiger prawn subfisheries in the respective fishing seasons (see Griffiths *et al.*, 2007).

From the bycatch survey, it has been found that there are some seasonal differences (between banana and tiger season) in the bycatch volume, with higher bycatch during the tiger season (Tonks *et al.*, 2008). These differences have been attributed to natural variations between wet and dry seasons (Tonks *et al.*, 2008). The authors found that the differences were due to a higher abundance of small individuals from six teleost species during spring (Tonks *et al.*, 2008). Bycatch survey results also showed high catch rates and bycatch of portunid crabs, mostly *Charybdis callianassa*, (5.7% of total biomass, Tonks *et al.*, 2008), although averages for portunid crabs in the last 10 years show percentage contributions less than 1% total biomass. Also *C. callianassa* is not reported in AFMA datasets on its own, it is most likely included in "Portunidae, Polybiidae - undifferentiated" (0.7%). Anecdotal evidence suggests that *C. callianassa* makes surface aggregations during September in the JBG (pers. com. M. Farrell—NPF skipper, in Tonks *et al.*, 2008). In CSIRO surveys datasets portunid crabs made small percentage contributions as well, less than 0.5%. Portunid crabs were not included in the Ecological risk assessments. Nevertheless, these group was found to be the most sustainable group of benthic invertebrates and have the highest recoverability rates after prawn trawling (Hill *et al.*, 2002). For all minor bycatch species, there is a high degree of certainty that the red-legged banana subfishery does not pose a risk of serious or irreversible harm and the species are within their biologically based limits.

3.4.5.2 Bycatch species management (PI 2.2.2)

NPF (Tiger, White Banana and Red-Legged Banana Prawn Subfisheries - all UoAs)

The NPF Management Plan 1995 (last revision in 2012) includes long-term management goals and objectives covering the protection of bycatch species.

- Objective 1. Ensure the utilisation of the fishery resources within the Northern Prawn Fishery is consistent with the principles of ecologically sustainable development and the exercise of the precautionary principle;

and

- Objective 5. Ensure that the incidental catch of non-target commercial and other species in the NPF is reduced to a minimum.

In accordance with the Fisheries Management Act (FMA) 1991 and Commonwealth Policy on Fisheries Bycatch 2000, all fishery management plans require the development and implementation of bycatch action plans (BAPs) to ensure that bycatch is reduced to a minimum (AFMA 2008b). The first BAP in the NPF was implemented in 1998 with the introduction of TEDs, BRDs, reduced effort and implementation of spatial and temporal closures (NPFI, 2015). Since then, more than 50% reduction in bycatch has been achieved. Since 2008, AFMA implemented a program to addressing bycatch and discarding, based on the new information that became available from the risk assessments, monitoring programs, bycatch surveys. BAPs were replaced by Bycatch and Discarding Workplans which include short and long term objectives and specific management actions. The workplans are formally reviewed every two years to assess the effectiveness of the measures (AFMA, 2014).

A timeline of the management measures implemented to address bycatch in the NPF fishery, before the introduction of the Bycatch and Discard Workplans is provided by Fry & Miller in Tuck *et al.* (2013), and is presented below:

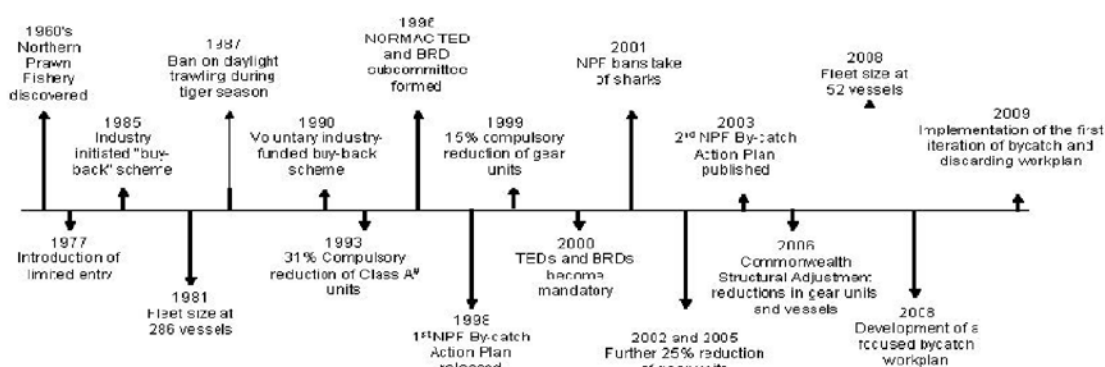


Figure 18. Time series of key management actions that have reduced bycatch in the NPF
(Source: Fry & Miller, in Tuck *et al.*, 2013)

NPFI is currently implementing a Bycatch Strategy based on AFMA Bycatch and Discarding Workplan. The vision of this strategy is "To reduce the capture of small fish and other bycatch in the Northern Prawn Fishery (NPF) by 30%, within three years, through a voluntary industry initiative" (NPFI, 2015). The objectives of the strategy are:

"1. Reduce the capture of small fish and other bycatch by 30% to continually improve and build on past successes in bycatch reduction;

2. Achieve bycatch reductions by July 2018;

3. Provide ongoing monitoring and reporting. " (NPFI, 2015)

Also, the NPFI is offering \$20,000 in cash incentives to encourage NPF skippers to develop and trial new and innovative approaches to reducing bycatch. Strict rules have been developed against which the performance of new innovations will be measured. Only those innovations which are tested and their performance validated by scientific trials in accordance with NPF TED and BRD testing protocol will be eligible for consideration in the incentive program (NPFI, 2015).

The strategy focusses on reducing bycatch in the three subfisheries of the NPF: tiger prawn subfishery; banana prawn subfishery and red-legged banana fishery. Bycatch reduction options, as the bycatch strategy document states, include (but not be limited to) new and/or improved BRD designs, gear modifications, spatial and temporal management and triggers/move-on provisions. The management actions, performance indicators and milestones to be achieved are presented in Table 14.

Table 14. The implementation of the NPF Bycatch Strategy

Management Actions	Risks being addressed	Performance Indicators	Milestones
1. Industry engagement to develop innovative options and/or gear modifications for testing.	Sea snake bycatch Small fish bycatch Crew safety	Have sufficient data collected to determine effectiveness of BRD or gear modification. Loss of prawns less than 2.5%	Industry engagement and options developed. Experimental designs established. At sea trials undertaken. Reports finalised. Industry-focused education and extension program developed and delivered.
2. Develop and trial robust, light-weight and crew-safe BRDs and/or gear modifications	Sea snake bycatch Small fish bycatch Crew safety	Have sufficient data collected to determine effectiveness of BRD. Loss of prawns less than 2.5%	Experimental design established. At sea trials undertaken. Report finalised. Industry-focused education and extension program developed and delivered.
3. Investigate the feasibility of spatial and temporal approach to reducing bycatch	Small fish bycatch	Have sufficient data from previous BRD trials and scientific observer data.	Analysis of catch data from BRD trials and scientific observer trips. Liaise with NPRAG and NORMAC on potential options. Finalise report, implement recommended changes
4. Review data collection requirements and observer protocols in the NPF.	Quantitative information gaps Inconsistency with data collection Discards data	Analysis of data collection requirements and protocols completed.	Establish internal review process. Identify information gaps. Liaise with NPRAG and NORMAC on potential research/monitoring solutions. Finalise report, implement changes.
5. Review and streamline the NPF gear directions.	Use of the most effective bycatch reduction devices. Compliance with minimum gear standards (align with US standards). Industry compliance with gear regulations.	Permitted gear types complied with. Minimum standards are met. Improved compliance rates with gear regulations.	Develop list of most effective devices permitted to be used. Review minimum gear standards (i.e. align TEDs with US standards). Simplify regulations. Update the NPF gear direction.

6. Continue to develop and implement training for Crew Member Observers (CMO) in the collecting and recording of valuable scientific data.	TEP species interactions e.g. Sawfish, Turtles and “at risk” species. General bycatch species	Training delivered and >80% of participants pass.	CMO training program delivered annually
7. Compile and report CMO, TEP and bycatch data to NORMAC.	TEP species interactions e.g. Sawfish, Turtles and “at risk” species. General bycatch	CMO report provided to AFMA and NORMAC at the end of each year.	Recruitment and education of CMOs. Report provided to AFMA and NORMAC.
8. CSIRO to complete sustainability assessment of bycatch species.	TEP species interactions e.g. Sawfish, Turtles and “at risk” species. General bycatch species	2014-2016 CMO data collated and analysed Report on bycatch trends completed	Undertake a catch trends analysis of CMO data collected to date and continue attendance at crew-member observer training workshops. Submission of a milestone report on the CMO data collected to date Deliver a triennial sustainability assessment report for the TEP and NPF ‘at risk’ bycatch

Bycatch Management Measures in Place:

Fishing effort control

Fishing effort control is achieved through the input control system, using a single control measure (gear units, as described in section 3.2.2) combined with other management measures, including limited entry to the fishery, gear restrictions, bycatch reducing devices and a system of seasonal, spatial and temporal closures. There are currently 35,479 gear SFRs issued for the fishery. In 2005 (prior to the structural adjustment scheme), there were 53,844 gear SFRs. Total vessel days (combined banana and tiger fishing seasons) have reduced from >30,000 days in 1982 to < 5,000 days since 2006 (Figure19) while the number of vessels has reduced from 268 to 52 (Jarrett *et al.*, 2015). This significant change in the management of the fishery has not only seen a reduction in bycatch, but has also provided for less swept area by the trawlers, further reducing total bycatch (Dichmont *et al.*, 2014). Footprint control is also monitored using Vessel Monitoring System (VMS) (Dichmont *et al.*, 2014).

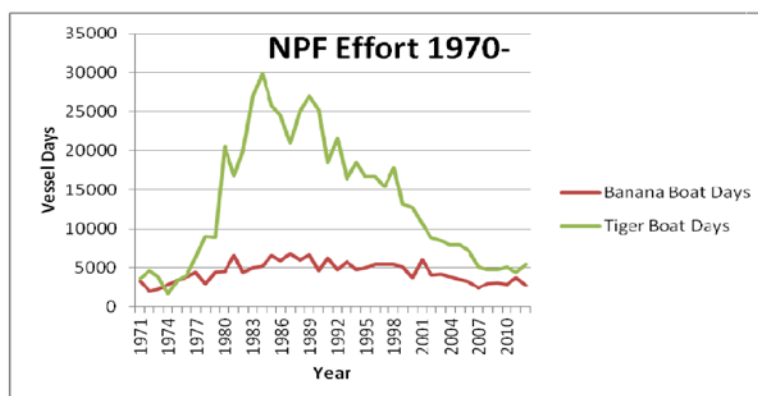


Figure 19. Total fishing effort (vessel days) for the NPF tiger prawn and banana prawn subfisheries between 1970 and 2012. (source: Jarrett *et al.*, 2015)

Gear Restriction

Gear SFRs entitle the holder to use a net with a certain headrope and footrope length. Gear SFRs have a different value depending on the configuration of nets an operator uses. Operators can use a configuration of two, three or four nets, with the use of the twin-tongue method also permitted. A gear SFR for operators using twin gear is currently worth 9 cm of headrope length. A gear SFR for operators using triple quad or twin tongue gear, has a value of 8.1 cm per SFR (AFMA, 2016). The total fishing effort an operator is allowed to use depends on the number of gear SFRs an operator owns.

It is compulsory that all nets rigged for fishing in the NPF are fitted with bycatch reduction devices (BRDs) and turtle excluder devices (TEDs) or modified TEDs for the entire fishing year. The approved specifications for both BRDs and TEDs are described in Direction No. (NPF) 150 (AFMA, 2017).

Bycatch Reduction Devices (BRD)

Turtle Excluder Devices (TEDs) were mandatory to use on all vessels in the NPF since 2000 when gear trials demonstrated their efficacy. As a result, large bodied bycatch such as of large sharks and rays, has reduced by more than 80% (Brewer *et al.* 2004). There has been a reduction in total bycatch by at least 50% since the BAP was implemented in 1998, due to the combination of TEDs and effort reduction measures (Jarrett *et al.*, 2015). Although TEDs significantly reduced the catches of large bycatch species, they had little (up to 8%) efficacy in reducing small bycatch (Brewer *et al.* 2004).

Currently, according to the bycatch surveys and AFMA Scientific Observer data, the most significant proportion of the bycatch in all three subfisheries is represented by small teleosts. Small teleosts also represent the most challenging part of the bycatch to eliminate from the net based on size selectivity (controlling codend the mesh size) because they are about the same size as commercially important prawns (Brewer *et al.*, 1998). Instead, several BRDs are designed to work by utilising differences in the behaviour of bycatch species and prawns, such as the superior swimming ability of most fish. Although in scientific trials many designs were successful, commercial trials were less successful. Few BRD devices have been proven to successfully reduce small fish without significant loss of prawns. Trials of the Popeye Fishbox showed a reduction of 48% of small fish bycatch, however there have been concerns about crew safety in adopting this design (Raudzens, 2007, in NPFI, 2015). Trials using a square mesh panel in combination with a Witch's Hat BRD enhancer installed at 100 meshes from the codend drawstrings, demonstrated that, when used with a TED, a 34% reduction in small fish is possible (Gerner & Maynard, 2010, in NPFI, 2015). However, this device needed further refinement to enhance durability and ease of use. Modified designs that were more user friendly were not as efficient (NPFI, 2015).

In February 2017, a breakthrough has been achieved with the successful trial and approval for use in the NPF of a new BRD, Kon's Covered Fisheyes BRD, which reduces bycatch by 36.7% and at the same time, it increases prawn catch by 0.5% (NORMAC, 2017). These results exceed the requirement for approval, which are: >10% bycatch reduction and <2.5% prawn loss (NORMAC, 2017).

Currently AFMA approved BRDs to be use in all three NPF subfisheries are as follows:

1. *Square Mesh Codend* (Figure 20) is a codend with at least half the circumference of the codend, having a nominal mesh size no less that 45mm, netting orientated so that the direction

of twine is longitudinal and transverse to the length of the codend, with an overall length no less than 75 meshes (3.375 metres) and no pieces of netting or other material covering any escape openings of the square mesh, nor any opening closed by any other means, during fishing operations (AFMA, 2016).

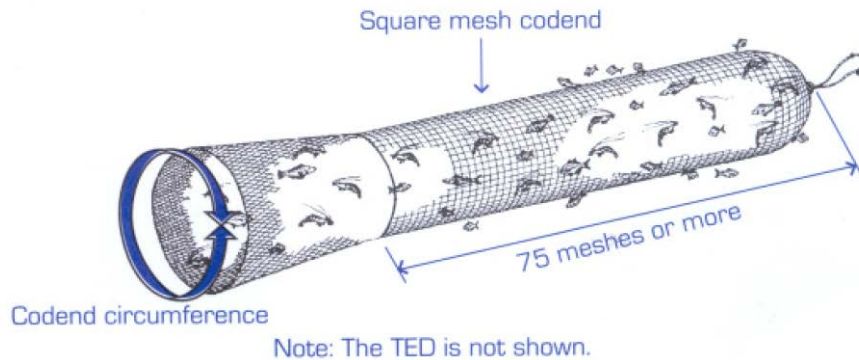


Figure 20. Diagram of a Square Mesh Codend (illustration by G. Day, AMC). Source: Burke *et al.*, 2012.

Modifications of the Square Mesh Codend were trialled in the NPF (e.g. an increase in the number of meshes and mesh size around the codend) with significant reductions of bycatch levels but with unacceptable prawn losses (Burke *et al.*, 2012).

2. *Square Mesh panel* (Figure 21) is a continuous panel of netting that has a nominal mesh size no less than 101 mm and an overall dimension no less than 400 mm wide and 600 mm long, with the aft edge of the panel located no further forward from the codend drawstrings than the number of meshes for a codend mesh size described in Schedule 3, NPFD 150, and no pieces of netting or other material covering any escape openings of the square mesh, nor any opening closed by any other means, during fishing operations (AFMA, 2016).

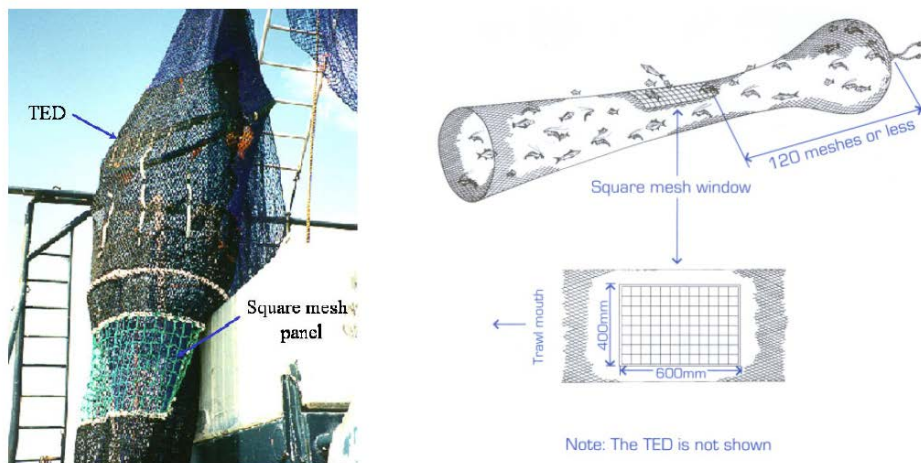


Figure 21. (left) Example square mesh panel positioned behind TED (photograph courtesy of Gary Day, source Brewer *et al.*, 2004; (right) Diagram of a Square Mesh Panel (illustration by G. Day, AMC). Source: Burke *et al.*, 2012.

During the scientific trials, the square mesh panel (when combined with a TED) reduced small bycatch up to 40% (Brewer *et al.* 1998). The square mesh panel was recommended for approval by NORMAC in November 1999 for use in the fishery in 2000. In commercial trials conducted in 2001, after BRDs had been mandatory for a year, the square mesh panel was found to only be reducing small bycatch by 8% (Brewer *et al.* 2004, 2006). The authors suggested poor

performance compared to earlier studies was largely due to the method by which this type of BRD was being used by the fleet.

In 2009, the witches hat BRD enhancer designed by AMC gear technologist John Wakeford was tested over a two-week period of commercial operation (Gerner and Maynard, 2010, in Burke *et al.*, 2012). The device (shown in Figure 22) creates a region of turbulent, reduced velocity water (wake) in the area of influence of the square mesh panel, making it easier for small teleosts to escape through the BRD. It was first trialled in the NPF in 2008 but required further testing and refinement (Evans, 2008, in Burke *et al.*, 2012). The 2009 trials demonstrated a 34% reduction in small bycatch with no associated target prawn loss (Gerner and Maynard, 2010, in Burke *et al.*, 2012).



Figure 22. Witches hat enhancers installed to the rear of the square mesh codend. Source: Burke *et al.*, 2012.

3. *Fisheye* (Figure 23) is a vertical escape opening held open by a rigid frame, the opening measuring no less than 350 mm wide x 150 mm high and being located no further forward from the codend drawstrings than the number of meshes for a codend mesh size described in Schedule 3 NPFD 150; and with no pieces of netting or other material covering any escape openings, nor any opening closed by any other means, during fishing operations (AFMA, 2016).

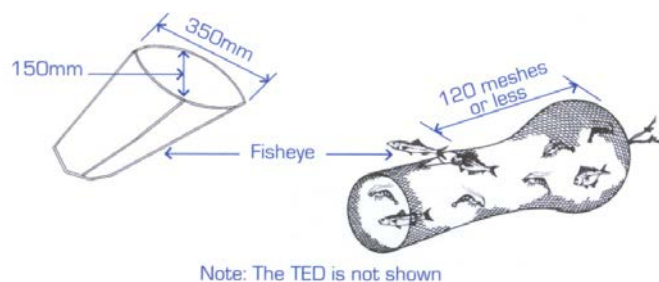


Figure 23. Diagram of a Fisheye BRD (illustration by G. Day, AMC). Source: Buke *et al.*, 2012

During the trials, the Fisheye (when combined with a TED) reduced small bycatch up to 30% (Brewer et al 1998). Additional studies also reported that use of fisheye BRD designs resulted in increased product quality, resulting in up to \$79 per night additional income (Burke *et al.*, 2012).

4. *Yarrow Fisheye* (Figure 24) is a fisheye that has an additional rigid bar running from the apex of the frame to the top of the escape opening; and it is located no further forward from the

codend drawstrings than the number of meshes for a codend mesh size described in Schedule 3, NPFD 150 and no pieces of netting or other material covering any escape openings, nor any opening closed by any other means, during fishing operations. The yarrow fisheye bycatch reduction device reduced the weight of small bycatch by an average of 22.7%, with no significant loss of prawn (Heales et al., 2008).

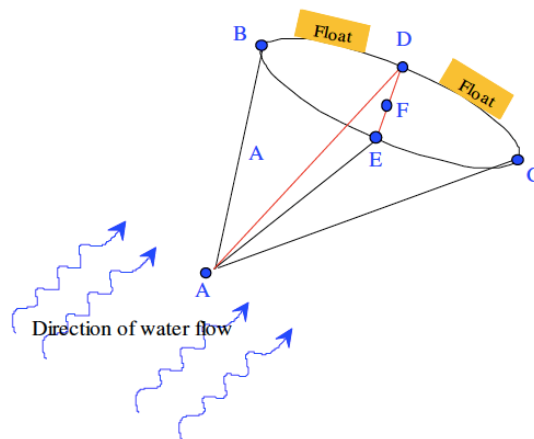


Figure 24. Diagram showing additions made by Jim Yarrow to standard Fisheye BRD. Source Burke *et al.*, 2012

5. *Radial Escape Section* (Figure 25), also known as ‘Large mesh/funnel excluder’) was developed by Watson and Taylor (1988). This BRD design has a small-mesh funnel surrounded by a radial section of large square mesh (Brewer, 1998). It is intended to funnel catch past the square meshed section, however stronger swimming animals are able to turn around, swim forward between the funnel and codend, and out through the large square meshes (Burke *et al.*, 2012). The individual escape openings should be no less than a square mesh size of 100mm, and overall escape openings no less than a panel of netting measuring 350 mm long and extending radially around the codend for at least half the circumference of the codend. The trailing edge of the funnel should extend no more than 500 mm past the aft edge of the escape openings. The forward edge of the BRD should be located no further forward than 900 mm of the TED grid, or if located further forward than 900 mm of the TED grid a wire hoop must be attached to the forward edge of the BRD. No pieces of netting or other material covering any escape openings, nor any opening closed by any other means, during fishing operations (AFMA, 2016).

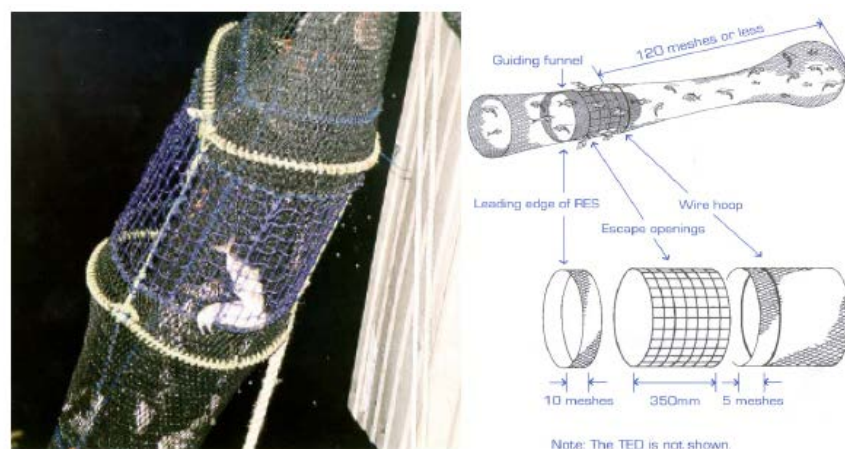


Figure 25. (left) Radial Escape Section BRD with square meshes extending around the codend circumference (Source: Brewer *et al.* 2004), (right) Diagram showing components of a Radial Escape Section (illustration by G. Day, AMC). Source: Burke *et al.*, 2012.

During trials, the this BRD (when combined with a TED) was shown to provide a reduction in small bycatch of up to 40%. Subsequent AMC Observer trials in 2000 (unpublished) indicated use of a RES BRD design resulted in an 8% reduction in bycatch, and 2% reduction in catch of targets species (Burke *et al.*, 2012).

6. *Popeye Fishbox* is a rigid framed BRD designed to create a turbulent back current of water flow with the net (Figure 26). The creation of a turbulent back current of water is thought to attract fish seeking to escape the net as they instinctively seek areas of low water flow. Once fish accumulate near the back current they are able to escape through a rigid framed opening in the net (Burke *et al.*, 2012). The vertical escape opening held open by the rigid frame should be no less than 375 mm wide x 375 mm and a rigid foil positioned at the forward edge of the BRD no less than 200 mm in depth. No pieces of netting or other material covering any escape openings, nor any opening closed by any other means, during fishing operations (AFMA, 2016).

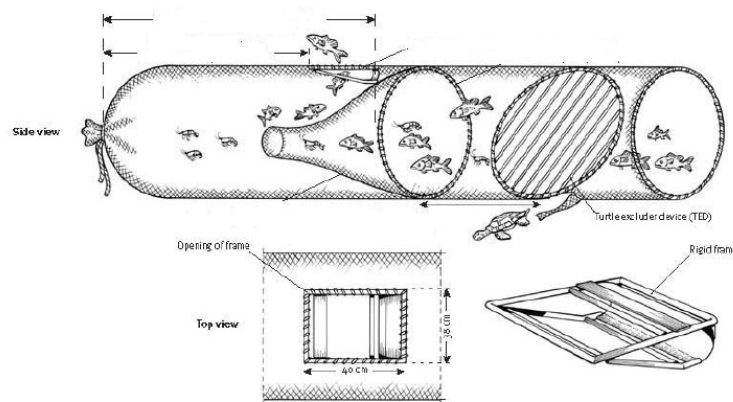


Figure 26. Diagram of the Popeye Fishbox BRD. Source: Burke *et al.*, 2016

During trial, in addition to reducing small bycatch by between 28 to 48%, the Popeye Fishbox also reduced the capture of sharks and rays by 35% (at 70 meshes) and 27% (at 100 meshes) (Raudzens, 2007, in Burke *et al.*, 2012). No Popeye Fishboxes were used after the trials. Skipper and crew safety concerns regarding installation of rigid structures in the net may have been a factor. Additionally, issues regarding commercially unacceptable levels of prawn loss using the device during the banana prawn fishery may have also been a factor (Burke *et al.*, 2012).

Examination of electronic logbook data for 2009 – 2011 shows that the majority of the fleet are still using the Square Mesh Panel (90% of operators using elog in 2011) and the use of Fisheyes has declined (10% of operators reporting using elog by 2011) (Burke *et al.*, 2012).

7. *Kon's Covered Fisheyes BRD* is a newly approved bycatch reduction device was trialled under scientific conditions in June and November 2016 of the industry's new Bycatch Strategy 2015-2018. The device will be included in the list of approved BRD's with a view to encouraging voluntary industry uptake over the next 12 months. The specifications for this device were provided by its designer, Kon Triantopoulou to be included in the NPF Directions document. "Covered Fisheyes" (Figure 27) means two devices in one net used in conjunction and each has a vertical escape opening held open by a rigid frame that encloses a rigid cone. The escape opening should measure no less than 450 mm wide x 240 mm high and it must face the codend. The rigid cone should measure no less than 300 mm wide, 210 mm high and 280 mm in length. The cone has to be fixed to the rigid frame. One of the two escape opening should be located at

78 meshes from codend drawstring and the second escape opening should be located at 55 meshes. The device must be used without any pieces of netting or other material covering any escape openings, nor any opening closed by any other means during fishing operations (NORMAC, 2017).

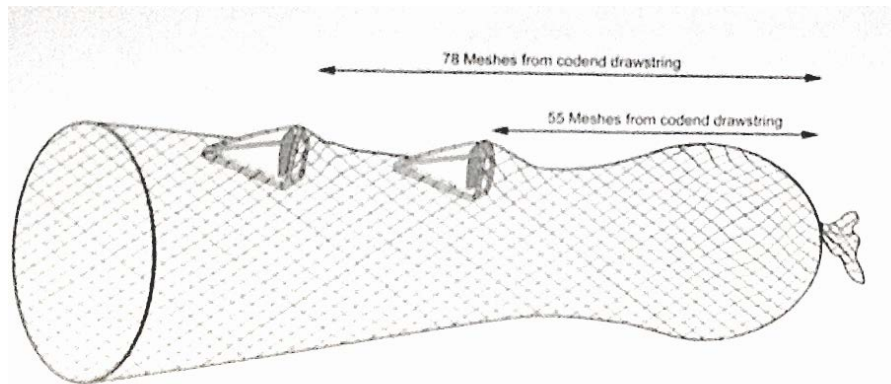


Figure 27. Diagram for Kon's Covered Fisheyes. (Source: NORMAC, 2017)

Closed Areas.

An extensive system of spatial and temporal closures has been implemented in the NPF since the 1980s. A total of 2.1% of the total managed zone of the fishery is subject to permanent closures, while 8.3% is subject to seasonal closures. Closures in the fishery include permanent closures of seagrass beds and other sensitive habitats and seasonal closures of juvenile prawn stock habitat. Even though these closures were mainly established to protect spawning habitat for target species, they also represent refuge for many bycatch species.

Seasonal closures are in place to protect small prawns, as well as to protect spawning individuals. Since 2011, the Northern Prawn Fishery Resource Assessment Group (NPRAG) recommended a fixed small prawn closure from 1 December to 1 March of each year. In the first half of each year trawling time is about ten weeks. In this season (banana season), bycatch is commonly low (approximately 0.8:1) as prawns are targeted in aggregations which are rarely associated with large volumes of other species. In the second half of each year (tiger season) trawling time is limited to 3.5 months on average, and fishing is banned during daylight hours to reduce bycatch and the catch of egg-bearing female tiger prawns (AFMA, 2017).

Conclusion. All three NPF subfisheries apply the same measures designed to manage the impact on bycatch specifically (a plan for 30% reduction, codes of practice, incentives, BRDs, risk assessments, research). These measures represent a "strategy", and it is understood how they work to achieve the required outcome (MSC FCR v2, Table SA8, Definitions). These measures work together with other measures designed primarily to manage the impact on target species (effort control through gear restrictions and spatial closures) or ETPs (TED), to achieve an overall reduction in bycatch. In conclusion, there is a strategy to manage bycatch species in all six UoAs: brown tiger prawn, grooved tiger prawn, blue endeavour prawn, red endeavour prawn, white banana prawn, red-legged banana prawn.

The testing of the bycatch strategy includes scientific and industry trial for new BRDs which have to meet the requirements (>10% reduction of bycatch and <2.5% of target catch reduction) in order to be officially approved and used. The BRDs that are in use are regularly assessed for performance in order to continue to be legislated and maintained on the approved BRDs list (Burke *et al.*, 2012). Currently approved BRDs will remain in legislation until 30 June 2018 when a review will be undertaken and ineffective devices will be removed from the list

(NORMAC, 2017).

Testing supports a high degree of confidence that the strategy will work in all six UoAs. Since the implementation of the first BAP in the NPF, in 1998, with the introduction of TEDs, BRDs, reduced effort and implementation of spatial and temporal closures, more than 50% reduction in bycatch has been achieved (NPFI, 2015). Moreover, the breakthrough achievement with the newly approved BRD, Kon's Covered Fisheyes, which reduces bycatch with more than 30% and at the same time increasing target catch, gives confidence that the uptake of this device by the fishing operators will be high and this will work towards achieving the goal of the new NPFI Bycatch Strategy. Bycatch sustainability assessments are undertaken every three years by CSIRO in order to identify trends in "at risk" bycatch species. Catch levels are found to be very low and it is difficult to identify statistically significant trends and there are no indications of populations depletions so far (Fry *et al.*, 2015), indicating that the strategy is working to sustainably manage these rare species and not only to reduce bycatch overall.

Compliance monitoring ensures that the strategy is implemented successfully. A gear monitoring program is in place to monitor vessel fishing power and Turtle Excluder Devices (TED)/Bycatch Reduction Device (BRD) configurations. Vessel Monitoring System (VMS) data covers the whole fleet throughout the seasons to monitor position of vessels especially with respect to spatial and temporal closures (Dichmont *et al.*, 2014).

3.4.5.3 Bycatch Species Information (PI 2.2.3)

There is comprehensive data collection program (Figure 16) in place for the NPF overall to ensure reliable information is available on which to base management decisions. Accurate information is collected and maintained on all bycatch species from the three subfisheries, through fishery dependent and independent programs (PI 2.2.3a). Although bycatch is not reported in logbooks, the bycatch monitoring program was able to combine the high sampling power of the fishery-dependent methods (CMO Program) to collect monitoring data for "at risk" bycatch with the higher reliability of the fishery-independent methods (AFMA Scientific Observers program and bycatch research surveys and studies), to provide additional data and validation (Brewer *et al.*, 2007). This information was sufficient to quantitatively assess the consequences for the status of the affected populations with high degree of certainty (PI 2.1.3b). The consequences for the bycatch species populations were assessed in ecological risk assessments which, together with the ongoing monitoring of the "at risk" bycatch and BRD performance monitoring and assessment, support the implementation of a management strategy for bycatch species (PI 2.2.3c). Data from monitoring programs (at risk species are monitored in CMO, AFMA SO and NPF prawn monitoring programs and subsamples of all bycatch in AFMA SO program) as well as from BRD trials and gear monitoring, is adequate to evaluate with high degree of certainty whether the strategy is achieving its objective (PI 2.2.3c). Monitoring of bycatch species is conducted in sufficient detail to assess ongoing mortalities to all retained species (CMO and AFMA SO programs). More information about the monitoring programs, surveys, research and ecological risk assessments (ERAs) is presented in the following sections.

Integrated Bycatch Monitoring Program

Designing and implementing a bycatch monitoring program in Australia's Northern Prawn Fishery (NPF) stemmed from its commitment to meet the requirements of the EPBC Act 1999 and demonstrate sustainability for all species and habitats impacted by Australian industry activities. The Bycatch Monitoring Project (FRDC Project 2002/035) aimed to select an effective sampling regime for monitoring diverse trawl bycatch. Five potential methods for monitoring bycatch – logbooks, requested industry collections, crew-member observers

(CMOs), scientific observers and fishery-independent surveys –were compared over two years and 4 seasons; tiger season 2003, banana season 2004, tiger season 2004 and banana season 2005. After the first year, the data collection was examined and altered, where necessary, to improve the design (Brewer *et al.*, 2007).

Brewer *et al.* (2007) found that the assessment of bycatch species composition can only be based on data collected by scientific observers or fishery independent surveys as the other methods collected an unacceptably high proportion of inaccurate data. Fishery-independent bycatch surveys can control and minimise spatial variation and diel and lunar periodicity from year to year, providing more precise assessments. They are also the only method that can provide an option for collecting control data (samples outside the high effort areas) to interpret whether any changes in species composition and structure are due to fishing impacts or some other cause such as climate change (Brewer *et al.*, 2007)

Responsibility for the long-term monitoring program was gradually transferred to AFMA throughout the collaborative AFMA and CSIRO project. In order to maintain the momentum of the long-term monitoring program, a series of detailed protocols have been developed (Brewer *et al.*, 2007).

Crew Member Observer Program

The Crew Member Observer (CMO) program began in 2003 as part of the long-term bycatch monitoring project (FRDC Project No. 2002/035) (see Brewer *et al.* 2007). Each year crew members from a selection of NPF vessels volunteered to participate in annual training workshops. At the 2007 and 2008 training workshops, crew members were trained in the identification and recording of ETP species and the three ‘at risk’ elasmobranch and two ‘at risk’ teleost bycatch species. In the 2009 training workshop, crew members were also required to record data on three ‘at risk’ invertebrate species (byproduct). From 2010 to 2013, the ‘at risk’ bycatch species list monitored by CMOs was determined by re-running of the SAFE approach in 2009 and 2011. Due to the difficulty in species identification using only photographs for the teleost and invertebrate ‘at risk’ bycatch species, CMOs were requested to retain all specimens; label, freeze and send to the CSIRO. These sample specimens were identified to species by scientific staff (Fry *et al.*, 2015). In 2012, the ‘at risk’ coral prawn, *Solenocera australiana* was found to have a widespread distribution across northern Australia, within and outside of current commercial prawn trawl effort areas. It has been consistently caught in significant numbers by the crew-member observer program since its inclusion on the priority monitoring list in 2009. From the recommendations of the 2009 Bycatch Sustainability Assessment (Fry *et al.* 2009), the Marine Stewardship Council (MSC) certification process for the NPF acknowledged that *Solenocera australiana* was not adversely susceptible to impacts from the commercial trawl fishery in northern Australia and was removed from the ‘at risk’ priority list in 2013 (MRAG 2012). The catch data recorded by CMOs is matched with the NPF commercial logbook data to obtain trawl information; trawl duration and depth, latitude and longitude of trawl and gear specifications for regular bycatch sustainability assessments (Fry *et al.*, 2015).

Crew member observers operate in all three subfisheries, with the highest coverage in the tiger prawn subfishery. CMO coverage was estimated per fishing season and not per subfishery. Recent years (2013 and 2014) coverage reached 18% during tiger prawn season and about 2% during the banana prawn season (Fry *et al.*, 2015). Initially, due to the difficulty of simultaneously monitoring bycatch and undertaking deck duties during the banana prawn fishing season, the CMO program has only covered the banana prawn subfishery in 2004 (79 days) (Jarrett *et al.*, 2015) Since 2011, banana prawn fishery has received CMO coverage every year (2011- 63 days, 2012 - 97 days, 2013 - 47 days, 2014 - 88 days, 2015 - 152 days) (Laird,

pers comm, July 2017). The focus on tiger prawn subfishery coverage provides a conservative measure for the NPF bycatch monitoring because of the higher level of impact from this subfishery. In each season CMO coverage estimation includes the red-legged banana coverage, i.e. the number of trawl observed in tiger prawn subfishery plus the ones in red-legged banana subfishery during the tiger prawn season and the number of trawls observed in white banana subfishery plus the ones in red-legged banana subfishery during the banana prawn season respectively (see Figure 5-1 in Fry *et al.*, 2015, p.25). In the red-legged banana subfishery, where the fishing effort has been variable, CMO coverage has been variable, from 0.9% in 2007 to 28.6% in 2006 and, the most recent available estimation, 7.4% in 2011 (Jarrett *et al.*, 2015).

Brewer *et al.*, 2007, estimated the level of coverage that would be necessary to achieve sufficient power to detect a significant decline in abundance even for rare species. This level has been achieved since 2011 (see Figure 28) providing confidence that sufficient data will be available for catch rates trend estimation for more species in the future sustainability assessments (every three years by CSIRO).

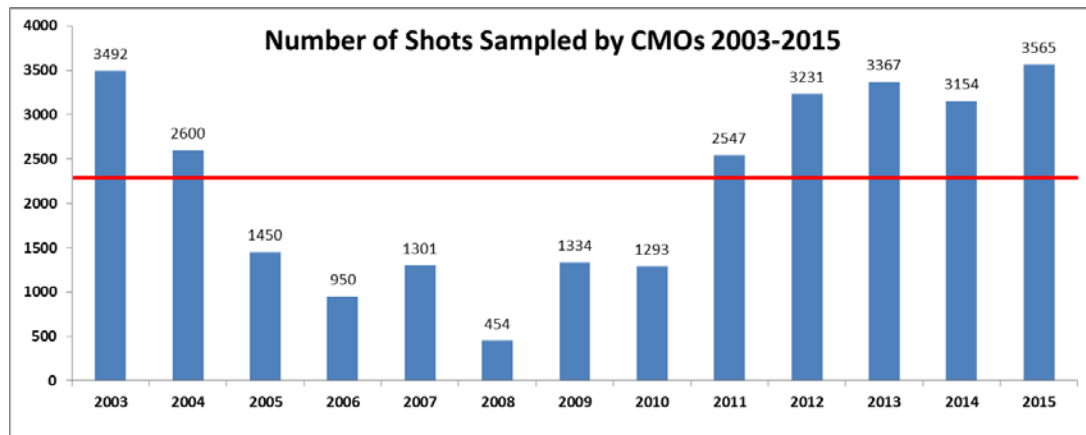


Figure 28. Number of shots monitored by the Crew Member Observer program between 2003 and 2015. (source: NPFI, unpublished data, 2017)

AFMA Scientific Observer Program

Catch data collected by AFMA scientific observers (AFMA SOs) is available since 2005. AFMA SOs collect data onboard commercial vessels using similar procedures used by the NPF CMOs but they have a higher level of training and higher accuracy in species identification. Besides data on ETPs, the AFMA SOs collected catch data on “at risk” bycatch species when this list became available (Fry *et al.*, 2015). The AFMA SOs also retain a sub-sample of the bycatch and sort these to species level where possible. AFMA SOs coverage varied over time, with more even coverage between tiger and banana seasons achieved in recent years (see Figure 5-2 in Fry *et al.*, 2015, p.31). Red-legged banana subfishery received AFMA SO cover since 2010 (119 trawls in 2010, 7 trawls in 2011, 2 trawls in 2012, 84 trawls in 2013, in Jarrett *et al.*, 2015).

NPF prawn population monitoring surveys; 2002 – 2014

Catch data on ‘at risk’ bycatch species were also collected from research trawling between 2002 and 2014 in the Gulf of Carpentaria as part of the NPF prawn population monitoring surveys (Projects: MIRF R01/1144 [2002]; FRDC 2002/101 [2002]; FRDC 2003/075 [2003-04]; FRDC

2004/099 [2004-05]; AFMA R05/0599 [2005-06]; AFMA R05/1024 [2006-08]; AFMA R08/0827 [2008-10]; AFMA R2009/0863 [2009-10]; AFMA R2011/0811 [2011-2015]).

Data collection and recording are similar to the procedures used by the CMOs where each trawl is inspected for 'at risk' bycatch species and ETPs. Catch numbers are recorded for each trawl and photographs taken of the selected species for verification of species identification and measurement of total length of the animals back at CSIRO (Fry *et al.*, 2015). Species distribution maps are created and published in Integrated Monitoring reports (Kenyon *et al.*, 2016)

CSIRO scientific research and observer surveys; 1975 – 2005

An extensive data collection is available from databases held by CSIRO. These include all scientific trawl surveys and scientific observer fieldwork undertaken by CSIRO staff in the NPF region from 1975 to 2005. The objectives of these surveys varied between projects, but all involved a stratified random trawl survey design. Catches of all bycatch species caught during these surveys were recorded to species, counted and weighed but sampling was not necessarily from the fished areas (Fry *et al.*, 2015).

Logbook Data Collection

In the fishery-wide Daily Catch & Effort logbook program, besides recording of all target and byproduct species catch and interactions with protected species, operators are required to record the location of fishing operations (latitude/longitude) for every day they fish and/or search, regardless of whether any catch is taken; the total number of shots for each fishing day; the species/product retained and size grade information (Dichmont *et al.*, 2014). This is used in combination with the CMOs and AFMA SOs bycatch records to assigned bycatch species catch rates to a location and infer their spatial distribution (Fry *et al.*, 2015)

Compliance monitoring

A gear monitoring program is in place to monitor vessel fishing power and Turtle Excluder Devices (TED)/Bycatch Reduction Device (BRD) configurations. Mandatory data collected through the program includes vessel length; beam; depth; engine make and model; engine power; max. trawl Revolutions per Minute (RPM); Operating RPM; gear box reduction ratio; korth nozzle; propeller diameter and pitch; plotter make and model; sonar; max. speed; trawl speed (banana and tiger prawn fisheries); TED and BRD configurations (Dichmont *et al.*, 2014). Gear surveys also contribute to fishing power analyses and identification of new gear technologies. Vessel Monitoring System (VMS) data covers the whole fleet throughout the season to monitor position of vessels especially with respect to spatial and temporal closures (Dichmont *et al.*, 2014).

Research on bycatch

The information on the bycatch component of the NPF from observer programs and surveys was used as input for the NPF ecological risk assessments (Griffiths *et al.*, 2007; Zhou and Griffiths, 2008; Zhou *et al.*, 2009; Zhou, 2011) as well as government-sponsored, NPF-specific and subfishery specific surveys and studies. Research studies that have been undertaken to narrow the knowledge gaps about the fishery's impacts on bycatch include Ramm *et al.*, 1990; Pender *et al.*, 1993; Stobutzki *et al.*, 2001a, 2001b; Dell *et al.*, 2009; Tonks *et al.*, 2008.

Risk Assessments

An ecosystem-based fishery management includes assessing the long-term sustainability of all species caught in commercial fisheries, especially tropical trawl fisheries such as the NPF, where large numbers of bycatch species are caught. In general, limited data is available in trawl fisheries about the impacts of trawling on bycatch species populations. However, demonstrating

that populations of bycatch species impacted by trawl fishing are sustainable requires species-specific and quantitative approaches; in particular, quantitative risk or stock assessments, or long-term monitoring programs (Brewer *et al.*, 2007).

In 2007, Griffiths *et al.* (2007) assessed the ecological impacts of the NPF on bycatch species by using the Ecological Risk Assessment for Effect of Fishing model (ERAEF V9.2) jointly developed by CSIRO and AFMA. This approach provided a hierarchical framework for a comprehensive assessment of the risks from the subfisheries to ecological components, including bycatch (Griffiths *et al.* 2007). Within this hierarchical framework a new higher level, quantitative approach, the Sustainability Assessment for Fishing Effects (SAFE) was developed for the diverse bycatch species of elasmobranchs (Brewer *et al.*, 2007; Zhou and Griffiths, 2008) and teleosts (Brewer *et al.*, 2007; Zhou *et al.*, 2009a). This method estimated fishing impacts and compared the impact to sustainability reference points based on basic life-history parameters for the species (Zhou and Griffiths, 2008).

In the first SAFE for elasmobranchs the proportion of species population distributed within trawled areas, was estimated from detection–nondetection data collected from scientific surveys. This estimate of species' abundance was then included in a model incorporating catch rate and escapement probability to give an estimate of the fishing mortality rate of each species. Fishing mortalities then were compared to two reference points based on natural mortality rate and growth rate: maximum sustainable fishing mortality (corresponding to MSY) and minimum unsustainable fishing mortality (that would produce population crush) (Zhou & Griffiths, 2008). A similar approach was used for the first SAFE for teleosts. The formula used in these assessments assumed that trawling uniformly sweeps an entire fished area once a year. This method tends to overestimate the fishing mortality rate. The improved method for the revised assessments for elasmobranchs and teleosts, the actual fishing effort to derive an estimate of the fishing mortality rate was used (Zhou, 2011).

For the red-legged banana subfishery (in JBG), there was less available information on the bycatch species abundance and distribution. A range of data from different sources were used in the assessment. The list of bycatch species was based on the Bycatch Monitoring database maintained by CSIRO. Three sources provided species distribution information: National Marine Bioregionalisation database, historical scientific surveys, and the bycatch monitoring program. Fishing effort, measured as total trawling hours, was extracted from AFMA logbooks. Fishing gear configuration, catch efficiency, escapement rate, as well as fish life history parameters, were taken from previous studies. Because no one single source can provide distribution information for all species, three alternative methods were used to derive distribution ranges and the resulting fishing impact. Method 1 was based on bioregional maps, Method 2 on historical surveys, and Method 3 on bycatch monitoring data. Fishing mortality was calculated for each species from spatial overlap between species distribution and area trawled, tuned by catch efficiency and probability of escapement. Five methods are used to derive sustainability reference points. These methods relate reference points to alternative life history traits, including natural mortality, growth parameters, maximum age, maximum length, and age at maturity. The key reference point is F_{msm} , the instantaneous fishing mortality rate that corresponds to the maximum number of fish in the population that can be killed by fishing in the long term (similar to F_{msy} for target species) (Zhou *et al.*, 2015).

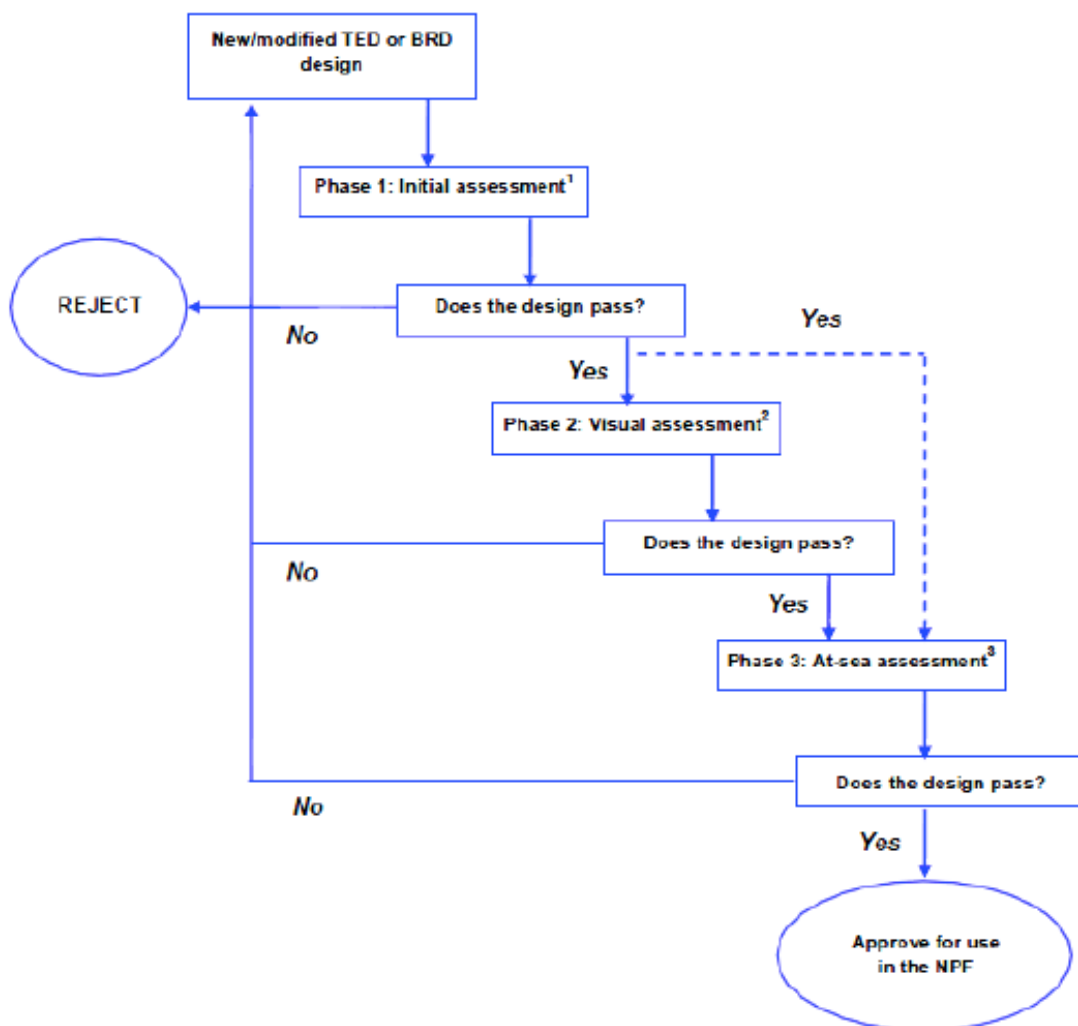
These bycatch assessments methods identified a number of bycatch species that may be 'at risk' to trawling from each of the three subfisheries. Each of these 'at risk' bycatch species are then assessed using the 'Highest Level of Assessment' method where the NPF Bycatch Subcommittee working group consults with an expert panel of scientists to evaluate all available data and provide justification on retaining or removing a species from the 'at risk' list. This

approach is repeated periodically as more data for each species becomes available and then considered by the Northern Prawn Fishery Management Advisory Committee (NORMAC) and Northern Prawn Fishery Resource Assessment Group (NPRAG). There is a comprehensive data collection process for the "at risk species, including bycatch species, even though these species are rarely recorded. CSIRO produces a bycatch sustainability report every three years, summarising CMO, AFMA SOs, CSIRO and logbook data, and updating the 'at risk' list, the most recent one being by Fry *et al.*, 2015.

A limitation of the ERAEF undertaken in the NPF was the fact that invertebrate species from bycatch have not been assessed. This is compensated by the fact that most invertebrates with meaningful percentage contributions are potentially retained species and were assessed under the "byproduct" component (see Griffiths *et al.*, 2007). Most bycatch invertebrate species not assessed under "byproduct" had percentage contributions under 0.5% and the impact of each subfishery on those species is *de minimis*. Also, the sustainability (susceptibility and recoverability) of all invertebrates caught in prawn trawls in the NPF has been assessed in studies of benthic biodiversity and trawl impact (Hill *et al.*, 2002).

Gear Trials

In addition to quantifying the risk to species from the current level of fishing operation, NPF is collecting data on the performance of new or modified BRDs and/or gear measured against the existing BRD performance, based on scientific trials using the approved NPF TED and BRD testing protocols. The NPF testing protocols (Figure 28) are based on power analyses that demonstrate the number of shots required to create a high probability of a significant difference in performance being detected (NPFI, 2015). The results of gear testing are reported regularly.



A diagram of the BRD/TED testing protocol (Source Brewer et al. 2004)

1. Initial assessment of TED or BRD design, including rigging details, specifications and location in the codend.
2. Visual assessment of actual device fitted to a codend.
3. At-sea assessment initially by fisher, then by TED/BRD observer if required.

Figure 29. Gear testing protocol in the NPF.

3.4.6 Endangered, Threatened and Protected species (P 2.3)

The MSC defines Endangered, Threatened and Protected (ETP) species as species that are recognised under national (both federal and state) and international ETP which may interact with the fishing gear deployed in the fishery under assessment. In addition, species classified as ‘out-of scope’ (amphibians, reptiles, birds and mammals) that are listed in the IUCN Redlist as vulnerable (VU), endangered (EN) or critically endangered (CE), even if they are not covered by national and international legislation, also classify as ETPs (MSC, 2013).

Such legislation relevant to the NPF includes:

International Agreements

- *Convention on the Conservation of Migratory Species of Wild Animals 1979 (CMS or the Bonn Convention)*³;
- *The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)*⁴;
- *The Agreement between the Government of Australia and the Government of Japan for the Protection of Migratory Birds in Danger of Extinction and their Environment 1974 (JAMBA)*⁵;
- *The Agreement between the Government of Australia and the Government of the People's Republic of China for the Protection of Migratory Birds and their Environment 1986 (CAMBA)*⁶;
- *The Agreement between the Government of Australia and the Government of the Republic of Korea on the Protection of Migratory Birds 2007 (ROKAMBA)*⁷; and
- Any other international agreement, or instrument made under other international agreements approved by the Environment Minister.

National legislation:

- EPBC Act: *Environment Protection and Biodiversity Conservation Act 1999*.
<http://www.environment.gov.au/epbc/index.html>

While a high number of EPBC listed species can be encountered in the region, not all are likely to interact with prawn trawling. With reference to the above-mentioned legislation, a number of species have been identified as ETPs within the NPF managed area. These include marine mammals, marine turtles, sharks, syngnathids (seahorses, seadragons, pipehorses and pipefish) and seabirds and migratory shorebirds.

In general, it is illegal to kill, injure, take, trade, keep or move a EPBC listed species, a listed migratory species, or a listed marine species in a Commonwealth Area, without a permit. If this happens unintentionally, all interactions need to be immediately reported to the Department of the Environment and Energy (DoEE). The EPBC Act covers the requirements for species protected under international agreements. For some species, Australia applies stricter domestic measures to regulate import and export than required under CITES convention, i.e. all species from Order Cetacea (whales, dolphins and porpoises) are treated as if they were included in Appendix I (DEH, 2002). Specific national requirements were defined for marine turtles (DEH, 2003), blue whale (DoE, 2015a) and sawfish and river sharks (DoE, 2015b) in the form of national recovery plans.

The fishery meets CITES requirements for all Appendix 1 listed species, most specifically because under the EPBC Act, Part 13, trade in Appendix 1 listed species is prohibited. The NPF has been re-certified for export exemption until January 2019 (DoE, 2013). As part of the requirement under the EPBC Act 1999, licensed fishers must report any interactions of their fishing activity with threatened, endangered and protected species to AFMA. To help operators

³ Further information on the CMS, JAMBA, CAMBA and ROKAMBA is provided at www.environment.gov.au/biodiversity/migratory/index.html

⁴ CITES Appendices Listing <<http://www.cites.org/eng/app/appendices.php>>

⁵ Further information on the CMS, JAMBA, CAMBA and ROKAMBA is provided at www.environment.gov.au/biodiversity/migratory/index.html

⁶ Further information on the CMS, JAMBA, CAMBA and ROKAMBA is provided at www.environment.gov.au/biodiversity/migratory/index.html

⁷ Further information on the CMS, JAMBA, CAMBA and ROKAMBA is provided at www.environment.gov.au/biodiversity/migratory/index.html

accurately report protected species interactions, AFMA has produced a protected species identification guide. This guide covers the range of protected species that AFMA managed fisheries interact with, or have the potential to interact with, during their normal fishing operations. The guide provides pictures of these species along with an indicative distribution and key biological information. All NPF boats have been provided with a copy of this identification guide (AFMA, 2016).

A Memorandum of Understanding (MOU) between the Australian Fisheries Management Authority (AFMA) and the Department of the Environment and Energy allows AFMA to report interactions with protected species in AFMA managed fisheries on behalf of fishers. AFMA provides summary reports on protected species interactions to the Department of the Environment and Energy on a quarterly basis. These reports are published on the AFMA website and the Commonwealth's Department of the Environment. Since 2007, license holders have reported interactions of their fishing activity with ETPs to AFMA using the *listed marine and threatened species* form located at the back of the logbook. The interactions are recorded against the corresponding catch and effort logbook number. The reported interactions in the last five years were with sawfish, syngnathids, turtles, sea snakes and occasionally with dolphins (NPFI, 2016, unpublished data).

The DoE considered the level of interaction reported to be within limits of national and international requirements for the protection of ETP species, and the NPF overall has been found to comply with the *Guidelines for the Ecologically Sustainable Management of Fisheries*. The fishery was most recently assessed and re-certified in 2013, with export approval with four recommendations for AFMA, one of these being relevant for ETPs (DoE, 2013):

Recommendation no. 4. The Australian Fisheries Management Authority to continue to:

- a) work with industry on extending the results of recent bycatch reduction research relevant to the Northern Prawn Fishery with a particular focus on reducing interactions with species protected under the *Environment Protection and Biodiversity Conservation Act 1999*, and
- b) improve the accuracy of estimates of protected species interactions in the fishery, including species level identification. Particular attention should be given to increasing the accuracy of information on interactions with sawfish and sea snake species.

All ETP species have been subject of ecological risk assessments under the ERAEF v.9.2 method. All ETP species have been assessed level 2, PSA (Griffiths *et al.*, 2007) and some have been also assessed at level 2.5, SAFE (snakes in Milton, 2008b; sawfish and other elasmobranchs in Zhou & Griffiths, 2008; Zhou, 2011, syngnathids in Zhou *et al.*, 2009a).

3.4.7 ETP Species Outcome Status (PI 2.3.1)

Tiger Prawn Subfishery (four UoA: brown tiger prawn, grooved tiger prawn, blue endeavour prawn and red endeavour prawn)

Tiger prawn subfishery produces the highest number of interactions with ETPs in the NPF. The number of ETP animals caught from 2011 to 2015 was nearly 29,000, with approximately 75% released back to the sea alive. The majority of ETPs caught in the net were snakes. Table 15 shows the number of interactions and the status of the animals released/discarded (NPFI, 2016, unpublished data).

Table 15. 2011-2015 interactions of the tiger prawn subfishery with Endangered Threatened or Protected species (ETPs).

TEP Species	Tiger Prawn Subfishery																								
	2011					2012					2013					2014					2015				
	Alive	Perished	Injured	Unknown	Total	Alive	Perished	Injured	Unknown	Total	Alive	Perished	Injured	Unknown	Total	Alive	Perished	Injured	Unknown	Total	Alive	Perished	Injured	Unknown	Total
Dolphin							1			1	1				1										
Dwarf Sawfish						1	1			2	2	1			3	20	4			24	2	4			6
Flatback Turtle	4				4	4				4	5				5	5				5	5				5
Freshwater Sawfish						1				1	4				4						3				3
Green Sawfish	24	4	2		30	49	4			53	47	20			67	9	9			18	3	1			4
Green Turtle	25				25	24	3			27	16				16	12				12	6				6
Hawksbill Turtle						2				2	1	1			2	1				1	1				1
Leatherback Turtle																					1				1
Loggerhead Turtle	7				7	6				6	9				9						1				1
Narrow Sawfish	36	8			44	69	6			75	40	28	1		69	21	1			22	9	3			12
Olive Ridley Turtle	8				8	7				7	8	1			9	1				1	3				3
Sea snake	3096	379	51	349	3875	4224	455	53	686	5418	4682	855	52	695	6284	4149	656	4	319	5128	4328	944	2	1193	6467
Syngnathid				5	5		1			1	67	73			140	7	21			28	46	91			137
Turtle Unidentified	2				2	10				10	18	1			19	31				31	43				43
Sawfish Unidentified	94	33	4		131	114	15	6		135	125	16	12		153	127	44	3		174	129	60			189

Source: NPFI, 2016, unpublished data

Marine Reptiles

Marine Turtles

All six species of marine turtles that occur in Australian waters are protected under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), and various State and Territory legislation. The leatherback, loggerhead and Olive Ridley turtle are each listed as endangered under the EPBC Act which means that these species may become extinct if the threats to their survival continue. The green, hawksbill and flatback turtle are each listed as vulnerable, which means that they may become endangered if threats continue (DEH, 2003).

All the six species of marine turtles were recorded within the NPF region (Table 16). Most turtle species are known to be highly migratory and widely distributed, occurring in most tropical waters of the Indo-Pacific region. There is one endemic species to northern Australia, the flatback turtle, with this species being the most common species recorded in the NPF (60% of the recorded turtles, Robins *et al.*, 2002 in Fry *et al.*, 2015) but not the most frequently caught (NPF, 2016, unpublished data).

Table 16. Marine turtle species with distributions on the NPF tiger prawn fishing grounds

Latin Name	Common name	CSIRO's PSA score	Expert Opinion
<i>Caretta</i>	Loggerhead turtle	2.85 (medium)	Low risk because TED allows escape;
<i>Chelonia mydas</i>	Green turtle	2.85 (medium)	Low risk because TED allows escape;
<i>Dermochelys coriacea</i>	Leathery turtle	2.85 (medium)	Low risk because TED allows escape;
<i>Natator depressus</i>	Flatback turtle	2.83 (medium)	Low risk because TED allows escape;
<i>Lepidochelys olivacea</i>	Olive Ridley turtle	2.95 (medium)	Low risk because TED allows escape;
<i>Eretmochelys imbricata</i>	Hawksbill turtle	2.95 (medium)	Low risk because TED allows escape;

International requirements. Marine turtles are recognised internationally as species of conservation concern. The six species found in Australia are listed in the 2000 IUCN Red List of Threatened Animals.

All marine turtle species occurring in Australian waters are listed on Appendix I of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). In addition, all marine turtles occurring in the Indo-Pacific region are a priority for conservation under the Convention on the Conservation of Migratory Species of Wild Animals (CMS, also known as the Bonn Convention). The flatback turtle is listed on Appendix II of the CMS and the other species are listed on both Appendices I and II. Australia is also a signatory to the CMS *Memorandum of Understanding on the Conservation and Management*

*of Marine Turtles and their Habitats of the Indian Ocean and South-East Asia*⁸ (IOSEA MoU). The MoU is designed to facilitate national level and transboundary actions that will lead to the conservation of turtle populations and their habitats.

National requirements, as set in the Recovery Plan for Marine Turtles in Australia, 2003, were to reduce mortality of the marine turtles and increase natural survivorship, develop programs to monitor and assess the size and the status of the populations and identify and protect habitats that are critical to survival for marine turtles. A prescribed management action for the NPF was to monitor the effectiveness of turtle excluder devices (TEDs) for all vessels in the Northern Prawn Fishery. The prescribed criteria for success was that marine turtle capture and mortality declines to levels approaching 5% of 1989-90 levels (>5000 turtles captured per year) and less for loggerhead turtles (DEH, 2003). This milestone has been surpassed, current level of interaction being < 70 per year in the NPF, with most in the tiger prawn subfishery. The turtle recovery plan was constructed to meet the requirements of the EPBC plan, i.e. to minimize the interactions with turtle to a level where the populations sustainability is not affected and compulsory reporting of all interactions.

International requirements are integrated in the national requirements under the EPBC Act. The NPF has been accredited with export exemption under the EPBC Act, Part 13 and the NPF Management Plan was certified as meeting the requirements of the EPBC Act. There is a high degree of certainty that the effects of the tiger prawn subfishery are within limits of national and international requirements.

Direct and indirect impact. In the tiger prawn subfishery, most frequent turtle interactions are with green turtles. Although an identification guide is available for the crew member and species identification has been improved in recent years (Fry *et al.*, 2015), in 2015 there was an increase in the number of turtles reported as unidentified. At the same time, less green turtle interactions were reported (NPFI, 2016, unpublished data). More than 90% of the turtles caught were released alive.

Since the introduction of TEDs in the NPF in 2000, catches of turtles have declined significantly (Brewer *et al.* 2006). Brewer *et al.* (2006) showed that TEDs were very effective at reducing the catches of turtles; excluding 99 – 100% of turtles from prawn nets with TEDs installed. It has been estimated that since the introduction of TEDs in the NPF, turtle catches have decreased from about 5,000 – 6,000 per year (Poiner and Harris 1996; Robins *et al.* 2003, in Fry *et al.* 2015) to the current number of interactions (Brewer *et al.* 2004, in Fry *et al.* 2015).

Ongoing monitoring by fishery-dependent and fishery-independent programs is in place. However, due to the effectiveness of TEDs in the fishery, it is unlikely that sufficient catch data will be recorded in the future to carry out a robust catch rate trend assessment on these species. Brewer *et al.* (2007) suggested that between 24,000 and 124,000,000 trawls were needed to detect an annual decline in catches of turtles in the NPF when TEDs were used.

Fry *et al.* (2015) assessed the sustainability of the NPF bycatch, including marine turtles. They found that turtles had a widespread distribution across northern Australia and mean catch rates were variable across 'Regions' and 'Years' in each of the three data sets used (CMOs, NPF prawn monitoring surveys, AFMA SOs). There appeared to be no general population declines for any of the turtle species or the 'Unidentified Cheloniidae' group from the AFMA scientific observer and NPF prawn population monitoring data (Fry *et al.*, 2015).

Fry *et al.* (2015) concluded that although it is difficult to quantify the effect of trawling on turtles with other impacts such as indigenous hunting for food, egg collecting and disruptions

⁸ <http://www.ioseaturtles.org/>

to turtle nesting sites caused by coastal infrastructure progress and other impacts such as pollution and ghost-fishing, there is strong evidence to indicate current commercial prawn trawling practices of using TEDs has minimal impact on turtle species populations. The turtles that continue to be captured while TEDs are used in the fishing gear are primarily taken during the winching-up of the nets, a late stage in the fishing operation. Most of these sea turtles are presumed to survive due to the short time they are in the trawl and, consequently, since the introduction of TEDs (Robins *et al.*, 2002). The mortality on turtles from commercial trawling has also been significantly reduced due to the effectiveness of TEDs at quickly removing these animals from the prawn trawl catch once they enter the net opening and travel down the net throat, thus, unobserved mortality is unlikely (Fry *et al.*, 2015). The NPF does not overlap with key breeding or aggregation areas and it does not disrupt turtles' habitat. Other direct and indirect effects, such as collision when anchoring, discarding biological and non-biological material have been assessed at ERAEF level 1, SICA, and were not considered significant (Griffiths *et al.*, 2007).

All marine turtle species have been risk assessed from the tiger prawn subfishery and the results were distributed to key biological researchers to provide expert opinion (see Table 16) (Griffiths *et al.*, 2007). Considering the results of the risk assessments (Griffiths *et al.* 2007) and CSIRO's sustainability assessments (Fry *et al.*, 2015), the level of interactions, TEDs performance, the existence of protected area, there is a high degree of confidence that there are no significant detrimental direct or indirect effects of the tiger prawn subfishery on marine turtle populations.

Sea snakes

All Sea snakes are protected under the EPBC Act as 'marine'. There are no specific requirements and limits for Sea snake species, other than minimising direct and indirect impacts and reporting of interactions. Sea snakes account for the highest number of tiger prawn subfishery interactions with ETPs. Sea snake species likely to be encountered in the NPF area are presented in Table 17. None of these species is listed as endangered.

Table 17. Sea snake species with distributions on the NPF tiger prawn fishing grounds⁹

Latin Name	Common name	CSIRO's PSA score	CSIRO's SAFE
<i>Acalyptophis peronii</i>	Horned Sea snake	3.07 (medium)	Low risk
<i>Aipysurus duboisii</i>	Dubois' Sea snake	3.07 (medium)	Low risk
<i>Aipysurus eydouxii</i>	Spine-tailed Sea snake	2.95 (medium)	Low risk
<i>Aipysurus laevis</i>	Olive Sea snake	2.70 (medium)	Low risk
<i>Astrotia stokesii</i>	Stokes' Sea snake	3.07 (medium)	Low risk
<i>Hydrophis inornatus</i>	Plain Sea snake	2.95 (medium)	Never recorded in catch
<i>Hydrophis ornatus</i>	Spotted Sea snake	3.07 (medium)	Low risk

⁹ from <http://www.environment.gov.au/cgi-bin/sprat/public/spratlookupspecies.pl?name=seasnake&searchtype=Wildcard>

<i>Disteira kingii</i>	Spectacled Sea snake	3.07 (medium)	Low risk
<i>Disteira major</i>	Olive-headed Sea snake	3.07 (medium)	Low risk
<i>Hydrelaps darwiniensis</i>	Black-ringed Sea snake	2.95 (medium)	Low risk
<i>Hydrophis atriceps</i>	Black-headed Sea snake	3.07 (medium)	Never recorded in catch
<i>Hydrophis belcheri</i>	Faint-banded Sea snake	3.58 (high)	Never recorded in catch
<i>Hydrophis caeruleus</i>	Dwarf Sea snake	2.95(medium)	Never recorded in catch
<i>Hydrophis czeblukovi</i>	Fine-spined Sea snake	2.95 (medium)	Low risk
<i>Hydrophis elegans</i>	Elegant Sea snake	2.58 (low)	Low risk
<i>Hydrophis mcdowelli</i>	Small headed Sea snake	2.95 (medium)	Low risk
<i>Hydrophis pacificus</i>	Large-headed Sea snake	3.07 (medium)	Low risk
<i>Lapemis curtus</i> (L. <i>hardwickii</i>)	Spine-bellied Sea snake	2.58 (low)	Low risk
<i>Enhydrina schistosa</i>	Beaked Sea snake	2.47 (low)	Low risk
<i>Parahydrophis mertoni</i>	Northern mangrove Sea snake	3.33. (high)	Never recorded in catch
<i>Pelamis platurus</i>	Yellow-bellied Sea snake	3.07 (medium)	Low risk

Direct and indirect impact. Sea snakes continue to be caught in significant numbers, as shown in logbooks data summarised in Table 15. About 75% of the snakes caught annually are released alive. Although in the NPF the number of Sea snake interactions is required to be reported in logbooks there is no requirement to be reported at species level. All the efforts are made for Sea snake species identification in the monitoring programs.

Milton *et al.*, 2008b, analysed survival rates and factors that influenced survival, for Sea snakes caught in tiger prawn subfishery. Some BRDs such as Popeye Fishbox, set at 70 meshes from the codend drawstring, were found to be efficient in reducing Sea snake bycatch, however, positioning the BRDs closer to the codend drawstring leads to prawn losses as well (Milton *et al.*, 2008b). At the time of the BRD assessment in 2012, popeye fishbox BRD was not being used in the NPF fleet (Burke *et al.*, 2012). However, the reduction in overall bycatch and particularly the exclusion of large bodied animals, when using TEDs, has led to 13% reduction in Sea snake mortality (Milton *et al.*, 2008b).

Species identification for Sea snakes is challenging because 1) they need to be returned to the sea as quickly as possible to increase survivability and 2) live Sea snakes are dangerous to handle. The crew members from the CMO program were trained in data collection and recording, photographing and safe handling practices for sea snakes. Even though the quality of data collection by the CMOs has improved, in logbooks, there is still a high number of Sea snake interactions reported as “unidentified” (Griffiths *et al.*, 2007).

Sustainability of Sea snake populations has been recognised as an issue in the NPF since early on. Milton (2001) undertook a ranked risk assessment similar to the one for fish by Stobutzki (in Stobutzki *et al.*, 2001b). In 2007-2008 all Sea snakes recorded in the NPF were risk

assessed from the tiger prawn subfishery at ERAEF level 2, PSA (Griffiths *et al.*, 2007), and at level 2.5, SAFE (Milton *et al.*, 2008b). From the earlier studies, two species of sea snake were found potentially at risk from trawling (Milton, 2001). These species, *Disteira kingii* and *Hydrophis pacificus* were mostly distributed within trawl grounds and had life history traits that made them vulnerable to increased mortality (late maturing, few young, and poor post-trawl survival) (Milton *et al.*, 2008b). However, Milton *et al.* (2008b) found that catch rates of most species have not shown a measurable change since the early 1970s and fishing mortality was well below maximum sustainable fishing mortality reference points.

The two species that had previously been identified to be at risk (*Disteira kingii* and *Hydrophis pacificus*) showed some evidence that catch rates from the trawl grounds in the southwestern Gulf of Carpentaria had declined. However, the distribution and pattern of trawling have also changed and these changes may have contributed to the declines detected. SAFE results showed that the estimated fishing mortalities for Sea snake species that interact with the tiger prawn subfishery were lower than the minimum unsustainable fishing mortality (set at natural mortality) and lower than maximum sustainable fishing mortality (set at 0.5 natural mortality). Even when the uncertainty was considered (95%CI) Sea snake species fishing mortality from tiger prawn subfishery was lower than the reference points. Thus, there appears to be a low risk of unsustainable trawl impacts of the NPF on sea snake populations in northern Australia with the current trawl fleet size and fishing practices (Milton *et al.*, 2008b). Even the BRDs used in the NPF so far are not efficient in removing Sea snake bycatch, this is compensated by the significant reduction in fishing effort, the low trawl footprint, the existence of permanently closed areas and the fact that all impacted species have wide distribution in unfished areas (Milton *et al.*, 2008b).

At the latest bycatch sustainability assessment, there was sufficient data available to undertake the catch rate trend analysis for seven sea snake species (*Aipysurus eydouxii*, *Aipysurus laevis*, *Astrotia stokesii*, *Disteira major*, *Hydrophis elegans*, *Hydrophis ornatus* and *Lapemis curtus*) (Fry *et al.*, 2015). None of these species showed clear declines in catches from 2003 to 2013 during either the CMO program or the AFMA SO program and CSIRO's NPF prawn population monitoring surveys. For most of these species, catches had appeared to increase slightly over the last few years. *Disteira major*, and the 'Unidentified Hydrophiidae' group showed decline in catches over the same time period. However, for *D. major*, this trend was only seen in the CMO data and not the AFMA SO and NPF prawn population monitoring data, thus, it may be an issue of species identification. The decline in 'Unidentified Hydrophiidae' might be due to improvement in species identification and reporting in the recent years (Fry *et al.*, 2015).

There were several species of sea snakes that were not recorded by the CMOs, AFMA SOs or NPF prawn population monitoring surveys between 2002 and 2014 but are known to occur within the NPF from previous Museum records and CSIRO scientific research and observer surveys (Fry *et al.*, 2015). From the distribution records available, these species (*Hydrelaps darwiniensis*, *Hydrophis atriceps*, *Hydrophis caeruleus*, *Hydrophis fasciatus*, *Hydrophis inornatus* and *Parahydrophis merroni*) appear to have a more inshore estuarine habitat preference and are therefore unlikely to be recorded in NPF prawn trawls (Fry *et al.*, 2015).

Considering all the information presented, in the tiger prawn subfishery all possible measures to minimise sea snake bycatch are undertaken and even though the number of interactions is still high, this is much lower than in the early 1990s (50,000, in Milton, 2001) and post-capture survival has increased (from 50%, in Milton, 2001, to 64% (Milton *et al.*, 2008b). Species level identification for sea snakes is challenging for CMOs however this is partially compensated for by the improvements in CMO training and the fact that data collections and catch trends

were possible to be assessed for seven species. There is a high degree of certainty that effects of the fishery are within the national and international requirements. Direct effects from the tiger prawn fishery are highly unlikely to create unacceptable impacts to sea snake species, although some uncertainty remains, since the interactions are not reported at species level. Indirect effects of the fishery have been considered during ERAEF at SICA level and it was concluded that these were not significant (Griffiths *et al.*, 2007). There is a high degree of confidence that there are no significant detrimental indirect effects of the tiger prawn subfishery on sea snake populations.

Crocodiles are known to occur in the NPF area although the configuration on the prawn trawl gear and the use of TEDs would prevent the large animals to enter the net and the smaller ones would be able to escape. There have been no reported or known interactions with crocodiles in the NPF tiger prawn subfishery.

Marine mammals

Twenty species of cetaceans and the dugong (see Table 18) have been identified as potentially occurring in the NPF managed area (Griffiths *et al.*, 2007).

Table 18. Marine mammal species potentially occurring in the NPF managed area

Latin name	Common name
<i>Balaenoptera bonaerensis</i>	Antarctic minke whale
<i>Balaenoptera edeni</i>	Bryde's whale
<i>Balaenoptera musculus</i>	Blue whale
<i>Kogia breviceps</i>	Pygmy sperm whale
<i>Kogia simus</i>	Dwarf sperm whale
<i>Physeter catodon</i>	Sperm whale
<i>Ziphius cavirostris</i>	Cuvier's beaked whale
<i>Orcinus orca</i>	Killer whale
<i>Peponocephala electra</i>	Melon-headed Whale
<i>Pseudorca crassidens</i>	False killer whale
<i>Globicephala macrorhynchus</i>	Short-finned Pilot Whale
<i>Feresa attenuata</i>	Pygmy killer whale
<i>Delphinus delphis</i>	Common dolphin
<i>Orcaella brevirostris</i>	Irrawaddy dolphin
<i>Grampus griseus</i>	Risso's dolphin
<i>Sousa chinensis</i>	Indo-pacific humpback dolphin
<i>Stenella attenuata</i>	Spotted dolphin
<i>Stenella longirostris</i>	Long-snouted Spinner Dolphin
<i>Tursiops truncatus</i>	Bottlenose dolphin
<i>Tursiops aduncus</i>	Ocean bottlenose dolphin
<i>Dugong dugon</i>	Dugong

International requirements. Australia is party to the CITES convention that regulates international trade in endangered species and, as mentioned before, Australia applies stricter

measures and considers all cetaceans listed in Appendix II as if they are listed in Appendix I. Australia is also a party to the CMS and signatory to a number of agreements and memoranda of understanding developed under the convention, including the *Memorandum of Understanding for the Conservation of Cetaceans and their habitats in the Pacific Islands Region*¹⁰ and *Memorandum of Understanding (MoU) on the Conservation and Management of Dugongs and their Habitats throughout their Range*¹¹. The requirements for these conventions are not to engage in trade on these protected species and minimise direct and indirect impact as to not further threaten their survival and allow recovery. These requirements are integrated into the national requirements.

National Requirements. The blue whale is listed as endangered and the sperm whale and Irrawaddy dolphin are listed as vulnerable under the EPBC Act. Currently, apart from the blue whale recovery plan (DoE, 2015a), there are no species-specific requirements for these ETPs. One action required in the blue whale recovery plan that is relevant to fisheries is to minimise vessel collisions. Under the EPBC Act, all cetaceans (whales, dolphins and porpoises) are protected in Australian waters. The Australian Whale Sanctuary¹² includes all Commonwealth waters from the 3 nautical mile state waters limit out to the boundary of the Exclusive Economic Zone. Within the Sanctuary it is an offence to kill, injure or interfere with a cetacean. Because the NPF was accredited with export approval under the EPBC Act, interaction with these species is not an offence if fishing operations are consistent with the NPF Management Plan. Fishers are required to report all interactions in logbooks (AFMA, 2017). Based on the NPF assessments by the DoE, and the very low level of interactions, there is a high degree of confidence that the effects of the tiger prawn subfishery on marine mammals are within limits of national and international requirements.

Direct and indirect impact. Whales and dugong interactions have never been recorded in the NPF history. Trawlers operate at relatively low speeds (3.24 knots average, Bishop, 2003 in Zhou, 2011). At such speeds, it is highly unlikely that any big size cetacean or dugong will be seriously injured if they would come in direct contact with a trawler. Vanderlaan and Taggart (2007) found that the speed a ship is travelling when it strikes a whale is directly linked to the severity of the injury the whale will sustain and at trawler's speed, the probability for serious injury is very low (<5%) (Figure 30).

¹⁰ <http://www.cms.int/en/legalinstrument/pacific-islands-cetaceans>

¹¹ <http://www.cms.int/en/legalinstrument/dugong>

¹² <http://www.environment.gov.au/marine/marine-species/cetaceans/australian-whale-sanctuary>

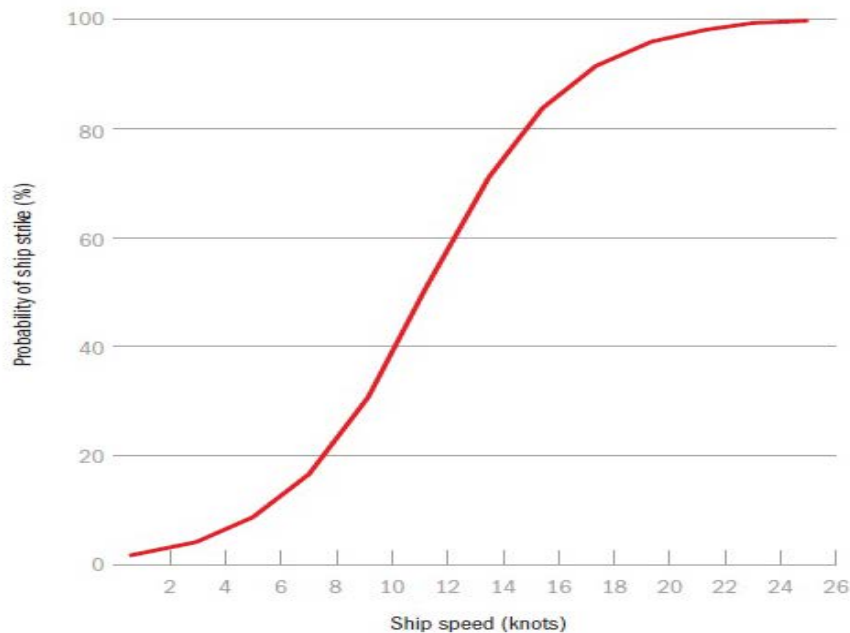


Figure 30. Probability of a lethal strike for a ship striking a whale at various ship speeds. Calculated using equations from Vanderlaan and Taggart (2007).

Reports from the tiger prawn subfishery indicate two dolphin interactions occurred in the 2011-2015 period, with one dolphin killed in 2012 after being caught in the codend drawstrings, and one dolphin released alive in 2013 (NPFI, 2016, unpublished data). The dolphins were not identified to species in the unpublished subfishery data provided by AFMA, although the common dolphin was reported to the Department of Environment and Energy for 2013 tiger prawn season¹³.

All marine mammal species have been risk assessed from tiger prawn subfishery at Level 2 PSA within the ERAEF framework in 2007. All, but the common dolphin, which scored "low risk", scored as "medium risk" which was downgraded by expert override by NPRAG. The reason for downgrade was for most species, they are too large to be caught in a prawn trawl and for the smaller species, TEDs allow escape (Griffiths *et al.*, 2007). The remaining interactions with dolphins usually occur at the codend drawstrings or in try nets (small nets that can be used when searching for prawns) which do not have TEDs (AFMA's ETPs quarterly reports to the DoEE)¹⁴.

Dolphins are known to follow prawn trawlers and feed on discarded bycatch (Wassenberg & Hill, 1990; Hill & Wassenberg, 2000, Svane, 2005). There is no clear evidence to demonstrate this would be harmful for dolphin populations (Svane, 2005). Chilvers and Corkeron (2001), showed that bottlenose dolphin may form different social structures with certain groups following trawls and others foraging in seagrass. This would suggest, according to the authors, that trawling can have different impact on different groups of dolphins and seasonal closures of the fishery would affect trawler foragers by food depletion (Chilvers and Corkeron, 2001). Ansmann *et al.*, 2012, however, have found that social structures are not fixed but they

¹³ <http://www.afma.gov.au/sustainability-environment/protected-species-management/protected-species-interaction-reports/>

¹⁴ <http://www.afma.gov.au/sustainability-environment/protected-species-management/protected-species-interaction-reports/>

represent a “complex adaptive system that is resilient to disturbance”. Tiger prawn trawling indirect effects on dolphins’ behavior have been assessed at SICA and considered negligible because discarding is very limited spatially (Griffiths *et al.*, 2007).

Considering the results of the risk assessments (Griffiths *et al.* 2007), the low speed of the trawler, the use TEDs, the existence of protected areas, there is a high degree of confidence that there are no significant detrimental direct or indirect effects of the tiger prawn subfishery on marine mammal populations.

Seabirds

Seabirds include any species of bird that spends a significant part of their life eating or breeding at sea, such as the albatross, petrels and shearwaters. Interactions with seabirds can happen when boats are trawling and the bird comes into contact with the wires used to drag the net along¹⁵.

National and international requirements. All seabirds are protected under the EPBC Act. None of the 12 species of seabirds (see Table 19) that have been identified at ERAEF as occurring in the NPF area, are listed as threaten under the EPBC Act. All species are listed as marine and some are listed under one or more of the agreements: Jamba, Camba and Rokamba¹⁶. None of these species are on listed on Appendix I of CITES. There are no specific limits and requirements defined for these species. The only requirements are to minimize direct and indirect impacts of the fishery on marine bird species.

Table 19. Marine bird species potentially occurring in the NPF managed area

Latin name	Common name
<i>Fregata ariel</i>	Lesser frigatebird
<i>Fregata minor</i>	Great frigatebird
<i>Anous stolidus</i>	Common noddy
<i>Larus novaehollandiae</i>	Silver gull
<i>Sterna anaethetus</i>	Bridled tern
<i>Sterna bengalensis</i>	Lesser crested tern
<i>Sterna bergii</i>	Crested tern
<i>Sterna dougallii</i>	Roseate tern
<i>Sterna sumatrana</i>	Black-naped tern
<i>Anous minutus</i>	Black noddy
<i>Calonectris leucomelas</i>	Streaked shearwater
<i>Sula leucogaster</i>	Brown booby

Direct impact. The only data available on the distribution of these marine bird species is very outdated but it may still be relevant. Previous research has shown that the islands in the southern gulf support large breeding colonies of the crested tern (*Sterna bergii*), least frigatebird (*Fregata ariel*), brown booby (*Sula leucogaster*) and roseate tern (*Sterna dougallii*) as well as small colonies of other species (Garnett and Crowley 1987a, 1987b; Walker 1992, in Blaber & Milton, 1994). There are also significant roosts of the least frigatebird at Weipa and Mornington Island (Blaber & Milton, 1994). The CSIRO undertook two summer cruises in

¹⁵ <http://www.afma.gov.au/portfolio-item/seabirds/>

¹⁶ http://www.environment.gov.au/biodiversity/migratory-species/migratory-birds#International_cooperation

1990 and 1991 to study the fish and benthos of the Gulf of Carpentaria and at the same time, a census of the seabirds was conducted (Blaber & Milton, 1994). During the surveys, only the crested tern, common tern (*Sterna hirundo*), lesser frigatebird and the brown booby followed the trawls and actively fed on discards. The common tern was not in the list of birds identified at the ERAEF process in 2007. The species is a seasonal visitor during summer and it does not breed in the NPF area.

In the risk assessment report, the authors noted that there have been no historical bird interactions in the NPF (Griffiths *et al.*, 2007). At the first MSC Certification assessment (MRAG, 2012), 5 gull-billed tern interactions have been identified in the tiger prawn subfishery in 2006. According to subfishery interactions data, since 2011, no bird interactions have been reported (NPFI, 2016, unpublished data).

All marine bird species have been risk assessed at ERAEF level 2, PSA, and except for the streaked shearwater (medium risk) all scored low risk from the tiger prawn subfishery. Streak shearwater scored medium risk due to missing of several productivity attributes, while susceptibility score was low. The score was downgraded by NPFRAG experts based on the species never being captured (Griffiths *et al.*, 2007). There is a high degree of confidence that there are no significant detrimental direct effects of the tiger prawn subfishery on marine birds.

Indirect impact. Indirect effects on bird populations have been considered at SICA, level 1 of the ERAEF process and it was concluded that the trawl discards may significantly affect the behavior and movements of the populations of birds. The effect on birds of the significant reduction in food availability during the closed season when discards are not available, is unknown (Griffiths *et al.*, 2007).

Seabirds scavenging near fishing vessels, are commonly observed around the world. However, there is little information on the relative importance of discarded by-catch as food and the natural availability of food sources. The number of seabirds scavenging in the Gulf of Carpentaria has not been studied. Studies in Torres Strait Prawn Fishery in the northern Great Barrier Reef showed that only a minor part of prawn trawlers discards is consumed by birds and this occurred mainly during the day (Hill & Wassenberg, 1990; Hill & Wassenberg, 2000). In Torres Strait area (the closest to the NPF area), common and crested terns and lesser and greater frigatebirds were feeding on discards during the day. In tiger prawn subfishery this bird species can only feed for a short time at dusk, because the fishery operates at night (Griffiths *et al.*, 2007). Svane, studying the fate of discards from Spencer Gulf Prawn Fishery, reported a correlation between trawl intensity and bird abundance (Svane, 2005). The overall mean number of seabirds observed to feed on discarded by-catch was 1.2 seabirds per boat and observation, which is less than in other parts of the world (Svane, 2005).

Birds feed mainly on small fish and soft bodied invertebrates (squid and cuttlefish). While the BRDs did not have a significant effect in reducing small fish bycatch so far, the significant reduction in fishing effort leading to a very low trawl footprint, reduced the quantity of the discarded bycatch and the area affected. Considering that tiger prawn subfishery operates at night, there is little temporal overlap with the marine birds feeding behavior. Indirect effects are highly unlikely to create unacceptable impact to marine birds, however, because there have been no studies of population trends in bird species that actively feed on discards, some uncertainty remains.

Elasmobranchs

Sawfish

According to the DoEE's website¹⁷, five species of sawfish are found and three of these, the largetooth sawfish (*Pristis pristis*), green sawfish (*P. zijsron*) and the dwarf sawfish (*P. clavata*), are currently listed as vulnerable under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), while the other two, the narrow sawfish (*Anoxypristis cuspidata*) and smalltooth sawfish (*P. pectinata*), are not vulnerable in Australia. For one species, *P. pectinata* (smalltooth sawfish), its distribution in Australian waters needs confirmation. All *Pristis* species are EPBC listed as migratory and are declared endangered (narrow and dwarf sawfish) or critically endangered (smalltooth, largetooth and green sawfish) on the IUCN Red List¹⁸. Although sawfish species are endangered globally, the Australian sawfish populations are probably the healthiest in the world (Stevens *et al.*, 2008).

Four species were recorded in the NPF managed area (see Table 20). There are reported interactions with all four species but only the narrow and the green sawfish were commonly caught during fishery independent surveys, the other two species being exceptionally rare.

Table 20. Sawfish species potentially occurring in the NPF managed area

Latin name	Common name	CSIRO's PSA score (Griffiths <i>et al.</i> , 2007)	CSIRO's SAFE score (Brewer <i>et al.</i> , 2007; Zhou & Griffiths, 2008; Zhou, 2011)
<i>Pristis clavata</i>	Dwarf sawfish	3.19 (high)	Low risk
<i>Pristis pristis</i>	Largetooth (freshwater) sawfish	3.19 (high)	Low risk
<i>Pristis zijsron</i>	Green sawfish	3.31 (high)	Low risk
<i>Anoxypristis cuspidata</i>	Narrow sawfish	3.31 (high)	Low risk

International requirements. All sawfish species, family Pristidae, are listed in CITES Appendix I, trade in these species or any products from sawfish being prohibited. They are also listed in both CMS Appendix I (endangered migratory species) and Appendix II (migratory species conserved through agreements)¹⁹. Australia is a signatory country for the CMS *Memorandum of Understanding on the Conservation of Migratory Sharks*²⁰ which includes sawfish species and aims to achieve favourable conservation status for the species concerned, throughout their range. CITES requirements are met because the NPF was accredited with export approval under the EPBC Act Part 13 that prohibits trade in species listed in Appendix I of CITES. The CMS requirements are integrated in the national requirements.

National requirements. A combined recovery plan for the three sawfish species listed as vulnerable under the EPBC Act and two species of river shark, was released in November 2015 (DoE, 2015b). The recovery plan considers international requirements for conservation of sawfish across their range, and identifies actions to be taken, to ensure long-term sustainability of the species (DoE, 2015b).

Most of the actions required by the recovery plan, that are relevant to commercial trawl fisheries, are already in place in the NPF management. To summarise, these actions refer to:

1. compliance to the management measures to minimise direct and indirect effects on populations,

¹⁷ <http://www.environment.gov.au/marine/marine-species/sharks/sawfish>

¹⁸ <http://www.iucnredlist.org>

¹⁹ <http://www.cms.int/en/page/appendix-i-ii-cms>

²⁰ <http://www.cms.int/sharks/>

2. creating new managements arrangements to further mitigate adverse impacts,
3. improving monitoring and data validation,
4. improving fishers' awareness on sawfish conservation needs and training in species identification (DoE, 2015b).

1. AFMA applies an efficient risk-based compliance monitoring, with internal and external reviews²¹ to ensure fishing operators comply with management measures. There is a high degree of certainty that there is no systematic non-compliance with sawfish handling or reporting by the CMOs and fishing operators.

2. Currently new measures to mitigate sawfish bycatch are considered, and a research application is currently waiting for approval by FRDC. The project will investigate a novel sawfish mitigation device using electric pulse to deter the animals from entering the trawl net. Also, AFMA expects that recent CSIRO work in PNG will provide information for the NPF on reducing sawfish interactions. This work trialled top and bottom shooting TEDs without the mesh flaps over the openings (this is one of the main locations sawfish get their rostrums stuck as they are escaping via the TED) (Laird, 2016, email communication).

4. In the NPF, it is compulsory to report all sawfish interactions in logbooks which are validated by CMOs and AFMA SOs reports. Interactions have been recorded in the NPF over the past 25 years through a combination of monitoring programs (CMO program since 2002, AFMA SO program since 2005, CSIRO prawn monitoring surveys since 2002 and other CSIRO surveys and observer trips since 1990) (Fry *et al.*, 2015). Sustainability assessments by CSIRO are done every 3 years using CMO, AFMA SOs, CSIRO and logbook data. This assessment is not currently used to validate logbook data but it is possible to do so comparing CMO and SO data to the logbooks (Laird, 2016, email communication). NPF produces annual data summary of catch and effort which also includes TEP interactions. From 2015, sawfish interactions were broken down to species. These reports are public and published on the AFMA website (Laird, 2016, email communication). Even though there is a significant number of interactions reported in logbooks as unidentified, CSIRO surveys and AFMA SO program identified that 97% of these interactions are with narrow sawfish (Fry *et al.*, 2015) which is less vulnerable and not included in the recovery plan, nevertheless, accurate distinction between species is necessary to ensure any increase in risk for the vulnerable species can be identified. NPF is working with CSIRO to investigating ways to improve and validate species identification in logbooks. Operators will be trained in species identification and vessels will be provided with cameras for operators to photograph sawfish interactions. These will be used by CSIRO scientists to identify species, similar to the CMO program, and validate logbook entries (Laird, pers. comm, 2017).

CSIRO and NPF train CMOs in sawfish identification and tissue sample collection. CMOs collect sawfish tissue samples for CSIRO researchers doing population genetics. There is an increased interest in the CMO program, with 12 crew-member observers attending the CMO workshops in both 2013 and 2014, and 11 of these collecting data during the tiger prawn seasons. This represented a fleet coverage of around 18% of boat days in both years (Fry *et al.*, 2015). The CMOs also contribute significantly in educating the crew on the importance of protecting these species and ethical handling that increases survival of sawfish species.

There is a high degree of confidence that the NPF tiger prawn subfishery's effects on sawfish species are within the limits of national and international requirements.

²¹ <http://www.afma.gov.au/wp-content/uploads/2014/08/Compliance-risk-methodology-Final-2015-17.pdf>

Direct and indirect effects. In the tiger prawn subfishery, in a five-year period (2011-2015) period, 1219 sawfish interactions have been reported (see Table 10), with 75% of the animals released alive. *Anoxypristis cuspidata* was the most common sawfish species recorded in the NPF, around 97% of all sawfish captured during monitoring programs were from this one species. The distribution of *Anoxypristis cuspidata* was widespread, from western Joseph Bonaparte Gulf to Weipa in the east. Catch rates were up to 35 individuals per km² during tiger prawn season. This species was caught in a total of 172 trawls (2.5%) from the CSIRO scientific research and observer surveys. The second most common species, *Pristis zijsron*, was caught in 13 trawls from CSIRO surveys and trips between 1990 and 2005. This species was rarely recorded during the NPF prawn population monitoring surveys and the AFMA scientific observer program however it was also recorded (14 trawls) during the CMO program. The other two species were very rarely caught (Fry *et al.*, 2015).

Monitoring programs indicate that catches of the different species of sawfish are remaining constant. It is difficult to determine statistically significant trends though, because of the low number of interactions. With ongoing monitoring, the power of analysis will increase and the uncertainty in trends will be reduced (Fry *et al.*, 2015).

In the NPF, the need for sawfish protection has been identified early on, since the first risk assessments by Stobutzki *et al.* (2001b, 2002). Sawfish vulnerability was identified based on the high susceptibility of the species to capture (being demersal) and mortality (due to their rostrum entanglement in the net not allowing escape), and the low capacity to recover (low productivity, long lived animals) if the population becomes depleted (Stobutzki *et al.* 2000; Stobutzki *et al.* 2002; Zhou and Griffiths 2008). Other information such as survival rates, population size and distribution ranges and their catchability between day and night is also limited. The combination of these factors meant that these species are likely to occur on trawl grounds and that they have a low capacity to recover from trawl impacts (Fry *et al.*, 2015).

Sawfish species were risk assessed at ERAEF level 2, PSA and 2.5, SAFE (Griffiths *et al.*, 2007; Zhou & Griffiths in 2008; Zhou in 2011. Although sawfish species scored as high risk at PSA, at SAFE, which is a more quantitative assessment, using species attributes and the actual fishing impact, sawfish scored low risk, even when the uncertainty was considered (90% Confidence Interval). Sawfish species continue to be monitored and AFMA and the NPFI are committed to improve species identification and find ways to eliminate sawfish bycatch.

There is a high degree of confidence there are no significant direct effects from the tiger prawn subfishery on narrow sawfish. Direct effects from the tiger prawn fishery are highly unlikely to create unacceptable impacts to the other three sawfish species, especially to green sawfish which is the second commonly caught, although some uncertainty remains, since not all the interactions are not reported at species level.

Indirect effects on sawfish populations, such as interfering with their feeding or breeding behaviour, were considered low at ERA Level 1, SICA (green sawfish was assessed under a “worst scenario” approach, Griffiths *et al.*, 2007). In addition, sawfish pupping grounds are entirely within permanently closed areas. There is a high degree of confidence there are no significant detrimental indirect effects from the NPF tiger prawn subfishery on sawfish species.

No interactions with ETP elasmobranch species other than sawfish have been recorded in logbooks or monitoring surveys for the tiger prawn subfishery.

Teleost (Syngnathids and Solenostomids)

The NPF interacts with ETP teleost species from the families Syngnathidae (seahorses, seadragons, pipefishes and pipehorses) and Solenostomidae (ghost pipefish). Forty-four species of syngnathids and solenostomids were identified as potentially occurring in the NPF

managed area (Griffiths *et al.*, 2007) but only two species are commonly caught, the pipefish *Trachyrhamphus longirostris* and the seahorse *Hippocampus histrix* (Fry *et al.*, 2015).

National and International Requirements. Families Syngnathidae and Solenostomidae are EPBC listed as marine, since 2001. It is an offence to kill, injure, take or trade syngnathids and solenostomids in, or from, a Commonwealth area. Actions undertaken in accordance with an accredited management regime such as the NPF Management Plan, or in accordance with a permit under which the action is approved, are not an offence. If interactions with these species occur, and it does not constitute an offence under the Act and it was not authorised by a permit, then the EPBC Act requires that the interaction be reported. *Hippocampus spp.* from family Syngnathidae are listed on CITES Appendix II, their international trade being regulated²². There are no other international requirements for syngnathids and solenostomids. Because the NPF was granted export approval by the DoE until 2019 and because the NPF Management Plan was accredited under the EPBC Act by the DoE, any activity that is conducted according to the plan meet national and international requirements. Under this management plan, in the NPF tiger prawn subfishery all interactions with syngnathids and solenostomids are compulsorily reported and caught animals are quickly returned to the water. There is a high degree of certainty that the effects of the NPF tiger prawn subfishery are within limits of national and international requirements.

Direct and indirect impacts. Syngnathids are particularly susceptible to fishing pressures because their biology is characterised by relatively low population densities; low productivity and lengthy parental care; strict monogamy, with complicated social structures; sparse distribution, which means that lost partners are not quickly replaced; strong association with preferred habitat, which can make populations vulnerable to site-specific impacts; and low mobility and small home ranges, which restrict recolonisation of depleted areas (Foster & Vincent 2004). Shokri *et al.* (2009) found that most species are more localised than previously thought, and, according to these authors, preserving habitats is one of the most important factors in protecting seahorses. Syngnathids tend to use only certain parts of the suitable habitat, for example, they have been recorded occupying the edges of seagrass beds or macroalgae-dominated reefs and leaving large areas unoccupied (Scales, 2010). Most species associate strongly with site, presumably with localised reproduction, although some solenostomids, such as the blue-finned ghost pipefish, may have a prolonged larval stage that may permit longer range dispersal (Kuitert 2009 in DSEWPfC, 2012).

More than ten species of syngnathids were included in the bycatch sustainability assessment from 2006-2014 monitoring data (Fry *et al.*, 2015). There were three species of syngnathids recorded by the crew-member observers; *Trachyrhamphus longirostris*, *Hippocampus zebra* and *Trachyrhamphus sp.* The most common species was *T. longirostris*, occurring in about 2.5% of trawls since 2006, although another 114 trawls recorded catches of syngnathids where individuals were not identified to species as they were released immediately after capture and could not be identified only from photographs (Fry *et al.*, 2015). From AFMA SO program, *T. longirostris* was recorded in 72 of the 3239 trawls (2% of all trawls). Similarly, *T. longirostris*, was the most commonly caught species (in 63 trawls) with only two other species being recorded during the NPF prawn population monitoring surveys. However, most syngnathids caught were not identified to species due to the difficulty in positive identification from photographs (Fry *et al.*, 2015). A trend analysis of catch rate was possible only for *T. longirostris* so far and no decline was identified. A permit has been issued to NPFI by the DoEE²³ for CMOs to take, keep and move up to 150 landed dead syngnathids for CSIRO

²² <https://cites.org/eng/app/appendices.php>

²³ <http://www.environment.gov.au/biodiversity/threatened/permits/e2016-0127>

species identification. This is a replacement of a previously held permit to collect 100 specimens. The collection of specimens will allow proper identification and collection of life-history information for each species of syngnathid the tiger prawn subfishery interacts with.

Syngnathids and solenostomids were risk assessed within the ERAEF framework. At level 2 assessment (PSA), all species of syngnathids and solenostomids potentially occurring in the NPF area were assessed separately from the tiger prawn subfishery and from the banana prawn subfishery. All species scored as low risk, apart from one syngnathid and one solenostomid which scored medium risk from the tiger prawn subfishery. The syngnathid, *Hippocampus spinosissimus* scored medium risk due to spatial uncertainty, while the solenostomid, *Solenostomus cyanopterus*, for missing productivity attributes (Griffiths *et al.*, 2007). These two species have not been reported in the tiger prawn subfishery monitoring data but it is possible they are included in the ‘unidentified’ group. The uncertainty will be lowered when each species will be identified. At the level 2.5 assessment, SAFE, only the species that have been recorded as captured by the fishery before 2007 were included *Trachyrhamphus longirostris* and *Hippocampus queenslandicus* and *Filicampus tigris* (Griffiths *et al.*, 2007). Currently, *H. queenslandicus* is considered the same species as *H. spinosissimus*.

At SAFE assessment, syngnathid species scored low risk from tiger prawn and banana prawn subfisheries cumulatively (Zhou & Griffiths, 2008, Zhou, 2011). All syngnathids and solenostomids that occur in the NPF area have wide distributions (although patchy) in unfished areas, and most species have preference for structured habitats (usually seagrass beds or reef habitat) that occur within permanently closed areas. Also, tiger prawn subfishery’s footprint is very low compared to the NPF managed area, considering that annual NPF trawl footprint is currently about 1.6%.

The number of annual interactions of the tiger prawn subfishery with syngnathids and solenostomids was variable between 2011-2015, with a maximum of 140 in 2013. The animals caught are likely to represent a very small proportion of the population. For the most commonly caught syngnathid, *T. longirostris*, there is a high degree of confidence that there are no significant detrimental direct effects of the tiger prawn subfishery on this species. For all the other species of syngnathids and solenostomids, direct effects are highly unlikely to create unacceptable impacts but because of the difficulty to identify species there is higher uncertainty about species distributions and biology, and possibility of localised depletions.

Indirect effects on syngnathids and solenostomids were assessed at ERAEF level 1 (SICA) when assessing TEP component (threaten, endangered and protected) and they were not considered unacceptable. Breeding habitats for syngnathids and solenostomids are sheltered areas of seagrass or coral reef/ rubble, which are inaccessible to prawn trawling or protected in permanently closed areas. The syngnathids and the solenostomids eat small invertebrates and fish larvae, thus the populations are not likely to be affected by the tiger prawn subfishery’s removals. Indirect effects from the tiger prawn subfishery are thought to be unlikely to create unacceptable impact to syngnathids. Because species identification for syngnathids and solenostomids and information on their distribution are limited the degree of confidence is not high.

White Banana Prawn Subfishery (one UoA: white banana prawn)

For the period 2011-2015, white banana prawn subfishery reported about three times less interactions with ETPs than tiger prawn subfishery in the same period. More than 80% of the ETP animals caught were released alive. As for the tiger prawn subfishery, the most commonly caught group was sea snakes. Table 21 shows the number of ETP interactions and the status of the animals released/discarded (NPFI, 2016, unpublished data).

Table 21. 2011-2015 interactions of the white banana prawn subfishery with Endangered Threatened or Protected species (ETPs).

TEP Species	White Banana Prawn Subfishery																								
	2011					2012					2013					2014					2015				
	Alive	Perished	Injured	Unknown	Total	Alive	Perished	Injured	Unknown	Total	Alive	Perished	Injured	Unknown	Total	Alive	Perished	Injured	Unknown	Total	Alive	Perished	Injured	Unknown	Total
Dwarf Sawfish						23	14			37	1	1			2						8	6			14
Flatback Turtle						2				2	3	1			4										
Freshwater Sawfish						4				4	5				5	1				1					
Green Sawfish	31	3	3		37	17	1	2		20	28	3			31	36	29			65	1	1			2
Green Turtle	2			2	4	4				4	2				2	1				1					
Leatherback Turtle						1				1															
Narrow Sawfish	51	2			53	38	6		2	46	18	15	4		37	10	33			43	4	3			7
Olive Ridley Turtle											5	1			6										
Sea snake	1194	109	14	25	1342	1736	287	29	160	2212	1341	196	73	45	1655	1080	237	13	3	1333	596	116	2	269	973
Syngnathid	1				1	1	1		1	3		1			1							3			3
Turtle Unidentified	4				4	4				4	2				2	4				4	3				3
Sawfish Unidentified	112	30	4		146	69	23	5	2	99	71	9	5		85	39	12			51	45	22			67

Source: NPFI, 2016, unpublished data

Marine Reptiles

Marine Turtles

All six species of marine turtles that occur in Australian waters are protected under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), and various State and Territory legislation. The Leatherback, Loggerhead and Olive Ridley turtle are each listed as endangered under the EPBC Act which means that these species may become extinct if the threats to their survival continue. The Green, Hawksbill and Flatback turtle are each listed as vulnerable, which means that they may become endangered if threats continue (DEH, 2003).

All six species were recorded within the NPF region (Table 22). Most turtle species are known to be highly migratory and widely distributed, occurring in most tropical waters of the Indo-Pacific region. There is one endemic species to northern Australia, the flatback turtle, with this species being the most common species recorded in the NPF (60% of the recorded turtles, Robins *et al.*, 2002 in Fry *et al.*, 2015).

Table 22. Marine turtle species with distributions on the NPF white banana prawn fishing grounds

Latin Name	Common name	CSIRO's PSA score (banana prawn subfishery)	Expert Opinion
<i>Caretta caretta</i>	Loggerhead turtle	2.85 (medium)	Low risk because TED allows escape;
<i>Chelonia mydas</i>	Green turtle	2.85 (medium)	Low risk because TED allows escape;
<i>Dermochelys coriacea</i>	Leathery turtle	2.85 (medium)	Low risk because TED allows escape;
<i>Natator depressus</i>	Flatback turtle	2.83 (medium)	Low risk because TED allows escape;
<i>Lepidochelys olivacea</i>	Olive Ridley turtle	2.95 (medium)	Low risk because TED allows escape;
<i>Eretmochelys imbricata</i>	Hawksbill turtle	2.95 (medium)	Low risk because TED allows escape;

International requirements. Marine turtles are recognised internationally as species of conservation concern. The six species found in Australia are listed in the 2000 IUCN Red List of Threatened Animals.

All marine turtle species occurring in Australian waters are listed on Appendix I of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). In addition, all marine turtles occurring in the Indo-Pacific region are a priority for conservation under the Convention on the Conservation of Migratory Species of Wild Animals (CMS, also known as the Bonn Convention). The flatback turtle is listed on Appendix

II of the CMS and the other species are listed on both Appendices I and II. Australia is also a signatory to the CMS *Memorandum of Understanding on the Conservation and Management of Marine Turtles and their Habitats of the Indian Ocean and South-East Asia*²⁴ (IOSEA MoU). The MoU is designed to facilitate national level and transboundary actions that will lead to the conservation of turtle populations and their habitats.

National requirements, as set in the Recovery Plan for Marine Turtles in Australia, 2003, were to reduce mortality of the marine turtles and increase natural survivorship, develop programs to monitor and assess the size and the status of the populations and identify and protect habitats that are critical to survival for marine turtles. A prescribed management action for the NPF was to monitor the effectiveness of turtle excluder devices (TEDs) for all vessels in the Northern Prawn Fishery. The prescribed criteria for success was that marine turtle capture and mortality declines to levels approaching 5% of 1989-90 levels (>5000 turtles captured per year); less for loggerhead turtles (DEH, 2003). This milestone has been surpassed, current level of interaction less than 100 per year in the NPF, and less than 15 per year in the white banana subfishery. The turtle recovery plan was constructed to meet the requirements of the EPBC plan, i.e. to minimize the interactions with turtle to a level where the populations sustainability is not affected and compulsory reporting of all interactions.

International requirements are integrated in the national requirements under the EPBC Act. The NPF has been accredited with export exemption under the EPBC Act, Part 13 and the NPF Management Plan was certified as meeting the requirements of the EPBC Act. There is a high degree of certainty that the effects of the white banana prawn subfishery are within limits of national and international requirements.

Direct and indirect impact. In the white banana prawn subfishery, there are considerably less interactions with turtles than the tiger prawn subfishery. In 2011-2015 period, there were usually less than 10 interactions per year, with a maximum of 14 interactions in 2013. Out of 41 turtles caught in this period, 39 were released alive. Although an identification guide is available for the crew member and species identification has been improved in recent years (Fry *et al.*, 2015), there is still a low number of turtles reported as unidentified (NPFI, 2016, unpublished data).

Since the introduction of TEDs in the NPF in 2000, catches of turtles have declined significantly (Brewer et al 2006). Brewer et al (2006) showed that TEDs were very effective at reducing the catches of turtles; excluding 99 – 100% of turtles from prawn nets with TEDs installed. It has been estimated that since the introduction of TEDs in the NPF, turtle catches have decreased from about 5,000 – 6,000 per year (Poiner and Harris 1996; Robins et al 2003, in Fry *et al.*, 2015) to current number of interactions (Brewer et al 2004, in Fry *et al.*, 2015).

Ongoing monitoring by fishery-dependent and fishery-independent programs have shown no apparent decline in turtle population, although at the current low level of catches when TEDs were used, a statistically significant trend analysis is not possible (Fry *et al.*, 2015). Fry *et al.*, 2015 concluded that although it is difficult to quantify the effect of trawling on turtles there is strong evidence to indicate current commercial prawn trawling practices of using TEDs has minimal impact on turtle species populations. Moreover, white banana trawls are short (30min) and turtles, if caught in the net are more likely to survive. The mortality on turtles from trawling has also been significantly reduced due to the effectiveness of TEDs at quickly removing these animals from the prawn trawl catch once they enter the net opening and travel down the net throat, thus, unobserved mortality is unlikely (Fry *et al.*, 2015).

²⁴ <http://www.ioseaturtles.org/>

All marine turtle species have been risk assessed from the banana prawn subfishery and the results were distributed to key biological researchers to provide expert opinion (see Table 22) (Griffiths *et al.*, 2007). Considering the results of the risk assessments (Griffiths *et al.* 2007) and CSIRO's sustainability assessments (Fry *et al.*, 2015), the low level of interactions, TEDs performance, the existence of protected area, there is a high degree of confidence that there are no significant detrimental direct effects of the white banana prawn subfishery on marine turtle populations. Indirect effects have been assessed at ERAEF level1, SICA, and were not considered to be unacceptable. The NPF does not overlap with key breeding or aggregation areas and it does not disrupt turtles' habitat. There is a high degree of confidence that there are no significant detrimental indirect effects of the white banana prawn subfishery on turtles.

Sea Snakes

All sea snakes are protected under the EPBC Act as 'marine'. There are no specific requirements and limits for sea snake species, other than minimising direct and indirect impacts and reporting of interactions. Sea snakes account for the highest number of the white banana prawn subfishery interactions with ETPs. Sea snake species likely to be encountered in the NPF area are presented in Table 23. None of these species is listed as endangered.

Table 23. Sea snake species with distributions on the NPF white banana prawn fishing grounds²⁵

Latin Name	Common name	CSIRO's PSA score	CSIRO's SAFE
<i>Acalyptophis peronii</i>	Horned sea snake	3.07 (medium)	Low risk
<i>Aipysurus duboisii</i>	Dubois' sea snake	3.07 (medium)	Low risk
<i>Aipysurus eydouxii</i>	Spine-tailed sea snake	2.95 (medium)	Low risk
<i>Aipysurus laevis</i>	Olive sea snake	2.70 (medium)	Low risk
<i>Astrotia stokesii</i>	Stokes' sea snake	3.07 (medium)	Low risk
<i>Hydrophis inornatus</i>	Plain sea snake	2.95 (medium)	Never recorded in catch
<i>Hydrophis ornatus</i>	Spotted sea snake	3.58 (high)	Low risk
<i>Disteira kingii</i>	Spectacled sea snake	3.07 (medium)	Low risk
<i>Disteira major</i>	Olive-headed sea snake	3.07 (medium)	Low risk
<i>Hydrelaps darwiniensis</i>	Black-ringed sea snake	2.95 (medium)	Low risk
<i>Hydrophis atriceps</i>	Black-headed sea snake	3.07 (medium)	Never recorded in catch
<i>Hydrophis belcheri</i>	Faint-banded sea snake	3.58 (high)	Never recorded in catch
<i>Hydrophis caeruleus</i>	Dwarf sea snake	2.95 (medium)	Never recorded in catch
<i>Hydrophis czeblukovi</i>	Fine-spined sea snake	2.95 (medium)	Low risk
<i>Hydrophis elegans</i>	Elegant sea snake	2.58 (low)	Low risk
<i>Hydrophis mcdowelli</i>	Small headed sea snake	2.95 (medium)	Low risk
<i>Hydrophis pacificus</i>	Large-headed sea snake	3.58 (high)	Low risk
<i>Lapemis curtus</i> (L. hardwickii)	Spine-bellied sea snake	3.17 (medium)	Low risk
<i>Enhydrina schistosa</i>	Beaked sea snake	2.47 (low)	Low risk

²⁵ <http://www.environment.gov.au/cgi-bin/sprat/public/spratlookupspecies.pl?name=seasnake&searchtype=Wildcard>

<i>Parahydrophis mertoni</i>	Northern mangrove sea snake	3.80 (high)	Never recorded in catch
<i>Pelamis platurus</i>	Yellow-bellied sea snake	3.07 (medium)	Low risk

Direct and indirect impact. Sea snakes continue to be caught in significant numbers in the white banana subfishery, as shown in logbooks data summarised in Table 23. In white banana subfishery, because of the short trawl duration (up to 30 min), snakes have more chances to survive than in tiger prawn subfishery or in red-legged banana prawn subfishery where trawl duration is approximately 3 hours. According to logbook reports, 80% of the sea snakes caught in 2011-2015 period were released alive.

In 2007-2008 all sea snakes recorded in the NPF were risk assessed from banana prawn subfishery at ERAEF level 2, PSA (Griffiths *et al.*, 2007). Sea snake species were also assessed at level 2.5, SAFE, focusing on tiger prawn subfishery where the risk is higher due to long trawl duration (Milton *et al.*, 2008b). Milton *et al.* (2008b) found that catch rates of most species have not shown a measurable change since the early 1970s and fishing mortality was well below maximum sustainable fishing mortality reference points. There appears to be a low risk from the NPF fishery overall on sea snake populations at the current trawl fleet size and fishing practices (Milton *et al.*, 2008b). Even the BRDs used in the NPF so far are not efficient in removing sea snake bycatch, this is compensated by the significant reduction in fishing effort, the low trawl footprint, the existence of permanently closed areas and the fact that all impacted species have wide distribution in unfished areas (Milton *et al.*, 2008b).

There is a high degree of certainty that effects of the fishery are within the national and international requirements. Species level identification for sea snakes is challenging for CMOs however, this is partially compensated for by the improvements in CMO training and data collections and catch trends were possible to be assessed for seven species. Direct effects from the white banana prawn subfishery are highly unlikely to create unacceptable impacts to sea snake species, although some uncertainty remains, since the interactions are not reported at species level. Indirect effects of the fishery have been considered during ERAEF at SICA level and it was concluded that these were not significant (Griffiths *et al.*, 2007). There is a high degree of confidence that there are no significant detrimental indirect effects of the white banana prawn subfishery on sea snake populations.

Crocodiles are known to occur in the NPF area although the configuration on the prawn trawl gear and the use of TEDs would prevent the large animals to enter the net and the smaller ones would be able to escape. There have been no reported or known interactions with crocodiles in the NPF white banana subfishery.

Marine mammals

Twenty species of cetaceans and the dugong (see Table 18) have been identified as potentially occurring in the NPF managed area (Griffiths *et al.*, 2007).

International requirements. Australia is party to the CITES convention that regulates international trade in endangered species and, as mentioned before, Australia applies stricter measures and considers all cetaceans listed in Appendix II as if they are listed in Appendix I. Australia is also a party to the CMS and signatory to a number of agreements and memoranda of understanding developed under the convention, including the *Memorandum of Understanding for the Conservation of Cetaceans and their habitats in the Pacific Islands Region*²⁶ and *Memorandum of Understanding (MoU) on the Conservation and Management*

²⁶ <http://www.cms.int/en/legalinstrument/pacific-islands-cetaceans>

of *Dugongs and their Habitats throughout their Range*²⁷. The requirements for these conventions are not to engage in trade on these protected species and minimise direct and indirect impact as to not further threat their survival and allow recovery. These requirements are integrated into the national requirements.

National Requirements. The blue whale is listed as endangered and the sperm whale and Irrawaddy dolphin are listed as vulnerable under the EPBC Act. Currently, apart from the blue whale recovery plan (DoE, 2015a), there are no species-specific requirements for these ETPs. One action required in the blue whale recovery plan that is relevant to fisheries and that is to minimise vessel collisions. Under the EPBC Act, all cetaceans (whales, dolphins and porpoises) are protected in Australian waters. The Australian Whale Sanctuary²⁸ includes all Commonwealth waters from the 3 nautical mile state waters limit out to the boundary of the Exclusive Economic Zone. Within the Sanctuary, it is an offence to kill, injure or interfere with a cetacean. Because the NPF was accredited with export approval under the EPBC Act, interaction with these species is not an offence if fishing operations are consistent with the NPF management Plan. Fishers are required to report all interactions in logbooks (AFMA, 2017).

Based on the NPF assessments by the DoE, and the very low level of interactions, there is a high degree of confidence that the effects of the white banana prawn subfishery on marine mammals are within limits of national and international requirements.

Direct and indirect impact. Whales and dugong interactions have never been recorded in the NPF history. Trawlers operate at relatively low speeds (3.24 knots average, Bishop, 2003 in Zhou, 2011). At such speeds, it is highly unlikely that any big size cetacean or dugong will be seriously injured if they would come in direct contact with a trawler. Vanderlaan and Taggart (2007) found that the speed a ship is travelling when it strikes a whale is directly linked to the severity of the injury the whale will sustain and at trawler's speed, the probability for serious injury is very low (<5%) (Figure 30). No dolphin interactions were reported in white banana prawn subfishery in 2011-2015 period.

All marine mammal species have been risk assessed from banana prawn subfishery at Level 2 PSA within the ERAEF framework in 2007. All, but the common dolphin, which scored 'low risk', scored as 'medium risk' which was downgraded by expert override by NPRAG. The reason for downgrade was for most species, they are too large to be caught in a prawn trawl and for the smaller species, TEDs allow escape (Griffiths *et al.*, 2007).

Dolphins are known to follow prawn trawlers and feed on discarded bycatch (Wassenberg & Hill, 1990; Hill & Wassenberg, 2000, Svane, 2005). There is no clear evidence to demonstrate this would be harmful for dolphin populations (Svane, 2005). Chilvers and Corkeron (2001), showed that bottlenose dolphin may form different social structures with certain groups following trawls and others foraging in seagrass. This would suggest, according to the authors, that trawling can have different impact on different groups of dolphins and seasonal closures of the fishery would affect trawler foragers by food depletion (Chilvers and Corkeron, 2001). Ansmann *et al.*, 2012, however, have found that social structures are not fixed but they represent a "complex adaptive system that is resilient to disturbance". White banana prawn trawling indirect effects on dolphins' behavior have been assessed at SICA and considered negligible because discarding is very limited spatially (Griffiths *et al.*, 2007).

Considering the results of the risk assessments (Griffiths *et al.* 2007), the low speed of the trawler, the use TEDs, the existence of protected areas, there is a high degree of confidence

²⁷ <http://www.cms.int/en/legalinstrument/dugong>

²⁸ <http://www.environment.gov.au/marine/marine-species/cetaceans/australian-whale-sanctuary>

that there are no significant detrimental direct or indirect effects of the white banana prawn subfishery on marine mammal populations.

Seabirds

National and international requirements. All seabirds are protected under the EPBC Act. None of the 12 species of birds (see Table 19) that have been identified in the NPF area at ERAEF, are listed as threaten under the EPBC Act. All species are listed as marine and some are listed under one or more of the agreements: Jamba, Camba and Rokamba²⁹. None of these species are on listed on Appendix I of CITES. There are no specific limits and requirements defined for these species. The only requirements are to minimize direct and indirect impacts of the fishery on marine bird species.

Direct impact. Previous research has shown that the islands in the southern gulf support large breeding colonies of the crested tern (*Sterna bergii*), least frigatebird (*Fregata ariel*), brown booby (*Sula leucogaster*) and roseate tern (*Sterna dougallii*) as well as small colonies of other species (Garnett and Crowley 1987a, 1987b; Walker 1992, in Blaber & Milton, 1994). There are also significant roosts of the least frigatebird at Weipa and Mornington Island (Blaber & Milton, 1994). No bird interactions have been reported in the white banana prawn subfishery (NPF, 2016, unpublished data), although the risk for direct impact may be higher in white banana prawn subfishery than in the tiger prawn subfishery because the fishing operations take place day and night.

All marine bird species have been risk assessed from banana prawn subfisheries, at ERAEF level 2, PSA, and apart from the streaked shearwater (medium risk) all scored low risk. Streaked shearwater scored medium risk due to missing of several productivity attributes, while susceptibility score was low. The score was downgraded by NPFRAG experts based on the species never being captured (Griffiths *et al.*, 2007). There is a high degree of confidence that there are no significant detrimental direct effects of the white banana prawn subfishery on marine birds.

Indirect impact. Indirect effects on bird populations have been considered at SICA, level 1 of the ERAEF process and it was concluded that although the NPF prawn trawls do not impact on birds, the trawl discards may significantly affect the behavior and movements of the populations of birds. The effect on birds of the significant reduction in food availability during the closed season when discards are not available, is unknown (Griffiths *et al.*, 2007). The quantity of discards in the white banana subfishery is usually lower than in the tiger prawn subfishery and with the significant reduction of the NPF fishing effort in recent decades and the use of BRDs led to reductions in discards. Indirect effects from white banana subfishery are highly unlikely to create unacceptable impact to marine birds, however, because there have been no studies of population trends in bird species that actively feed on discards, some uncertainty remains.

Elasmobranchs

Sawfish

According to the DoEE's website³⁰, in Australia, five species of sawfish are found and three of these, the largetooth sawfish, green sawfish and the dwarf sawfish, are currently listed as vulnerable under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). For one species, *P. pectinate* (smalltooth sawfish), it's distribution in

²⁹ http://www.environment.gov.au/biodiversity/migratory-species/migratory-birds#International_cooperation

³⁰ <http://www.environment.gov.au/marine/marine-species/sharks/sawfish>

Australian waters needs confirmation. All *Pristis* species are EPBC listed as migratory and are declared endangered (narrow and dwarf sawfish) or critically endangered (smalltooth, largetooth and green sawfish) on the IUCN Red List³¹. Although sawfish species are endangered globally, the Australian sawfish populations are probably the healthiest in the world (Stevens *et al.*, 2008).

Four species were recorded in the NPF managed area (see Table 24). Like the tiger prawn subfishery, the white banana prawn subfishery interacts with all four species but only the narrow and the green sawfish were commonly caught during fishery independent surveys, the other two species being exceptionally rare.

Table 24. Sawfish species potentially occurring in the NPF managed area and risk assessment scores from the banana prawn subfishery (PSA) and from the NPF overall (SAFE)

Latin name	Common name	CSIRO's PSA score (Griffiths <i>et al.</i> , 2007)	CSIRO's SAFE score (Brewer <i>et al.</i> , 2007; Zhou & Griffiths, 2008; Zhou, 2011)
<i>Pristis clavata</i>	Dwarf sawfish	3.19 (high)	Low risk
<i>Pristis pristis</i>	Largetooth (freshwater) sawfish	3.19 (high)	Low risk
<i>Pristis zijsron</i>	Green sawfish	3.31 (high)	Low risk
<i>Anoxypristis cuspidata</i>	Narrow sawfish	3.31 (high)	Low risk

International requirements. All sawfish species, family Pristidae, are listed in CITES Appendix I, trade in these species or any products from sawfish being prohibited. They are also listed in both CMS Appendix I (endangered migratory species) and Appendix II (migratory species conserved through agreements)³². Australia is a signatory country for the CMS *Memorandum of Understanding on the Conservation of Migratory Sharks*³³ which includes sawfish species and aims to achieve favourable conservation status for the species concerned, throughout their range. CITES requirements are met because the NPF was accredited with export approval under the EPBC Act Part 13 that prohibits trade in species listed in Appendix I of CITES. The CMS requirements are integrated in the national requirements.

National requirements. A combined recovery plan for the three sawfish species listed as vulnerable under the EPBC Act and two species of river shark, was released in November 2015 (DoE, 2015b). The recovery plan considers international requirements for conservation of sawfish across their range, and identifies actions to be taken, to ensure long-term sustainability of the species (DoE, 2015b).

Most of the actions required by the recovery plan, that are relevant to commercial trawl fisheries, are already in place in the NPF management and apply to the white banana prawn subfishery as well as for the other two subfisheries. To summarise, these actions refer to:

- compliance to the management measures to minimise direct and indirect effects on populations,

³¹ <http://www.iucnredlist.org>

³² <http://www.cms.int/en/page/appendix-i-ii-cms>

³³ <http://www.cms.int/sharks/>

- creating new managements arrangements to further mitigate adverse impacts,
- improving monitoring and data validation,
- improving fishers' awareness on sawfish conservation needs and training in species identification (DoE, 2015b).

How the NPF responds to these actions was detailed for the tiger prawn subfishery, above.

There is a high degree of confidence that the NPF white banana prawn subfishery's effects on sawfish species are within the limits of national and international requirements.

Direct and indirect effects. In the white banana prawn subfishery, over 750 sawfish interactions were reported for the period 2011-2015, with over 80% of animals released alive. *Anoxypristis cuspidata* was the most common sawfish species recorded in the NPF, around 97% of all sawfish captured during monitoring programs were from this one species. The distribution of *Anoxypristis cuspidata* was widespread, from western Joseph Bonaparte Gulf to Weipa in the east. Catch rates were similar between banana and tiger prawn seasons. (Fry *et al.*, 2015).

Monitoring programs indicate that catches of the different species of sawfish are remaining constant. It is difficult to determine statistically significant trends though, because of the low number of interactions. With ongoing monitoring, the power of analysis will increase and the uncertainty in trends will be reduced (Fry *et al.*, 2015).

Sawfish species were risk assessed at ERAEF level 2, PSA, from the white banana prawn subfishery, and at level 2.5, SAFE, cumulatively with the risk from the tiger prawn subfishery (Griffiths *et al.*, 2007; Zhou & Griffiths in 2008; Zhou in 2011). Although sawfish species scored as high risk at PSA, at SAFE, which is a higher level, more quantitative assessment, using species attributes and the actual fishing impact, sawfish scored low risk, even when the uncertainty was considered (90% Confidence Interval). Sawfish species continue to be monitored and AFMA and the NPF are committed to improve species identification and find ways to eliminate sawfish bycatch.

There is a high degree of confidence there are no significant direct effects from the white banana prawn subfishery on narrow sawfish. Direct effects from the white banana prawn fishery are highly unlikely to create unacceptable impacts to the other three sawfish species, although some uncertainty remains, since not all the interactions are not reported at species level and a clear differentiation of the level of impact on green sawfish (vulnerable) from the impact on narrow sawfish (not vulnerable) is not possible.

Indirect effects on sawfish populations, such as interfering with their feeding or breeding behaviour, where considered low at ERA Level 1, SICA (green sawfish was assessed under a "worst scenario" approach, Griffiths *et al.*, 2007). In addition, sawfish pupping grounds are entirely within permanently closed areas. There is a high degree of confidence there are no significant detrimental indirect effects from the NPF white banana prawn subfishery on sawfish species.

No interactions with ETP elasmobranch species other than sawfish have been recorded in logbooks or monitoring surveys for the tiger prawn subfishery.

Teleost (Syngnathids and Solenostomids)

The NPF interacts with ETP teleost species from the families Syngnathidae (seahorses, seadragons, pipefishes and pipehorses) and Solenostomidae (ghost pipefish). Forty-four species of syngnathids and solenostomids were identified as potentially occurring in the NPF managed area (Griffiths *et al.*, 2007) but only two species are commonly caught, the pipefish

Trachyrhamphus longirostris and the seahorse *Hippocampus histrix* (Fry *et al.*, 2015). However, in the white banana subfishery, interactions with these syngnathids and solenostomids are exceptionally rare because of the specific fishing method above the sea bottom.

National and International Requirements. Families Syngnathidae and Solenostomidae are EPBC listed as marine, since 2001. It is an offence to kill, injure, take or trade syngnathids and solenostomids in, or from, a Commonwealth area. Actions undertaken in accordance with an accredited management regime such as the NPF Management Plan, or in accordance with a permit under which the action is approved, are not an offence. If interactions with these species occur, and it does not constitute an offence under the Act and it was not authorised by a permit, then the EPBC Act requires that the interaction be reported. *Hippocampus spp.* from family Syngnathidae are listed on CITES Appendix II, their international trade being regulated³⁴. There are no other international requirements for syngnathids and solenostomids.

Because the NPF was granted export approval by the Department of the Environment until 2019 and because the NPF Management Plan was accredited under the EPBC Act by the DoE, any activity that is conducted according to the plan meet national and international requirements. Under this management plan, in the NPF white banana prawn subfishery all interactions with syngnathids and solenostomids are compulsorily reported and caught animals are quickly returned to the water. There is a high degree of certainty that the effects of the NPF white banana prawn subfishery are within limits of national and international requirements.

Direct and indirect impacts. Most species of syngnathids and solenostomids have a strong association with the site, presumably with localised reproduction, although some solenostomids, such as the blue-finned ghost pipefish, may have a prolonged larval stage that may permit longer range dispersal (Kuitert 2009 in DSEWPaC, 2012). Because white banana prawn fishing occurs off the sea bottom, the likelihood of capture for these groups is very low, which is shown in very low level of interaction (8 individuals in a 5year period see Table 21).

A trend analysis of catch rate for *T. longirostris* (most commonly caught) has shown no decline over the years. A permit has been issued to NPM by the DoEE³⁵ for CMOs to take, keep and move up to 150 landed dead syngnathids for CSIRO species identification. This is a replacement of a previously held permit to collect 100 specimens. The collection of specimens will allow proper identification and collection of life-history information for each species of syngnathid the tiger prawn subfishery interacts with.

Syngnathids and solenostomids were risk assessed within the ERAEF framework. The level 2 assessment (PSA), considered all species of syngnathids and solenostomids potentially occurring in the NPF area and the risk was assessed separately from the tiger prawn subfishery and from the banana prawn subfishery. All species scored as low risk from the banana prawn fishery. At the level 2.5 assessment, SAFE, only the species that have been recorded as captured by the NPF were included *Trachyrhamphus longirostris*, *Hippocampus queenslandicus* and *Filicampus tigris* (Griffiths *et al.*, 2007). At SAFE assessment syngnathid species scored low risk from tiger prawn and banana prawn subfisheries cumulatively (Zhou & Griffiths, 2008, Zhou, 2011). All syngnathids and solenostomids that occur in the NPF area have wide distributions in unfished areas and most species have preference for structured habitats (usually seagrass beds or reef habitat) that occur within permanently closed areas.

Indirect effects on syngnathids and solenostomids were assessed at ERAEF level 1 (SICA) when assessing TEP component (threaten, endangered and protected) and they were not

³⁴ <https://cites.org/eng/app/appendices.php>

³⁵ <http://www.environment.gov.au/biodiversity/threatened/permits/e2016-0127>

considered unacceptable. Breeding habitats for syngnathids and solenostomids are sheltered areas of seagrass or coral reef/ rubble, which are inaccessible to prawn trawling or protected in permanently closed areas. The syngnathids and the solenostomids eat small invertebrates and fish larvae, thus the populations are not likely to be affected by the white banana prawn subfishery's removals. There is a high degree of confidence that the white banana prawn subfishery does not produce significant detrimental direct and indirect effects on syngnathids and solenostomids.

Red-Legged Banana Prawn Subfishery (one UoA: red-legged banana prawn)

For the period 2011-2015, red-legged banana prawn subfishery reported about three times less interactions with ETPs than tiger prawn subfishery, with more than 80% of the animals released alive. As for the tiger prawn subfishery, the most commonly caught group was sea snakes. Table 25 shows the number of ETP interactions and the status of the animals released/discarded (NPFI, 2016, unpublished data).

Table 25. 2011-2015 interactions of the red-legged banana prawn subfishery with Endangered Threatened or Protected species (ETPs).

Red-Legged Banana Prawn Subfishery																									
TEP Species	2011					2012					2013					2014					2015				
	Alive	Perished	Injured	Unknown	Total	Alive	Perished	Injured	Unknown	Total	Alive	Perished	Injured	Unknown	Total	Alive	Perished	Injured	Unknown	Total	Alive	Perished	Injured	Unknown	Total
Dolphin							1			1															
Flatback Turtle											1				1										
Green Sawfish	1	1			2	2				2	7	1	1		9	8	3			11					
Narrow Sawfish	2				2						8	1	4		13										
Sea snake	117	15			132	38	1			39	357	62	5	9	433	672	155	7		834	61	28			89
Turtle Unidentified	1				1											1				1					
Sawfish Unidentified	17	5	3		25	1				1	29	2	2		33	17	5	6		28		2			2

Source: NPFI, 2016, unpublished data

Marine Reptiles

Turtles

All six species of marine turtles that occur in Australian waters are protected under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), and various State and Territory legislation. The leatherback, loggerhead and Olive Ridley turtle are each listed as endangered under the EPBC Act which means that these species may become extinct if the threats to their survival continue. The green, hawksbill and flatback turtle are each listed as vulnerable, which means that they may become endangered if threats continue (DEH, 2003).

All six species were recorded within the NPF region (Table 16 and Table 22). Most turtle species are known to be highly migratory and widely distributed, occurring in most tropical waters of the Indo-Pacific region. There is one endemic species to northern Australia, the flatback turtle, with this species being the most common species recorded in the NPF (60% of the recorded turtles, Robins *et al.*, 2002 in Fry *et al.*, 2015)

International requirements. Marine turtles are recognised internationally as species of conservation concern. The six species found in Australia are listed in the 2000 IUCN (World Conservation Union) Red List of Threatened Animals.

All marine turtle species occurring in Australian waters are listed on Appendix I of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). In addition, all marine turtles occurring in the Indo-Pacific region are a priority for conservation under the Convention on the Conservation of Migratory Species of Wild Animals (CMS, also known as the Bonn Convention). The flatback turtle is listed on Appendix II of the CMS and the other species are listed on both Appendices I and II. Australia is also a signatory to the CMS *Memorandum of Understanding on the Conservation and Management of Marine Turtles and their Habitats of the Indian Ocean and South-East Asia*³⁶ (IOSEA MoU). The MoU is designed to facilitate national level and transboundary actions that will lead to the conservation of turtle populations and their habitats.

National requirements, as set in the Recovery Plan for Marine Turtles in Australia, 2003, were to reduce mortality of the marine turtles and increase natural survivorship, develop programs to monitor and assess the size and the status of the populations and identify and protect habitats that are critical to survival for marine turtles. A prescribed management action for the NPF was to monitor the effectiveness of turtle excluder devices (TEDs) for all vessels in the Northern Prawn Fishery. The prescribed criteria for success was that marine turtle capture and mortality declines to levels approaching 5% of 1989-90 levels (>5000 turtles captured per year); less for loggerhead turtles (DEH, 2003). This milestone has been surpassed (current level of interaction < 100 per year in the NPF, <1 per year for red-legged banana subfishery). The turtle recovery plan was constructed to meet the requirements of the EPBC plan, i.e. to minimize the interactions with turtle to a level where the populations sustainability is not affected and compulsory reporting of all interactions.

International requirements are integrated in the national requirements under the EPBC Act. The NPF has been accredited with export exemption under the EPBC Act, Part 13 and the NPF Management Plan was certified as meeting the requirements of the EPBC Act. There is a high degree of certainty that the effects of the red-legged banana prawn subfishery are within limits of national and international requirements.

Direct and indirect impact. In the red-legged banana prawn subfishery, where fishing effort is much lower than in the other two NPF subfisheries, the level of interaction with turtles is also very low. Only three turtle interactions were reported in the red-legged banana subfishery in the period 2011-2015, which were released alive (NPFI, 2016, unpublished data). One of the interactions was with a flatback turtle, while for the other two, the species was not identified.

³⁶ <http://www.ioseaturtles.org/>

Since the introduction of TEDs in the NPF in 2000, catches of turtles have declined significantly (Brewer et al 2006). Brewer et al (2006) showed that TEDs were very effective at reducing the catches of turtles; excluding 99 – 100% of turtles from prawn nets with TEDs installed. It has been estimated that since the introduction of TEDs in the NPF, turtle catches have decreased from about 5,000 – 6,000 per year (Poiner and Harris 1996; Robins et al 2003, in Fry *et al.*, 2015) to current number of interactions (Brewer et al 2004, in Fry *et al.*, 2015). In the JBG, 68 turtle interactions have been recorded in logbooks in 1998 and 1999 but only 11 after the introduction of TEDs (2000-2012, Jarrett *et al.*, 2015).

There is a high degree of confidence that there are no significant detrimental direct effects of the red-legged banana prawn subfishery on marine turtle populations.

Indirect effects have been assessed at ERAEF level1, SICA, and were not considered to be unacceptable. The NPF does not overlap with key breeding or aggregation areas and it does not disrupt turtles' habitat. There is a high degree of confidence that there are no significant detrimental indirect effects of the red-legged banana prawn subfishery on turtles.

Sea snakes

All sea snakes are protected under the EPBC Act as “marine”. There are no specific requirements and limits for sea snake species, other than minimising direct and indirect impacts and reporting of interactions. As for the other two subfisheries, sea snakes account for the highest number of the red-legged banana prawn subfishery interactions with ETPs. Sea snake species encountered in the JBG area are presented in Table 26. None of these species is listed as endangered.

Table 26. Sea snake species recorded in the red-legged banana subfishery (Jarrett *et al.*, 2015)

Latin Name	Common name
<i>Acalyptophis peronii</i>	Horned sea snake
<i>Aipysurus duboisii</i>	Dubois' sea snake
<i>Aipysurus eydouxii</i>	Spine-tailed sea snake
<i>Aipysurus laevis</i>	Olive sea snake
<i>Astrotia stokesii</i>	Stokes' sea snake
<i>Hydrophis ornatus</i>	Spotted sea snake
<i>Disteira kingii</i>	Spectacled sea snake
<i>Disteira major</i>	Olive-headed sea snake
<i>Hydrophis elegans</i>	Elegant sea snake
<i>Hydrophis mcdowelli</i>	Small headed sea snake
<i>Hydrophis pacificus</i>	Large-headed sea snake
<i>Lapemis curtus (L. hardwickii)</i>	Spine-bellied sea snake
<i>Enhydrina schistosa</i>	Beaked sea snake

Direct and indirect impact. Sea snakes continue to be caught in significant numbers in the red-legged banana subfishery, although this number is much lower than in the tiger and white banana subfisheries, as shown in logbooks data summarised in Table 25. More than 80% of the snakes caught between 2011-2015 were released alive. Milton *et al.*, 2008b, analysed survival rates and factors that influenced survival, for sea snakes caught in tiger prawn subfishery and found that the use of TEDs has led to 13% reduction in sea snake post-capture mortality due to exclusion of large bodied animals are excluded from the catch thus, the snakes are less likely to be compressed (Milton *et al.*, 2008b). This most likely apply to the red-legged banana subfishery because the fishing method and the trawl duration in the two subfisheries are similar.

The crew members from the CMO program were trained in data collection and recording, photographing and safe handling practices for dangerous sea snakes. Even though the quality of data collection by the CMOs has improved, with now more than 80% of all ETP and 'at risk' bycatch species being photographed for species identifications by scientific staff, in logbooks, there is still a high number of sea snake interactions reported as 'unidentified'.

In 2007-2008 all sea snakes recorded in the NPF were risk assessed from the tiger prawn subfishery and banana prawn subfisheries at ERAEF level 2, PSA (Griffiths *et al.*, 2007), and at level 2.5, SAFE (Milton *et al.*, 2008b). As the fishing method in the red-legged banana subfishery is more similar to the tiger prawn subfishery method, the level of risk to sea snakes is similar. At SAFE analysis, Milton *et al.* (2008b) found that catch rates of most species have not shown a measurable change since the early 1970s and fishing mortality was well below maximum sustainable fishing mortality reference points for all species of snakes.

Even the BRDs used in the NPF so far are not efficient in removing sea snake bycatch, this is compensated by the significant reduction in fishing effort, the low trawl footprint, the existence of permanently closed areas and the fact that all impacted species have wide distribution in unfished areas (Milton *et al.*, 2008b). Species level identification for sea snakes is challenging for crew members however this is partially compensated for by the improvements in CMO training and data collections and catch trends were possible to be assessed for seven species.

Direct effects from the red-legged prawn subfishery are highly unlikely to create unacceptable impacts to sea snake species, although some uncertainty remains, since the interactions are not reported at species level.

Indirect effects of the fishery have been considered during ERAEF at SICA level and it was concluded that these were not significant (Griffiths *et al.*, 2007). There is a high degree of confidence that there are no significant detrimental indirect effects of the red-legged banana prawn subfishery on sea snake populations.

Crocodiles are known to occur in the NPF area although the configuration on the prawn trawl gear and the use of TEDs would prevent the large animals to enter the net and the smaller ones would be able to escape. There have been no reported or known interactions with crocodiles in the NPF red-legged banana subfishery.

Marine mammals

Twenty species of cetaceans and the dugong (see Table 18) have been identified as potentially occurring in the NPF managed area (Griffiths *et al.*, 2007).

International requirements. Australia is party to the CITES convention that regulates international trade in endangered species and Australia applies stricter measures and considers all cetaceans listed in Appendix II as if they are listed in Appendix I. Australia is also a party to the CMS and signatory to a number of agreements and memoranda of understanding developed under the convention, including the *Memorandum of Understanding for the Conservation of Cetaceans and their habitats in the Pacific Islands Region*³⁷ and *Memorandum of Understanding (MoU) on the Conservation and Management of Dugongs and their Habitats throughout their Range*³⁸. The requirements for these conventions are not to engage in trade on these protected species and minimise direct and indirect impact as to not further threaten their survival and allow recovery. These requirements are integrated into the national requirements.

National Requirements. The blue whale is listed as endangered and the sperm whale and Irrawaddy dolphin are listed as vulnerable under the EPBC Act. Currently, apart from the blue whale recovery plan (DoE, 2015a), there are no species-specific requirements for these ETPs. One action required in the blue whale recovery plan that is relevant to fisheries is to minimise vessel collisions. Under the EPBC Act, all cetaceans (whales, dolphins and porpoises) are protected in Australian waters. The Australian Whale Sanctuary includes all Commonwealth waters from the 3 nautical mile state waters limit out to the boundary of the Exclusive Economic Zone within the Sanctuary it is an offence to kill, injure or interfere with a cetacean³⁹. Because the NPF was accredited with export approval under the

³⁷ <http://www.cms.int/en/legalinstrument/pacific-islands-cetaceans>

³⁸ <http://www.cms.int/en/legalinstrument/dugong>

³⁹ <http://www.environment.gov.au/marine/marine-species/cetaceans/australian-whale-sanctuary>

EPBC Act, interaction with these species is not an offence if fishing operations are consistent with the NPF management Plan. Fishers are required to report all interactions in logbooks (AFMA, 2017).

Based on the NPF assessments by the Department of Environment, and the very low level of interactions, there is a high degree of confidence that the effects of the red-legged banana prawn subfishery on marine mammals are within limits of national and international requirements.

Direct and indirect impact. Whales and dugong interactions have never been recorded in the NPF history. Trawlers operate at relatively low speeds (3.24 knots average, Bishop, 2003 in Zhou, 2011). At such speeds, it is highly unlikely that any big size cetacean or dugong will be seriously injured if they would come in direct contact with a trawler. Vanderlaan and Taggart (2007) found that the speed a ship is travelling when it strikes a whale is directly linked to the severity of the injury the whale will sustain and at trawler's speed, the probability for serious injury is very low (<5%) (Figure 30). In the red-legged banana fishery, one interaction with a dolphin was reported for 2012 (NPFI, 2016, unpublished).

All marine mammal species have been risk assessed at Level 2 PSA from the tiger prawn subfishery and for the banana prawn subfishery within the ERAEF framework in 2007. The risk from the red-legged banana subfishery has been included in the risk estimation for the other two subfisheries, as at the time of the risk assessment the subfisheries were classified according to fishing season (banana and tiger). All, but the common dolphin, which scored "low risk", scored "medium risk" which was then downgraded by expert override by the NPFRAG. The reason for downgrade was for most species, they are too large to be caught in a prawn trawl and for the smaller species, TEDs allow escape (Griffiths *et al.*, 2007). The remaining interactions with dolphins usually occur at the cod's drawstrings or in try nets (small nets that can be used when searching for prawns) which do not have TEDs (AFMA's ETPs quarterly reports to the DoEE).

Dolphins are known to follow prawn trawlers and feed on discarded bycatch (Wassenberg & Hill, 1990; Hill & Wassenberg, 2000, Svane, 2005). There is no clear evidence to demonstrate this would be harmful for dolphin populations (Svane, 2005). Chilvers and Corkeron (2001), showed that bottlenose dolphin may form different social structures with certain groups following trawls and others foraging in seagrass. This would suggest, according to the authors, that trawling can have different impact on different groups of dolphins and seasonal closures of the fishery would affect trawler foragers by food depletion (Chilvers and Corkeron, 2001). Ansmann *et al.*, 2012, however, have found that social structures are not fixed but they represent a "complex adaptive system that is resilient to disturbance". Trawling indirect effects on dolphins' behavior have been assessed at SICA and considered negligible because discarding is very limited spatially (Griffiths *et al.*, 2007), and this is true especially for the red-legged banana subfishery because the fishing effort is much lower than in the other two subfisheries.

Considering the results of the risk assessments (Griffiths *et al.* 2007), the low speed of the trawler, the use TEDs, the existence of protected areas, there is a high degree of confidence that there are no significant detrimental direct or indirect effects of the red-legged banana prawn subfishery on marine mammal populations.

Seabirds

National and international requirements. All seabirds are protected under the EPBC Act. None of the 12 species of birds (see Table 19) that have been assessed at ERAEF level 2, PSA, are listed as threaten under the EPBC Act. All species are listed as marine and some are listed under one or more of the agreements: Jamba, Camba and Rokamba⁴⁰. None of these species are on listed on Appendix I of CITES. There are no specific limits and requirements defined for these species. The only requirements are to minimize direct and indirect impacts of the fishery on marine bird species.

Direct impact. The only data available on the distribution of these marine bird species is very outdated but it may still be relevant. Previous research has shown that the islands in the southern gulf support

⁴⁰ http://www.environment.gov.au/biodiversity/migratory-species/migratory-birds#International_cooperation

large breeding colonies of the crested tern (*Sterna bergii*), least frigatebird (*Fregata ariel*), brown booby (*Sula leucogaster*) and roseate tern (*Sterna dougallii*) as well as small colonies of other species (Garnett and Crowley 1987a, 1987b; Walker 1992, in Blaber & Milton, 1994). There are also significant roosts of the least frigatebird at Weipa and Mornington Island (Blaber & Milton, 1994). The CSIRO undertook two summer cruises in 1990 and 1991 to study the fish and benthos of the Gulf of Carpentaria and at the same time, a census of the seabirds was conducted (Blaber & Milton, 1994). During the surveys, only the crested tern, common tern (*Sterna hirundo*), lesser frigatebird and the brown booby followed the trawls and actively fed on discards. The common tern was not in the list of birds identified at the ERAEF process in 2007. The species is a seasonal visitor during summer and it does not breed in the NPF area.

All marine bird species have been risk assessed from the tiger and banana prawn subfisheries, at ERAEF level 2, PSA, and apart from the streaked shearwater (medium risk) all scored low risk. Streak shearwater scored medium risk due to missing of several productivity attributes, while susceptibility score was low. The score was downgraded by NPFRAG experts based on the species never being captured (Griffiths *et al.*, 2007). This level of risk is probably conservative for the red-legged banana fishery where the fishing effort is much lower. The risk from this subfishery was included in the PSA assessment for the tiger and banana subfisheries because at the time of the assessment fishing activity in the NPF was classified according to the two seasons, with red-legged banana not considered a separate subfishery. There is a high degree of confidence that there are no significant detrimental direct effects of the red-legged banana prawn subfishery on marine birds.

Indirect impact. Indirect effects on bird populations have been considered at SICA, level 1 of the ERAEF process and it was concluded that the trawl discards may significantly affect the behavior and movements of the populations of birds. The effect on birds of the significant reduction in food availability during the closed season when discards are not available, is unknown (Griffiths *et al.*, 2007).

Seabirds scavenging near fishing vessels, are commonly observed around the world. However, there is little information on the relative importance of discarded by-catch as food and the natural availability of food sources. The number of seabirds scavenging in the Gulf of Carpentaria has not been studied. Studies in Torres Strait Prawn Fishery in the northern Great Barrier Reef showed that only a minor part of prawn trawlers discards is consumed by birds and this occurred mainly during the day (Hill & Wassenberg, 1990; Hill & Wassenberg, 2000). In Torres Strait area (the closest to the NPF area), common and crested terns and lesser and greater frigatebirds were feeding on discards during the day. In tiger prawn subfishery this bird species can only feed for a short time at dusk, because the fishery operates at night (Griffiths *et al.*, 2007). Svane, studying the fate of discards from Spencer Gulf Prawn Fishery, reported a correlation between trawl intensity and bird abundance (Svane, 2005). As trawl intensity is very low in the red-legged banana subfishery, as well as the subfishery's footprint, this risk is minimal.

Indirect effects from the red-legged banana subfishery are highly unlikely to create unacceptable impact to marine birds, however, because there have been no studies of population trends in bird species that actively feed on discards, some uncertainty remains.

Elasmobranchs

Sawfish

According to the DoEE's website⁴¹, in Australia, five species of sawfish are found and three of these, the largetooth sawfish, green sawfish and the dwarf sawfish, are currently listed as vulnerable under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). For one species, *P. pectinate* (smalltooth sawfish), it's distribution in Australian waters needs confirmation. All *Pristis* species are EPBC listed as migratory and are declared endangered (narrow and dwarf sawfish) or

⁴¹ <http://www.environment.gov.au/marine/marine-species/sharks/sawfish>

critically endangered (smalltooth, largetooth and green sawfish) on the IUCN Red List⁴². Although sawfish species are endangered globally, the Australian sawfish populations are the probably the healthiest in the world (Stevens *et al.*, 2008).

Four species were recorded in the NPF managed area (see Table 20). The red-legged banana subfishery reported interactions with two of these species, *Anoxypristis cuspidata* or narrow sawfish (15 in 2011-2015) and *Pristis zijsron*, or green sawfish (24 in 2011-2015), although most interactions were reported as “unidentified” (89 in 2011-2015).

International requirements. All sawfish species, family Pristidae, are listed in CITES Appendix I, trade in these species or any products from sawfish being prohibited. They are also listed in both CMS Appendix I (endangered migratory species) and Appendix II (migratory species conserved through agreements)⁴³. Australia is a signatory country for the CMS *Memorandum of Understanding on the Conservation of Migratory Sharks*⁴⁴ which includes sawfish species and aims to achieve favourable conservation status for the species concerned, throughout their range. CITES requirements are met because the NPF was accredited with export approval under the EPBC Act Part 13 that prohibits trade in species listed in Appendix I of CITES. The CMS requirements are integrated in the national requirements.

National requirements. A combined recovery plan for the three sawfish species listed as vulnerable under the EPBC Act and two species of river shark, was released in November 2015 (DoE, 2015b). The recovery plan considers international requirements for conservation of sawfish across their range, and identifies actions to be taken, to ensure long-term sustainability of the species (DoE, 2015b). Most of the actions required by the recovery plan, that are relevant to commercial trawl fisheries, are already in place in the NPF management (see tiger prawn subfishery).

There is a high degree of confidence that the red-legged banana prawn subfishery’s effects on sawfish species are within the limits of national and international requirements.

Direct and indirect effects. *Anoxypristis cuspidata* was the most common sawfish species recorded in the NPF, around 97% of all sawfish captured during monitoring programs were from this one species. The distribution of *Anoxypristis cuspidata* was widespread, from western Joseph Bonaparte Gulf to Weipa in the east. It is very likely that most “unidentified” interactions were with this species. The second most common species, *Pristis zijsron*, was rarely recorded during fishery independent programs but was recorded more often during the crew-member observer program (Fry *et al.*, 2015).

Monitoring programs indicate that catches of the different species of sawfish are remaining constant. It is difficult to determine statistically significant trends though, because of the low number of interactions. With ongoing monitoring, the power of analysis will increase and the uncertainty in trends will be reduced (Fry *et al.*, 2015).

Sawfish species were risk assessed at ERAEF level 2, PSA and 2.5, SAFE (Griffiths *et al.*, 2007; Zhou *et al.*, 2015). PSA assessed the risk from the tiger prawn and the banana prawn subfisheries separately but red-legged banana subfishery was not considered on its own (Griffiths *et al.*, 2007). However, SAFE assessments were undertaken for teleosts and elasmobranchs specifically for this subfishery (Zhou *et al.*, 2015). Sawfish species were included in the SAFE for elasmobranchs. No species of elasmobranchs, including sawfish, had an estimated fishing mortality rate greater than their F_{msm} (fishing mortality at MSY), even when the uncertainty was considered (Zhou *et al.*, 2015). There is a high degree of confidence there are no significant direct effects from the red-legged prawn subfishery on narrow sawfish. Direct effects from the red-legged prawn fishery are highly unlikely to create unacceptable impacts to the other three sawfish species, although some uncertainty remains, since not all the interactions are not reported at species level.

⁴² <http://www.iucnredlist.org>

⁴³ <http://www.cms.int/en/page/appendix-i-ii-cms>

⁴⁴ <http://www.cms.int/sharks/>

Indirect effects on sawfish populations, such as interfering with their feeding or breeding behaviour, were considered low at ERA Level 1, SICA (green sawfish was assessed under a worse scenario approach “worst scenario”, Griffiths *et al.*, 2007). In addition, sawfish pupping grounds are entirely within permanently closed areas. There is a high degree of confidence there are no significant detrimental indirect effects from the red-legged banana prawn subfishery on sawfish species.

No interactions with ETP elasmobranch species other than sawfish have been recorded in logbooks or monitoring surveys for the tiger prawn subfishery.

Teleost (Syngnathids and Solenostomids)

No interactions with syngnathids or solenostomids have been reported in 2011-2015 period for the red-legged banana subfishery (NPFI, 2016, unpublished data). Historically, only two specimens have been recorded by the CMO program, in 2009 (Jarrett *et al.*, 2015). According to Jarrett *et al.* (2015), it is likely prevailing conditions in the JBG are unsuitable for this group; principally high current flow and an absence of seabed structure (either biotic or hard substrate), which may affect them.

Because interactions with syngnathids and solenostomids are exceptionally rare (if any), there is a high degree of certainty that the effects from the red-legged banana subfishery are within the limits of the national and international requirements. Also, there is a high degree of confidence that there are no significant detrimental direct or indirect effects from the red-legged banana prawn subfishery on syngnathids and solenostomids.

3.4.7.1 ETP Species Management (P 2.3.2)

NPF (Tiger, White Banana and Red-Legged Banana Prawn Subfisheries - all UoAs)

ETP species are managed in the NPF within the Bycatch Strategy (NPFI, 2015) which conforms to the latest Bycatch and Discarding Workplan (AFMA, 2014) and extends the NPF Harvest Strategy (Dichmont *et al.*, 2014). This strategy aims to achieve the objectives of the Fisheries Management Act 1991 (FMA) for Ecologically Sustainable Development (ESD), and the EPBC Act 1999, for endangered, threatened and protected species. There are no subfishery specific management measures for ETPs, all three subfisheries having to comply to the same measures.

The MSC definition for a strategy is: a cohesive and strategic arrangement which may comprise one or more measures, an understanding of how it/they work to achieve an outcome and which should be designed to manage impact on that component specifically and it should contain mechanisms for the modification fishing practices in the light of the identification of unacceptable impacts. Applicable to ETPs only, a “comprehensive strategy” is a complete and tested strategy made up of linked monitoring, analyses, and management measures and responses.

With the introduction of the NPF Bycatch Strategy, the NPF adopted a comprehensive strategy that addresses bycatch overall, and focuses on ETP and ‘at risk species’. Management actions are informed by fishery dependent and fishery independent monitoring:

- A fishery-wide (including all three subfisheries) daily catch and effort logbook program under which interactions with ETPs are required to be recorded;
- Scientific and Crew Member Observer programs with higher cover in the tiger prawn subfishery, where the highest number of ETP interactions occur. These programs collect detailed data on ETPs with species identification as far as possible;
- Annual independent pre-season surveys (NPF prawn monitoring program) which collect data on ETP catch rates in order to estimate their abundance and distribution within the Gulf of Carpentaria where the most fishing effort occurs.
- A gear monitoring program to monitor vessel fishing power and TED/BRD configurations. Mandatory data is collected through the program, including vessel length, beam, depth, engine power, sonar, trawl speed and TED/BRD configurations.

Data from monitoring programs is regularly analysed and reported: bycatch and ETPs sustainability reports (every three years, e.g. Fry *et al.*, 2015), integrated prawn monitoring reports (for the NPF prawn monitoring program in GoC, every two years, e.g. Kenyon *et al.*, 2015), BRD performance assessments (next one in 2018, source: NORMAC, 2017). The information obtained from monitoring and research studies is used to regularly assess the risk from each subfishery to the affected species, including ETPs, through ecological risk assessments within ERAEF ranked risk framework developed jointly by AFMA and CSIRO (Griffiths *et al.*, 2007, Zhou & Griffiths, 2008, Zhou *et al.*, 2009, Zhou, 2011, Zhou *et al.*, 2015). A revision of SAFE assessments is scheduled to be completed in 2017. Any identified increase in risk for any ETP species would trigger as response, revision of the risk level by the Bycatch Subcommittee and expert panel and update the NPF priority list. Nevertheless, AFMA and NPF are proactive (not waiting for an increase in risk) in their ongoing efforts to gear innovations and improvement of the mitigation measure to ensure the effects of the three subfisheries are within the national and international requirements (see Table 14). Defined and measurable performance indicators specific for ETP species, and milestones, are presented in Table 14 (Section 5.2.2, Bycatch Management). The strategy is tested through testing the TEDs and BRDs performance on reducing ETP interactions, as well as assessing the status of the affected populations through monitoring and sustainability assessments.

Specific measures: Gear modifications and gear trials, Training and dissemination of information

Turtle Excluder Device

The use of TEDs (together with an approved BRD) is compulsory in the NPF since 2000. With the use of TEDs, the NPF has been very successful in reducing the incidental capture of turtles from approximately 5700 in the late 1980s (Poiner *et al.*, 1990, in Brewer *et al.*, 2006) to the current level of <100 per year and most being released alive. The use of TEDs has also reduced the incidental capture of large elasmobranchs. Brewer *et al.*, 2006 found that TED reduced the capture of narrow sawfish, the most commonly caught sawfish, with 73%, but the effect on the other sawfish species was not statistically significant. Smaller mammals and protected sharks may also be excluded through TEDs. Even though the use of TEDs did not reduce the number of sea snakes caught, it was found to increase sea snakes post-capture survival due to the exclusion of large bodied animals (Brewer *et al.*, 2006).

TEDs are combinations of structures with rigid or semirigid bars with a maximum of bar spacing of 120mm, and an escape opening of at least 700 mm. The escape opening can be placed upward or downward (Figure 31).

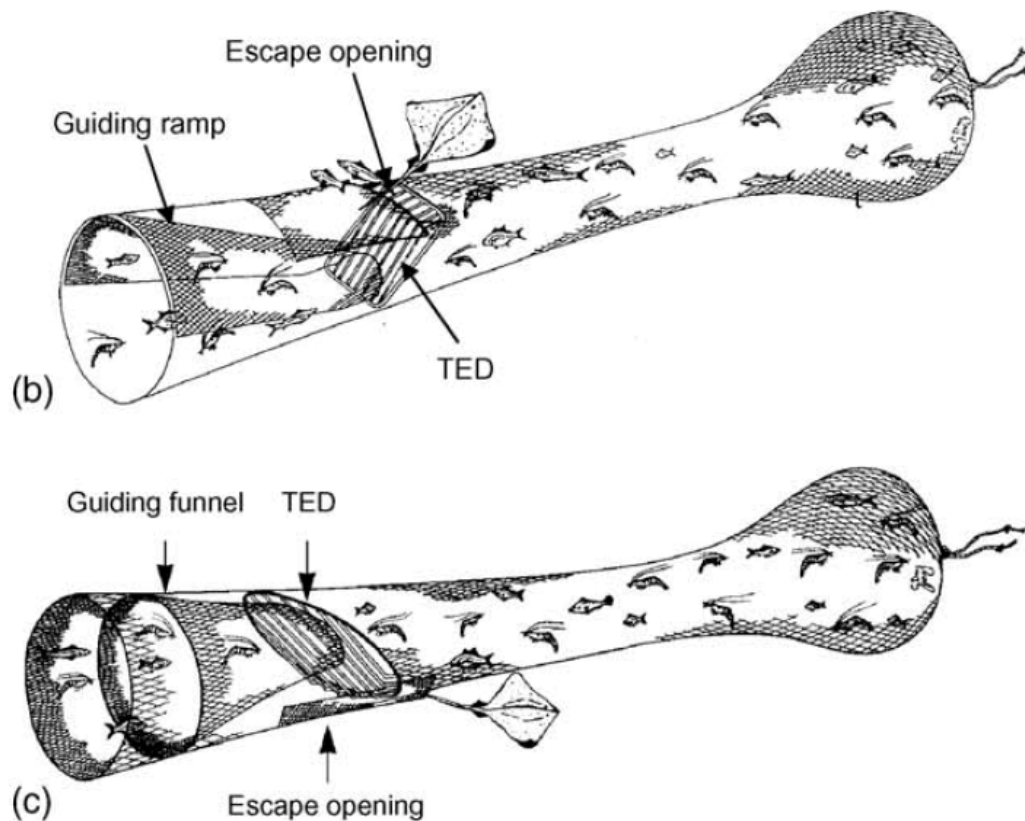


Figure 31. Net fitted with b) upward excluding TED and c) downward excluding TED. Source: Steve Eayrs, Australian Maritime College and Lee Crosswell, CSIRO, in Brewer *et al.*, 2006.

TEDs must be constructed, installed, and maintained in accordance with minimum technical specifications as defined by the US National Oceanic and Atmospheric Administration (NOAA), to ensure the NPF maintains export approval to the US. In July 2016, officers from NOAA visited Australia to conduct inspections of Australia's TEDs and to find resolution to the inconsistencies between NPF standards and US standards. AFMA, NOAA and industry have collaborated on the best way forward for meeting the US best practice gear specifications with specific attention on the use of floats for bottom shooting TEDs and correct measurements of flap overlap.

The updated TED specifications in NPF Direction No. 174 include:

- Turtle Excluder Device" (TED) means a device fitted to a net, and modification made to a net, that allows turtles to escape immediately after being taken in the net, and which has: a) a rigid or semi-rigid inclined barrier grid comprised of bars extending from the foot to the head of the net that is attached to the circumference of the net which must guide turtles towards an escape hole immediately forward of the grid.
- The minimum dimensions of this grid should be at least 81 cm by 81 cm.
- This structure is to be set at a minimum angle of between 30 and 55 degrees in relation to the horizontal plane of water through the net
- The escape opening which must be a double flap rectangular net opening where the cut immediately forward of the TED must allow a minimum opening of 61 cm when attached to the frame and the two forward cuts of the escape opening must not be less than 51 cm long from the points of the cut immediately forward of the TED frame. The resultant length of the leading edge of the escape opening cut must be no less than 142 cm stretched, or a double flap net triangular opening where the cut immediately forward of the TED must allow a minimum opening of 102 cm when attached to the frame with minimum forward cuts of 101 cm. The flaps

must be composed of two mesh panels. Each panel must be a minimum of 147 cm wide when stretched and may overlap each other no more than 38 cm along the leading edge when stretched.

- floats attached to the top one-half of all TEDs with bottom escape openings. The floats may be attached either outside or inside the net, but not to a flap.
- weights, meshing or other materials which may inhibit the opening of this escape flap must not be attached. (source: AFMA, 2017)

Bycatch Reduction Devices. At least one BRD must be used in combination with TEDs. Operators have worked closely with scientists and Government to trial TEDs and Bycatch BRDs to find the best combinations that would meet legislative requirements and ensure an environmentally sustainable fishery while also benefiting the operator (i.e. excluding turtles and other large animals and reducing small fish bycatch without prawn loss). In 2001, the AFMA legislated for the mandatory use of TEDs to be used in combination with BRDs. Various BRDs were tested specifically to mitigate ETP catch.

One approved BRD was proven to reduce sea snake catch. Popeye Fishbox trials in 2006 revealed that this design can deliver an 87% reduction in catches of sea snakes when installed at 70 meshes from the codend drawstrings (Raudzens, 2007). Adoption of this device has been hampered to date by concerns regarding crew safety. Trialling a modified Popeye Fishbox has been identified as an action under the new bycatch strategy (NPFI, 2015). No other BRDs were proven efficient in reducing ETP interactions. There is no data yet on the potential ETP catch reductions when using the newly approved BRD, Kon's Covered Fisheyes.

Training and Dissemination of Information

NPF Closures and Directions. An annual booklet with current gear regulations and spatial and temporal closures is provided by AFMA. This booklet includes, apart from the current gear regulations and closures, information about the ETPs and monitoring programs and reporting of interactions, about the ETPs identification guide and how to obtain it, and about incentives and opportunities to get involved in the CMO program or BRD testing.

Protected species identification Guide. To help operators accurately report their protected species interactions, AFMA has produced a protected species identification guide. This guide covers the range of protected species that AFMA managed fisheries do, or have the potential to interact with during their normal fishing operations. The guide provides pictures of these species along with an indicative distribution and key biological information. All NPF boats have been provided with a copy of this identification guide (AFMA, 2017).

CMO Training Workshops. The CMO program is a cost effective manner to obtain additional data on ETP interactions and 'at risk' bycatch species, including sawfish, sea snakes, turtles, and syngnathids, and other species identified as being potentially 'at risk' through the Ecological Risk Assessment (ERA) process.

Annual workshops are held for CMOs to undertake training and receive support from NPFI, CSIRO scientists and AFMA staff. CMO workshops are designed to provide a valuable learning experience for participants, and are typically held in July prior to the start of the tiger prawn season. The NPFI is responsible for management of the CMO program, including recruiting, training and supporting CMOs, as well as data entry, preliminary analysis, and reporting. In 2011 NPFI implemented a new incentive scheme to generate increased recruitment of CMOs, influence improved retention of CMOs both within and between years, and to enhance the volume and quality of information collected. This has proven to be a significant success. An increase in interest to be involved in the program has been observed since 2011, as well as an increase in the number of CMOs submitting data. Assessment has shown the data quality is of a high standard and is used in combination with CSIRO scientific surveys and AFMA scientific observer data to measure and assess trends in catch rates of the TEP and 'at-risk' species being monitored (AFMA, 2017).

Alternative measure under considerations

Currently new measures to mitigate sawfish bycatch are considered, and a research application is currently waiting for approval by FRDC. The project will investigate a novel sawfish mitigation device using electric pulse to deter the animals from entering the trawl net. Also, AFMA expects that recent CSIRO work in PNG will provide information for the NPF on reducing sawfish interactions. This work trialled top and bottom shooting TEDs without the mesh flaps over the openings (this is one of the main locations sawfish get their rostrums stuck as they are escaping via the TED) (Laird, 2016, email com). NPFI is working with CSIRO to investigating ways to improve and validate sawfish species identification in logbooks. Operators will be trained in species identification and vessels will be provided with cameras for operators to photograph sawfish interactions. These will be used by CSIRO scientists to identify species, similar to the CMO program, and validate logbook entries (Laird, pers. Comm, 2017).

Gear modifications so far did not prove efficient to reduce interactions with syngnathids and solenostomids. These interactions are significant only in the tiger prawn subfishery and are managed through all the other measures: ongoing monitoring, population trend assessments and trawl footprint control, which does not overlap with usually preferred habitats of these groups. An application for a permit to keep annually up to 100 dead syngnathids from trawl bycatch is waiting for approval by the DoEE. This will serve for a study to reduce knowledge gaps about species composition of the syngnathid bycatch, their life history and biology and species distribution in the NPF area (Fry *et al.*, 2015).

Non-specific measures

Other measures such as permanent and seasonal closures which offer protection to habitats important for ETP species survival and reproduction, substantial decrease in fishing effort after 2006 and trawl footprint control through VMS, contribute to mitigate ETP interactions positively affect ETP populations. Specific and non-specific measure work together and ensure the effects of the three subfisheries are under the limits of national and international requirements.

NPF strategy for managing impacts on ETP species is a complete and tested strategy made up of linked monitoring, analyses, and management measures and responses, thus it is a comprehensive strategy for managing impacts from the three subfisheries (all six UoAs), including measures to achieve above national and international requirements for the protection of ETP species.

3.4.7.2 ETP Species Information (PI 2.3.3)

Sufficient information is available to allow fishery related mortality and the impact of fishing to be quantitatively estimated for ETP species:

- A fishery-wide (including all three subfisheries) daily catch and effort logbook program under which interactions with ETPs are required to be recorded;
- Scientific and Crew Member Observer programs with higher cover in the tiger prawn subfishery, where the highest number of ETP interactions occur. These programs collect detailed data on ETPs with species identification as far as possible;

Information is sufficient to determine whether the fishery may be a threat to protection and recovery of the ETP species and, information is adequate to support a comprehensive strategy to manage impacts, minimize mortality and injury of ETP species, and evaluate with a high degree of certainty whether a strategy is achieving its objectives.

- Independent pre-season surveys (NPF prawn monitoring program) which collect data on ETP catch rates in order to estimate their abundance and distribution within the Gulf of Carpentaria where the most fishing effort occurs. This data together with data from observer programs, is regularly analysed and reported in bycatch and ETPs sustainability reports (every three years, e.g. Fry *et al.*, 2015) and integrated prawn monitoring reports (for the NPF prawn monitoring program in GoC, every two years, e.g. Kenyon *et al.*, 2015).

- A gear monitoring program to monitoring program to monitor vessel fishing power and TED/BRD configurations. Mandatory data is collected through the program, including vessel length, beam, depth, engine power, sonar, trawl speed and TED/BRD configurations.
- BRD performance assessments are undertaken to assess their efficiency including for ETPs (next one in 2018, source: NORMAC, 2017).
- The information obtained from monitoring and research studies is used to regularly assess the risk from each subfishery to the affected species, including ETPs, through ecological risk assessments within ERAEF ranked risk framework developed jointly by AFMA and CSIRO (Griffiths *et al.*, 2007, Zhou & Griffiths, 2008, Zhou *et al.*, 2009, Zhou, 2011, Zhou *et al.*, 2015). A revision of SAFE assessments is scheduled to be completed in 2017.

More information about the monitoring programs, surveys, research and ecological risk assessments (ERAs) is presented in the following sections.

Monitoring Programs (source: Fry et al., 2015)

Crew Member Observer program

The crew-member observer program began in 2003 as part of the long-term bycatch monitoring project (Brewer et al 2007). Each year crew members from a selection of NPF vessels volunteered to participate in annual training workshops. In the workshops run from 2003 to 2006, crew members were trained in the collection of reliable and accurate data for ETP species, i.e. turtles, sea snakes, sawfish, and other large elasmobranchs. This included collecting and recording vessel and trawl information, species catch statistics and photographing these species for later identification by CSIRO staff. For the 2007 and 2008 training workshops, crew members were trained in the identification and recording of the “at risk elasmobranch and teleosts, as well as all ETP species.

At the annual workshops, each crew-member observer was supplied with a sampling kit and disposable or digital cameras for recording catch data and taking photographs of the ETP species and ‘at risk’ bycatch species caught in trawls during the banana and tiger prawn seasons. For each trawl, the crew-member observer would inspect the total catch in both nets for the selected species and record on the datasheets provided if any of these species were caught in the nets. They would also take a photograph of the animal, including a scaled label with vessel name, date and shot number, and then release the animal back to the water.

Completed data sheets and disposable cameras or digital camera memory cards were returned to either AFMA, (for the years 2003 to 2008) or from 2009 onwards, returned to the NPF Industry Project Officer. The catch data was then entered into an MS Excel spreadsheet and sent, with the photos, to CSIRO for further analysis. For each digital image of a ETP or ‘at risk’ species, identification was verified by scientific staff.

For ETP and bycatch sustainability assessments, the catch data recorded by CMOs was matched with the NPF commercial logbook data to obtain trawl information; trawl duration and depth, latitude and longitude of trawl and gear specifications. CMO coverage focuses on tiger prawn subfishery (18%) because of the highest level of risk from this subfishery, although all three subfisheries are covered: 2% in banana prawn subfishery and variable coverage in the red-legged banana prawn subfishery (e.g. 7.4% in 2011)

AFMA scientific observers

Catch data on TEP species are collected by AFMA scientific observers since 2005. These are entered in the NPF Database Section at AFMA, Canberra. Similar to the procedures used by NPF CMOs, the AFMA scientific observers collect and record the numbers of these species caught in each trawl and take photographs for species identification purposes and measurement of total length of animal.

NPF prawn population monitoring surveys

Catch data on ETP and 'at risk' bycatch species are also collected from research surveys since 2002, in the Gulf of Carpentaria as part of the NPF prawn population monitoring surveys (Projects: MIRF R01/1144 [2002]; FRDC 2002/101 [2002]; FRDC 2003/075 [2003-04]; FRDC 2004/099 [2004-05]; AFMA R05/0599 [2005-06]; AFMA R05/1024 [2006-08]; AFMA R08/0827 [2008-10]; AFMA R2009/0863 [2009-10]; AFMA R2011/0811 [2011-2015]).

Data collection and recording is similar to the procedures used by the CMOs where each trawl is inspected for ETP and 'at risk' bycatch species. Catch numbers are recorded for each trawl and photographs taken of the selected species for verification of species identification and measurement of total length of animal back at CSIRO.

CSIRO scientific research and observer surveys; 1975 – 2005

Data on ETP occurrence and distributions can also be found in databases held by CSIRO. This search included all scientific trawl surveys and scientific observer fieldwork undertaken by CSIRO staff in the NPF region from 1975 to 2005. The objectives of these surveys varied between projects, but all involved a stratified random trawl survey design. Catches of all ETP and some 'at risk' bycatch species caught during these surveys were recorded to species, counted and weighed.

ETPs Risk Assessments

In 2006, Griffiths et al (2007) assessed the ecological impacts of the NPF on ETP species by using the Ecological Risk Assessment for Effect of Fishing model (ERAEF V9.2) jointly developed by CSIRO and AFMA. This approach provided a hierarchical framework for a comprehensive assessment of the ecological risks to species, communities and habitats (Griffiths et al 2007). Within this hierarchical framework, ETPs were assessed at SICA, Level 1, then all ETP species identified in the tiger and banana subfisheries, were assessed at level 2, PSA. Some ETP species have been assessed at a higher level, quantitative approach, the Sustainability Assessment for Fishing Effects (SAFE) developed for elasmobranchs, including sawfish (Brewer *et al.*, 2007; Zhou and Griffiths, 2008) teleosts, including syngnathids (Brewer *et al.*, 2007; Zhou *et al.*, 2009, Zhou, 2011) and sea snakes (Milton *et al.*, 2008b). This method estimated fishing impacts and compared the impact to sustainability reference points based on basic life-history parameters for the species (Zhou and Griffiths, 2008).

For the first two levels of assessment, the risk was assessed for tiger prawn subfishery and separately for banana prawn subfishery. Because subfisheries were identified with the fishing seasons, the risk from the red-legged banana fishery was not assessed separately but included in the risk estimation from tiger and banana subfisheries. SAFE assessments for teleosts, elasmobranchs and snakes focussed on tiger prawn subfishery to give a conservative level of risk overall because tiger prawn subfishery has the highest level of impact on bycatch and ETPs. However, more recently, SAFE assessments were applied to the red-legged banana prawn subfishery for elasmobranchs (including sawfish) and teleosts (no syngnathids were include because there are no interactions).

These bycatch assessments approaches identified the potential level of risk for all ETP species, even though the three subfisheries do not interact with all. Each of the species scored at medium and high risk where then assessed using the 'Highest Level of Assessment' method where the NPF Bycatch Subcommittee working group consults with an expert panel of scientists to evaluate all available data and provide justification on retaining or removing a species from the 'at risk' list. This approach is repeated periodically as more data for each species becomes available and then considered by the Northern Prawn Fishery Management Advisory Committee (NORMAC) and Northern Prawn Fishery Resource Assessment Group (NPRAG). However, irrespective of the level of risk identified, ETP species are subject of ongoing monitoring (Fry *et al.*, 2015).

Gear Trials and Benefits to ETPs (source: Burke et al., 2012)

Sea snakes

During the Square Mesh Panel (SMP) trials conducted in 1995 this form of BRD was found to reduce capture of sea snakes by 50% however the 2001 trials indicate that capture of these species was only

reduced by 5% (Brewer, 2006).

Trials of the Popeye Fishbox showed a reduction of 87% in sea snake captures (Raudzens, 2007), suggesting enhanced adoption of this BRD design throughout the fleet may further reduce the frequency of sea snake interactions in the NPF. This was not successfully adopted in the NPF fleet due to safety concerns.

Trials of the Witches Hat Enhancer did not report on sea snake catches. Consequently, it was not possible to determine whether this device enhances the capacity of the SMP to reduce sea snake catches.

Turtles

A project conducted in 1989 and 1990 estimated that 5000 to 6000 turtles were caught by NPF trawlers annually, with a mortality rate of up to 39% (Poiner and Harris, 1996). In 1999, logbook data showed there were 780 turtle captures with 96 fatalities reported. Interactions with turtles decreased further with the mandatory introduction of TEDs to 56 captures and 12 fatalities reported in 2000 and 99 captures and 6 fatalities reported in 2001 (Garvey and Lilly, 2001) (Figure 31). Current interactions with turtle in the tiger prawn subfishery are similar to the ones in early 2000s. It would appear that the implementation of TEDs has largely addressed issues associated with interactions between turtles and NPF operators; however, NPFI and AFMA remain committed to monitoring turtle interactions on an ongoing basis.

Sawfish

Introduction of the use of TEDs in the NPF has resulted in a 73% reduction in the capture of the sawfish species most commonly captured by NPF operators, the Narrow Sawfish (*Anoxypristis cuspidata*) (Brewer *et al.* 2004). The impact of TEDs on other, more rarely caught species of sawfish remains unknown. BRD designs approved for use in the NPF have not been shown to have an impact of the capture of sawfish, and this is probably due to sawfish escaping via TEDs before entering the codend.

Syngnathids

The incidental capture of Syngnathids has been reported through logbooks, CMOs and SOs since 2006. No information is available on the benefits of BRD use on Syngnathids in documents provided for the purpose of this review. Due to their small size and slow mobility, it is unlikely BRDs would reduce capture of Syngnathids.

3.4.8 Habitat (P2.4)

MSC standard for habitats requires that the fishery under assessment does not reduce the structure and function of the habitat to a point where there would be serious or irreversible harm. Serious harm means gross change in habitat types or abundances, and disruption of the function of the habitats. Irreversibility means changes that are expected to take much longer to recover than the dynamics in unfished situations would imply, some sort of regime change is implied from which recovery may not automatically occur (CB3.14.2, FCRv1.3, p C184, MSC, 2013).

The NPF managed area incorporates the Northern Marine Region (NMR) and part of the North-West Marine Region (NWMR) according to the Marine Bioregional Planning. Most characteristic habitats of the region are soft sediments on relatively flat terrain. The sediments are not uniform, but vary in factors such as the amounts of mud and sand and the availability of hard substrate for attachment by sessile organisms, and these factors affect the biological assemblages found within and on the sediments (Long *et al.* 1995, in Bustamante *et al.*, 2010, Przeslawski *et al.*, 2011).

Seagrasses provide key habitats in the Gulf of Carpentaria (GoC). They provide nursery grounds for commercially harvested fish and prawns. They also provide feeding grounds for dugongs and green turtles (Kirkman 1997, in Bustamante *et al.*, 2010). In the Joseph Bonaparte Gulf (JBG) however, seagrass habitats are absent (Przeslawski *et al.*, 2011). Other marine habitats include geomorphic features scattered around the region (e.g. reefs, shoals and valleys, in GoC and Arnhem Land Coast, Bustamante *et al.*, 2011; epifaunal terraces, deep valley communities and sponge gardens in JBG,

Przeslawski *et al.*, 2011). The coasts adjacent to the NMR and NWMR provide a number of key habitats. Mangroves provide habitat for waterbirds and support many commercially and recreationally important fish and commercial prawns for parts of their life cycles. The greatest species richness of mangroves can be found on the west side of Cape York peninsula and north of Arnhem Land. Beaches provide nesting sites for sea turtles, and coastal parts of rivers provide nesting sites for saltwater crocodiles (Letnic and Connors 2006, Read *et al.* 2004, in Bustamante *et al.*, 2011; Przeslawski *et al.*, 2011). Coastal wetlands provide feeding and nesting sites for waterbirds (National Oceans Office 2004a in Bustamante *et al.*, 2010). However, prawn trawling occurs only over soft sediments and the sensitive habitats are not directly affected.

The effects of trawling on benthic and demersal habitats include physical disturbance, biota removal, short-term damage and long-term modification of the structure and function. If the trawling intensity is frequent and the productivity/resiliency of the affected habitats is low, recovery times may be very long or the habitat may never recover to the unfished state. The impacts of trawling in the NPF would most often be associated with the tiger prawn subfishery, and to a lesser extent, the red-legged prawn subfishery, due to deployment of gear at or near the seabed. Impacts from the white banana prawn subfishery would not have significant effect on bottom habitats because fishing takes place off the seabed, in the water column. In the NPF, habitat impacts are expected to be mitigated by the fact that fishing effort has declined from 286 vessels in 1981 to 52, with a current trawl footprint of only 1.6% of the NPF managed area. Furthermore, a comprehensive system of permanent and seasonal closures adopted by the NPF serves to protect vulnerable habitats such as seagrass beds and coral and rocky reefs.

Although demersal trawl gear is considered non-selective fishing gear, it does not have the same catch efficiency for all benthic species and this needs to be taken into account when considering the impact. Haywood *et al.* (2005) compared catch efficiency between prawn trawl and epi-benthic sled and found that the trawl is far less efficient as a sampling device for the seabed biota. The only taxa that were captured with a high efficiency by the trawl were crustaceans, some sponges (Desmospongiae), polychaetes and cephalopods. Poiner *et al.* (1998, in Haywood *et al.*, 2005) found a similar low efficiency for prawn trawls in a study of the inter-reef fauna of the Great Barrier Reef.

3.4.8.1 Outcome status (PI 2.4.1)

Quantifying Trawl Impact on Habitats

In the NPF, fishing effort has varied over time. Catch and effort information is captured for the whole NPF fishery through the AFMA logbook database in 6 minute by 6 minute grids; there are an estimated 7281 grids in the area of the NPF. During the peak of effort in 1989, NPF-wide effort was reported in ~21% of grids; however, by 2010 grid coverage had fallen to ~10% of grids. The number of vessels recording catch in the NPF fell from 134 in 1995-96 to 52, as a result of combined internal industry restructuring and the 2006 Commonwealth Structural Adjustment Program (Jarrett *et al.*, 2015).

Pitcher *et al.* 2016, collated data and mapped distributions of predicted demersal assemblages and associated habitats, as well as data for current NPF fishing effort, fishery closures and marine reserves. Figure 32 presents the biotic assemblages predicted by environmental gradients, and Table 27 shows the overlap with fishing effort and areas closed to trawling. These assemblages were based on the predicted large marine region (LMRs) assemblages identified by Ellis & Pitcher (2009) and updated by Pitcher *et al.* (2016) to match the fishery's jurisdiction. They do not represent fine scale habitat mapping; however, they were predicted to have similar species composition. If fishing effort maps for each subfishery are overlaid on the assemblage map, the main habitats (large scale habitat) for each subfishery and the percentage of the respective habitat (assemblage) that is affected by trawling can be identified. This can be used to classify habitats in "main" and "minor". MSC defines main habitat as a commonly encountered habitat, that regularly comes into contact with a gear used by the UoA, considering the spatial (geographical) overlap of fishing effort with the habitat's range within the management area (MSC, 2014), while all the other habitats are minor.

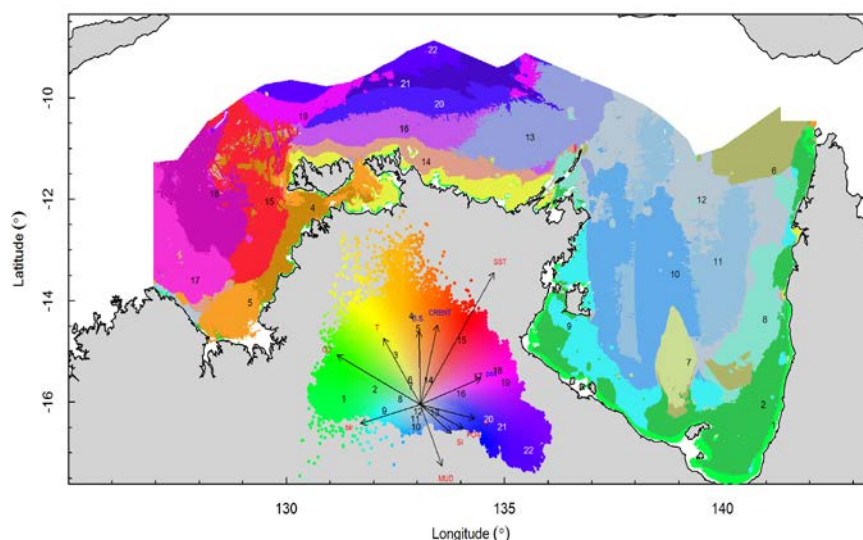


Figure 32. Map of the NPF region showing clustered patterns of species composition change predicted by relationships with multiple environmental gradients. The biplot shows the first 2 dimensions of the clustered multidimensional biological space, representing composition change in relation to vectors of the major environmental drivers. The clustering of the biological space suggests 22 assemblages. (source: Pitcher *et al.*, 2016).

Table 27 Intersection of Assemblages by area, in the NPF region with CMRs, MPAs and fishery closures (and both combined), and with trawl effort. Colours in the assemblage column correspond to the colours on the map.

Assembla	Grid_cou	Area(k	CMR_	CMR	CMR_	CMRs	%_C	MPA	Closure	%_Clos	Any	Total%Cl	Trl	Unifor	Aggregat	%_Trawl	Trl_Swe	%_Swe
1	13,698	16,306	107	183	423	713	4.4	604	2,464	15.1	3,687	22.6	1,870	183	156	1.0	194	1.2
2	50,011	59,520	30	7,074	8,785	15,889	26.7	73	1,525	2.6	17,396	29.2	22,374	4,109	3,375	5.7	4,715	7.9
3	17,719	21,421	2,098			2,098	9.8	725	29	0.1	2,843	13.3	4,759	777	637	3.0	881	4.1
4	16,232	19,572	4,508			4,508	23.0	0	216	1.1	4,724	24.1	2,240	405	328	1.7	551	2.8
5	16,987	20,402	7,457			7,457	36.5	45	75	0.4	7,576	37.1	1,497	126	107	0.5	138	0.7
6	25,486	30,760	854	10,45	5,782	17,090	55.6	0	12	0.0	17,102	55.6	196	26	21	0.1	31	0.1
7	11,688	13,934	5		1,977	1,982	14.2	0	0	0.0	1,982	14.2	75	6	5	0.0	9	0.1
8	27,804	33,338		1,827	3,164	4,991	15.0	0	0	0.0	4,991	15.0	3,836	630	509	1.5	681	2.0
9	28,363	33,846	2	579	819	1,400	4.1	0	1,008	3.0	2,408	7.1	17,297	5,492	4,409	13.0	8,346	24.7
10	64,800	77,804		98	1,999	2,097	2.7	0	0	0.0	2,097	2.7	2,904	928	754	1.0	1,510	1.9
11	49,485	59,536		73	21	93	0.2	0	0	0.0	93	0.2	22	0	0	0.0	0	0.0
12	54,801	66,193	44	2,206	1,249	3,499	5.3	1	0	0.0	3,500	5.3	1,675	477	384	0.6	627	0.9
13	40,914	49,670	880	31	792	1,703	3.4	0	0	0.0	1,703	3.4	19	0	0	0.0	0	0.0
14	19,786	23,942	5,919		6	5,925	24.7	65	0	0.0	5,990	25.0	5,230	1,199	951	4.0	1,347	5.6
15	31,569	38,150	17,280		1	17,281	45.3	0	1	0.0	17,283	45.3	104	8	6	0.0	13	0.0
16	23,415	28,415	2,867		11	2,878	10.1	0	0	0.0	2,878	10.1	81	1	1	0.0	1	0.0
17	22,963	27,622	641		6,459	7,100	25.7	0	0	0.0	7,100	25.7	2,751	482	395	1.4	629	2.3
18	30,612	36,978	17,198		3,926	21,124	57.1	0	0	0.0	21,124	57.1	0	0	0	0.0	0	0.0
19	14,817	18,015	5,138			5,138	28.5	0	0	0.0	5,138	28.5	0	0	0	0.0	0	0.0
20	20,801	25,289	3,367		44	3,411	13.5	0	0	0.0	3,411	13.5	0	0	0	0.0	0	0.0
21	14,904	18,144	9,608			9,608	53.0	0	0	0.0	9,608	53.0	0	0	0	0.0	0	0.0
22	11,546	14,060	7,440			7,440	52.9	0	0	0.0	7,440	52.9	0	0	0	0.0	0	0.0
	608,401	732,919	85,444	22,52	35,457	143,42	19.6	1,51	5,330	0.7	150,07	20.5	66,931	14,849	12,040	1.6	19,673	2.7

Source: Pitcher *et al.*, 2016

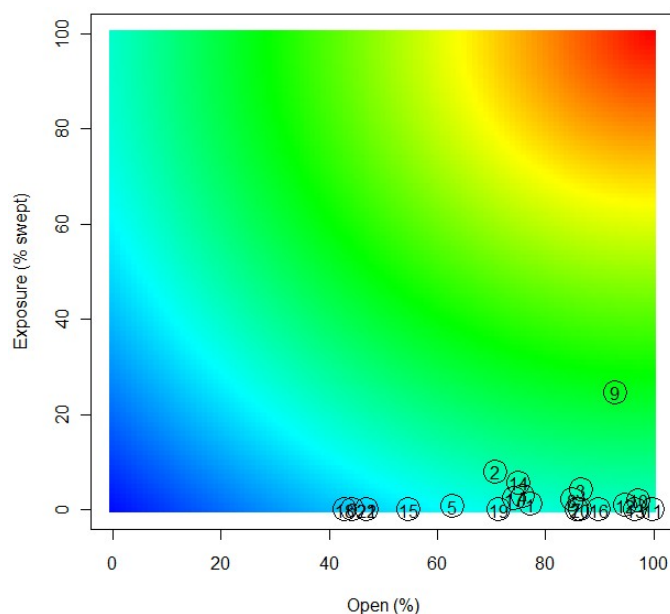


Figure 33. Plot of percentage of area of each assemblage open to potential trawling against actual exposure to trawl effort intensity in the NPF. (source: Pitcher *et al.*, 2016)

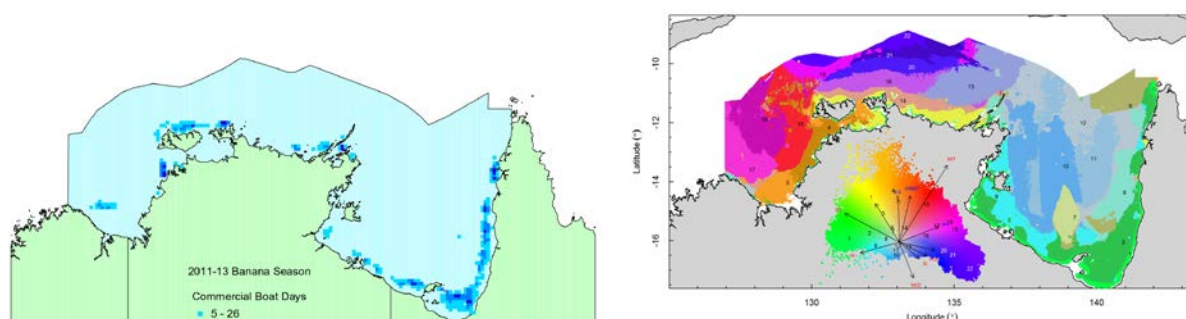


Figure 34. Maps showing the NPF commercial trawl effort distribution (boat days >5 days) in each 6 nautical mile grid for the 2011 – 13 banana prawn season across the Northern Prawn Fishery (Fry *et al.*, 2015), compared to predicted assemblages (Pitcher *et al.*, 2016). Note that white banana subfishery's main habitats are #2, #14. Habitats #8, #9, #5, #6, #4 and #3 receive low amount of effort, thus they are minor habitats. Red-legged banana subfishery (in JBG) main habitat is #17.

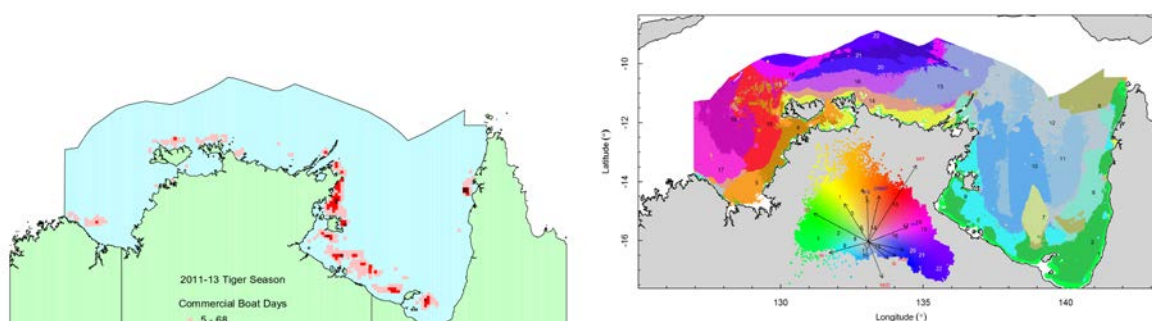


Figure 35. Maps showing the NPF commercial trawl effort distribution (boat days >5 days) in each 6 nautical mile grid for the 2011 – 13 tiger prawn season across the Northern Prawn Fishery (Fry *et al.*, 2015), compared to predicted assemblages (Pitcher *et al.*, 2016). Note that tiger prawn subfishery main habitats are #9 and #14.

Habitats #2, #3, #4, #8 and #10, where some fishing may occur, are minor habitats. Red-legged banana subfishery (in JBG) habitat is #17.

Pitcher et al (2016) found that about 19.6% of the NPF area (0-150 m) is closed in Commonwealth Marine Reserves (CMRs), ~0.2% in Marine Protected Area (MPAs) and ~0.7% under fishery regulation — the total closed is 20.5%. The annual footprint of the NPF trawl fishery is 1.6% overall, with most trawling around the perimeter of the GoC in assemblages '9' & '2' (Figure 32), with footprints of 13% & 5.7% trawled annually about 1.9 & 1.4 times on average, hence total swept ratios are 24.7% & 7.9% respectively. Other assemblages with notable trawling include assemblage '14' across Arnhem Land, and parts of assemblage '10' in the western gulf Pitcher *et al.*, 2016). Figure 33 shows the level of impact from trawling for each assemblage.

By comparing recent fishing effort in the tiger prawn season and in the banana prawn season with the predicted assemblages, it can be noted that assemblage #9 is the main habitat where most fishing effort occurs in the tiger prawn fishery, while assemblage #2 is the main habitat where most fishing effort occurs in the banana prawn fishery. A lower intensity trawling from both, tiger prawn and white banana subfishery occur on habitat associated with assemblage #14. The red-legged banana subfishery, operates entirely on habitat associated with assemblage #17.

Main Habitats.

Tiger prawn subfishery (brown tiger prawn, grooved tiger prawn, blue endeavour prawn, red endeavour prawn UoAs). The most affected type of habitat is the one associated with assemblage #9 (tiger prawn subfishery), with only 7% in closed areas and with a trawl footprint of 13%, trawled 1.9 times per year. According to Ellis and Pitcher (2009), assemblage #9 region is characterised by high variability of water temperature, at the surface as well as at the sea bottom. The main geomorphic feature is shelf, while terrace is a less extensive feature north of Groote Eylandt (Post *et al.*, 2006). The sediments in this region have variable mud content and are muddier than in the eastern and southern part of the GoC (Haywood *et al.*, 2005, fig. 5.3-18). The biotic community comprises mainly deposit-feeding spatangoids (heart urchins) and sand dollars, with a lower biodiversity than in eastern and northern GoC (Hill *et al.*, 2002). This groups belong to Echinoidea family. Although Hill et al (2002) found that at fishing effort levels before 2000 echinoids were one of the least sustainable group, Haywood *et al.*, (2005) found this group to be resilient to moderate intensity prawn trawling. Long *et al.*, (1995, in Hill *et al.*, 2002) found that spatangoid echinoids made up 60% of the biomass of the 107 dredge samples taken across the GoC and that five taxa accounted for 87% of the biomass. The remaining 841 taxa accounted for only 13% of the biomass. Rarely caught species - those captured in 3 or fewer trawls - were found mainly in the eastern and northern sections of the GoC, thus not in the assemblage #9 area. The most important environmental factors associated with rare species distributions were oxygen and temperature (Hill *et al.*, 2002).

More recent benthic impact studies did not find a significant overall impact at current levels of trawling (Bustamante *et al.*, 2010), although some habitat-forming species may be vulnerable to trawling. In assemblage #9 the mean abundance of habitat-forming benthos was low compared with other sampled assemblages, although gorgonians and bryozoans are present and they and some others do occur patchily at high abundance. According to Pitcher *et al.*, 2016, these vulnerable types occur in places potentially accessible to and removable by trawls and may be at risk at least locally within assemblages, if not at regional landscape scale. Bustamante et al (2010) have also shown these species to be negatively related to trawl intensity along trawl effort gradients, suggesting that there may have been depletion impacts by repetitive trawling at local scales (Bustamante *et al.*, 2010). The actual risk from tiger prawn trawling and vulnerability of these habitat-forming benthos is not currently clear. At a larger landscape scale, some of these benthic species may be more widely distributed in areas where prawn trawling does not occur (Pitcher *et al.*, 2016). Nevertheless, corals and anemones

and most bryozoans appear to be restricted to assemblage #2 (Pitcher *et al.*, 2016), where tiger prawn trawling is restricted to small areas and white banana prawn trawling does not touch the sea bed.

There is a low overlap of the tiger prawn fishing effort with assemblage #2, in the southern GoC, around Mornington Island. The trawl footprint in assemblage #2 area is only 5.7% with a trawl intensity of 1.4 times per year, with only small proportion of this being from tiger prawn subfishery.

This assemblage occurs on innershelf habitats with sediments with high percentage of sand content and low percentage of mud (Ellis & Pitcher, 2009). Long *et al.* (1995, in Hill *et al.*, 2002) found the biotic community in eastern and southern GoC comprised mainly of sessile suspension-feeding sponges, zoantharians, pennatulaceans, bivalve molluscs and ascidians (Hill *et al.*, 2002). Haywood *et al.*, 2005, surveyed east and west Mornington regions of the GoC and did not find zoantharians or other cnidarians, but found that sponges dominated in the eastern side. Hill *et al.* (2002) have shown that molluscs had high sustainability from prawn trawling. Attached invertebrates (e.g. sponges) were shown to be vulnerable to trawls but many of them had a well-developed ability to recover from trawl damage (Hill *et al.*, 2002). In Haywood *et al.* (2005) depletion experiments, bryozoans, gastropods, phaeophyta and holothuroids were less resilient to prawn trawling. These species also had lower recovery rates in Hill *et al.* (2002) study. According to Pitcher *et al.* (2016), most vulnerable habitat-forming benthos is distributed within assemblage #2, and they are potentially affected by tiger prawn trawling.

Assemblage #14 also classifies as "main habitat" for tiger prawn fishery. It occurs on innershelf habitats on sediments with high percentage of sand content and low percentage of mud content. This type of habitat is resilient to prawn trawling, with macrofauna with high recovery rates (Hill *et al.*, 2002). Although no benthic studies have been undertaken in Arnhem Land region, 25% of assemblage #14 is closed to trawling and only 4% trawled. Geomorphic features and sediment type are similar to assemblage #2 where overall trawling impact was not found to be significant (Bustamante *et al.*, 2010 did not find significant trawling effects in the GoC). The occurrence of sensitive habitat-forming species in this assemblage is not known, however, only a small percentage of this assemblage is affected by tiger prawn trawling.

Apart from the direct impact of trawls on the biota, trawling may have indirect effects. The most commonly cited disturbance is the suspension of fine sediments. A study by Hiddink *et al.* (in Haywood *et al.*, 2005) showed that the impacts of trawling were greatest in areas with low levels of natural disturbance, while the impact of trawling was small in areas with high rates of natural disturbance. The GoC has a high incidence of cyclones – around three per annum. In the shallow waters of the Gulf, these major natural events represent a significant disturbance. In the Haywood *et al.* (2005) study for example the authors found that sponges had been moved around by a cyclone. The seabed biota of the GoC presumably is adapted to coping with this disturbance. Also, Sainsbury (1988, in Haywood *et al.*, 2005) found that trawling can affect stock abundances of fish indirectly by affecting structures and organisms that serve as habitat and food. In addition, it is likely that an abundant supply of discards may benefit a range of scavengers on trawl grounds, changing communities' species composition. Haywood *et al.* (2005) however, concluded that the state of the habitats impacted by trawling in the NPF is not a steady state that favours the fast growing of 'weedy' species over the slow growing ones but a highly dynamic one in which the seabed biota is changing in response to factors other than trawling.

White banana prawn subfishery (white banana prawn UoA). Main habitats for white banana prawn subfishery are the same as for tiger prawn subfishery, although with different overlap. White banana subfishery overlaps mostly with assemblage #2, and in a lesser extent, with assemblages #9 and #14. The characteristics of these types of habitat are as presented for tiger prawn subfishery. Direct impact of the banana prawn subfishery is very low as the gear does not make contact with the sea bottom. Indirect impacts however may occur due to bycatch discards. Bycatch in the white banana

prawn subfishery is lower than in the tiger prawn subfishery, thus the discards are lower. As mentioned for the tiger prawn subfishery impacts, Haywood *et al.* (2005) found that indirect effects from prawn trawling in the GoC were not significant.

Red-legged banana prawn subfishery (red-legged banana prawn UoA). The JBG is an area of soft substrate expanses with localised rocky outcrops, gravel deposits, and raised features. Benthic communities are exposed to strong tidal currents, high turbidity, and substantial sediment mobility, with disturbance decreasing offshore. High turbidity exists in the inner JBG, particularly during the wet season (Przeslawski *et al.*, 2011). The main habitat for red-legged banana prawn subfishery is the habitat corresponding to assemblage #17. There is a very low overlap of the fishing effort with assemblage #17. The trawl footprint is 1.4% with a fishing intensity of about 1.6 times per year.

While prawn trawling, benthic impacts have not been studied in this area and no comprehensive habitat mapping is available, Przeslawski *et al.*, (2011) from Geoscience Australia, produced a spatial of seabed environments for the JBG and Timor Sea region (JBG-TS) (Figure 36). The authors identified and described significant habitats and communities in the area of interest. Data were sourced from existing literature, including publicly available industry data, as well as data collected from two seabed mapping surveys to the Van Diemen Rise in the Eastern Timor Sea in 2009 and 2010 (Przeslawski *et al.*, 2011).

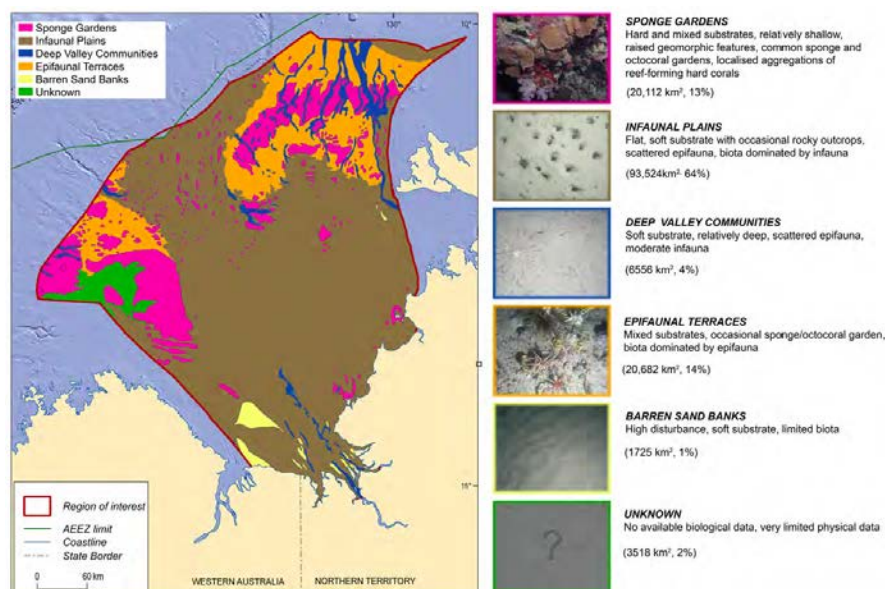


Figure 36. A generalised habitat map showing the potential distribution of habitats and biological communities in the JBG-TS. Habitats are based on the combination and characterisation of regional-scale geomorphic features according to available biological data. Parentheses indicate area of coverage for each habitat with percentages expressed as total area of the region of interest.

By comparing mapped trawling effort in JBG area (Figure 34 and Figure 35) with habitat distribution in Figure 36, red-legged banana prawn subfishery operates on infaunal plain, characterised by flat geomorphology, soft sediments and scattered epifauna, biota being dominated by infauna. Trawl impact to epifauna is most likely low and localised, however trawling can potentially occur over sponge gardens. Sponges were shown to be susceptible to catch but they also have high recoverability rates (Hill *et al.*, 2002). The impact of red-legged banana prawn trawl fishery on potentially occurring sponge gardens is not known, although if there is an impact, it affects a very small proportion of the sponge garden habitat (see Figure 36).

Minor habitats

Habitats associated with all the other predicted assemblages suffer a very low level of impact from trawling (Figure 33), although, there is little information on the nature of these impacts.

ERA for Habitats in the NPF

At the 2007 NPF ERAEF, photographic data, geomorphic unit mapping, literature, and expert opinion were used to classify 157 fine scale habitat types on the basis of substratum, geomorphology, and dominant fauna. Out of the 157 habitat types, only 50 were subject to trawling. No habitats were found to be at high risk and 17 of the habitats where trawling can occur were assessed to be at medium risk. Most of these habitats contained seagrass that was not protected at the time of writing the ERA report. These were coastal margin habitats (0-25 m), which also include several soft sediment seabed types but which were dominated by seagrass communities which were not in protected areas (Griffiths *et al.*, 2007). There have been records of seagrass at depths of 20 m in the less turbid south-west GoC (Coles *et al.*, 2004) but it is not clear if currently these seagrass beds are affected by trawling, however, most of the seagrass beds occur in areas permanently closed to prawn trawling (Dichmont *et al.*, 2014).

3.4.8.2 Habitat management (PI 2.4.2)

Habitat impacts are managed mainly by footprint control. Reduced fishing effort, permanent and seasonal closures, ongoing footprint monitoring using VMS and repeated risk assessments for habitat types within the NPF managed area measures to ensure any increase in risk is identified and the three subfisheries do not cause serious or irreversible harm to habitats structure and function.

Reduced fishing effort

A key measure in habitat management was to substantially reduce fishing effort. During the peak of effort in 1989, NPF-wide effort was reported in ~21% of grids; however, by 2010 grid coverage had fallen to ~10% of grids. The number of vessels recording catch in the NPF fell from 286 vessels in 1981 to 134 in 1995-96 then to 52 in 2010. Although Hill *et al.*, study showed a risk of depletion for some benthic invertebrate species at the level of trawling before 2002, the authors predicted recovery if the fishing effort was to be reduced by half. Fishing effort was reduced by more than half and in subsequent studies, Haywood *et al* (2005) concluded that trawling did not have significant effect on changing benthic biodiversity but that these changed as a response to factors other than trawling.

Closures

A comprehensive system of spatial and temporal closures is in place in the NPF to address ecological and economic objectives of the fishery. About 19.6% of the NPF area (0-150 m) is closed in CMRs, ~0.2% in MPAs and ~0.7% under fishery regulation — the total closed is 20.5%. The annual footprint of the NPF trawl fishery is 1.6% overall. Closures in the fishery include permanent closures of seagrass beds and other sensitive habitats and seasonal closures of juvenile prawn stock habitat. Seasonal closures are in place to protect small prawns, as well as to protect spawning individuals. Since 2011, the Northern Prawn Fishery Resource Assessment Group (NPRAG) recommended a fixed small prawn closure from 1 December to 1 March of each year. A daylight trawl closure is in place during the second (tiger prawn) fishing season to reduce the capture of spawning tiger prawns.

In addition to these permanent closures, a series of seasonal closures also apply (NPF 171, AFMA, 2016):

- If the banana prawn trigger limit is not met at any time during the reporting periods (weeks 4 and 5; weeks 6 and 7; weeks 8 and 9), the fishery will be totally closed **west of 138 degrees** and will be closed to daylight trawling **east of 138 degrees** between 8 am and 6 pm to allow access to the tiger prawn fishery.
- The first season will close on **15 June 2016** to all fishing.

- A daylight trawl ban is in operation during the tiger prawn season between 8 am and 6 pm (local time) for Northern Territory and Queensland areas specified in Schedules 19 and 20 of NPF Direction No. 171.
- This ban is in force during the period commencing at 6 pm on 1 August and finishing at 8 am on 1 December (local time).
- For the red-legged banana prawn fishery requires certain effort and catch rate conditions be met before fishing is permitted to be opened for the banana prawn season (first season). If permitted, it will open at the same time as the rest of the white banana prawn fishery. The fishery will close if the catch trigger limits/decision rules in place for the white banana prawn and tiger prawn fisheries close the rest of the NPF in any given season (AFMA, 2016).

Vessels Monitoring System

Vessel Monitoring System (VMS) data that covers the whole fleet throughout the season to monitor position of vessels especially with respect to spatial and temporal closures (Dichmont *et al.*, 2014). an AFMA approved VMS is fitted and operational at all time (AFMA, 2017a).

Evidence that this strategy works and achieving its objective can be drawn from studies of trawl impact on biodiversity. Moreover, only a very small percentage of the NPF managed area is trawled, in areas with high natural variability and disturbance thus, impact from sources other than prawn fishing are likely to be more significant for the changes in the structure and function of the habitats in the NPF managed area. Haywood *et al* (2005) found that the state of the habitats impacted by trawling in the NPF is not a steady state that favours the fast growing or ‘weedy’ species over the slow growing ones but a highly dynamic one in which the seabed biota is changing in response to factors other than trawling. Moreover, simulation of the food web processes demonstrated that the reduction of fishing (from 286 vessels in 1981 to 52 vessels in 2009) has resulted in clear reductions of the overall impacts on biomass (bycatch) and trophic levels, this including overall impacts on the structure and function of the habitat. These effects will however increase as fishing effort increases (Bustamante *et al.*, 2010).

3.4.8.3 Habitats Information (PI 2.4.3)

Information to support management actions for habitats derives from the ecological risk assessments, a number of historical and recent in-depth research projects which in combination, have produced a digital spatial library describing the state, composition and spatial variability of the NPF’s habitats (Bustamante *et al.*, 2010).

Although research on ecological effects of trawling in the NPF started in the early 1990s the effects of fishing on the benthic habitats, communities and key ecological processes have been addressed only since 2000s. The first study such study was a desktop evaluation of historical environmental and biological data (Hill *et al.* 2002). The aim was to identify environmental surrogates that could be used to characterise the impacts of prawn trawling in the NPF. This study, which relied mostly on historical data from prawn trawl samples, was only able to identify weak surrogates because of the lack of simultaneous, integrated and dedicated sampling for describing and characterising the different benthic habitats of the fishery. This project developed a basic and local management strategy evaluation (MSE) model for trawling impacts that had a good fine-scale trawling pattern model, but used depletion parameters from the Great Barrier Reef and a theoretical recovery model that required validation (Bustamante *et al.*, 2010).

Depletion experiments were also undertaken by CSIRO, measuring the depletion of benthos caused by a single trawling event and the recovery of the benthos following that event (Haywood *et al.* 2005). That project provided NPF specific parameters for depletion and recovery of the MSE model

developed in the first study. Some key information on the wider regional distribution of habitats, has been also provided by this project based on 2005 surveys (Bustamante *et al.*, 2010).

In 2007 a list of 157 habitats identified in the NPF managed area were risk assessed based on all the information available at the time. Knowledge of benthic habitats within the NPF was largely confined to the Gulf of Carpentaria, with little known from the greater area outside the Gulf that falls within the jurisdictional boundary of this fishery. The list of coastal margin and inner shelf habitats has been generated from limited seafloor image data of inshore fringing reefs in waters ~15-50m (CSIRO, survey SS-04-05), literature and expert opinion. For outer shelf and upper slope seabed habitats, the habitat types have been inferred from (1) the presence of known coarse-scale habitat types i.e. 'geomorphic features' (Geoscience Australia, National Bioregionalisation) and (2) the presence of fine-scale habitats known from better known adjacent or similar fishery areas where surveys have taken place. Only the coastal margin and inner shelf habitats were assessed in the PSA for this fishery.

A third project to address habitat impacts and larger ecosystem impacts, by Bustamante *et al* (2011) had the objective to provide key information on ecosystem processes and benthic habitats at the broader spatial scale, and provided models required to develop a spatial management framework in the NPF. The project considered: (a) recent changes in effort levels; (b) spatial management scenarios that evaluate the effects on benthic habitats and communities; and (c) informed on some aspects of indirect ecosystem effects for the scenarios considered. More specifically, this project developed and evaluated a range of management strategy scenarios for the complex spatially heterogeneous effects of prawn trawling on benthic habitats and communities.

The most recent project, Pitcher *et al.* 2016, collated data and mapped distributions of predicted demersal assemblages and associated habitats, as well as data for current NPF fishing effort, fishery closures and marine reserves, to provide: 1) quantification of the overlap of fishing effort and intensity with each mapped assemblage, 2) quantification of the overlap of each mapped assemblage with areas of spatial management that exclude fishing, such as closures and reserves, 3) a gap analysis and prioritization of which mapped assemblages, and in which fisheries, may require future focus for AFMA's fishery ERAs. 4) qualitative assessment of the potential risk implications for any habitat forming biota (if/where data available) in mapped assemblages with high exposure to fisheries, given current spatial management. This study was part of a bigger project that included Commonwealth managed fisheries in Australia.

The information available in the NPF allows the nature, distribution and vulnerability of all main habitat types in the three subfisheries to be known at a level of detail relevant to the scale and intensity of the fishery from coarse scale habitat mapping, benthic impacts studies and ERAs. Sufficient data are available from NPF specific sources (benthic impact and spatial management studies) or other sources (i.e. from the Australian offshore oil and gas industry) to allow the nature of the impacts of the fishery on habitat types to be identified and there is reliable information on the spatial and temporal extent of interactions (historical and current trawl footprint and fishing effort data).

Considering the fishing gear in white banana prawn subfishery does not overlap with the depth where benthic habitats are, the distribution of habitat types and their range, with particular attention to the occurrence of vulnerable habitat types is less relevant. The impact of white banana subfishery is likely to be indirect, affecting the broader ecosystem, and this will be considered under the Ecosystem PIs.

Ongoing information gathering is mainly in the form of VMS monitoring of vessel behaviour with regard to the temporal and spatial closures and to estimate trawl footprint. Research studies on habitat impact also inform a habitat management strategy, although the five -year Strategic Research Plan 2014-2018 highlights as research priorities only studies of the commercial prawn habitat, i.e. seagrass and mangrove habitats and the ecological services that they provide to juvenile tiger and banana prawn recruitment and survival (AFMA, 2014b).

3.4.9 Ecosystem (P 2.5)

An ecosystem consists in the spatially explicit association of abiotic and biotic elements within which there is a flow of resources, such as nutrients, biomass or energy (Crooks, 2002, in Griffiths *et al.*, 2007). In addition to the potential impacts to individual elements of the ecosystem such as species and habitats described in the preceding sections, trawl fisheries pose the risk of altering the structure and the flow of resources by removals (target, retained and bycatch species) and additions (discards), as well as by creating turbidity.

The NPF ecosystem includes two embayments, the GoC and the JBG and the northern coast of Arnhem Land, plus parts of Timor Sea and Arafura Sea to the Australian EEZ limits. The GoC is a large (370,200 km²), shallow (<70 m) tropical marine embayment located along Australia's northern coastline between Cape York Peninsula to the east and the Wessel Islands and Arnhem Land to the west. The GoC is an oligotrophic system and annual river inputs are not major contributors for the overall primary production. However, due to a coastal current that separates coastal area (<20m deep) from the deeper gulf, annual river inputs are likely to be significant for the primary production in coastal area. The JBG is an extensive, shallow (generally < 100 m) platform adjacent to the Sahul Shelf. The platform is one of the widest in the world, measuring 1170km from the southern shorelines of the gulf to the edge of the shelf (Lees 1992, in Przeslawski *et al.*, 2011). The western boundary of the JBG joins with the Indian Ocean, while the northern boundary joins with the Timor Sea. The JBG also receives significant loads of nutrients and sediment from the numerous rivers in the region, with high productivity in the coastal area (Lees 1992 in Przeslawski *et al.*, 2011b), and is dominated by tidal and wind-driven currents according to the season.

3.4.9.1 Ecosystem Outcome (PI 2.5.1)

The impacts of trawling on the ecosystem have been studied in-depth in the GoC, the area with the highest trawl footprint (approx. 2.5% of GoC plus part of Arafura Sea up to the EEZ limit, estimated from Pitcher *et al.*, 2016). For the other two regions, the trawl footprint is too small compared to the spatial extent of the ecosystem (0.8% of Arafura shelf, north of Arnhem Land to the EEZ limit, and 0.6% of JBG plus Timor Sea up to the EEZ limit) to pose a risk of serious and irreversible harm to the structure and function of the ecosystem. In addition, fishing occurs in areas with high natural disturbance (i.e. frequent cyclones) and the effects of prawn fishing would be undistinguishable.

Previous research has characterized the NPF ecosystem as driven by land-sea interactions, particularly freshwater input which triggers productivity in the form of benthic diatoms and tropical plankton. These studies found no evidence that the fishery affects this ecosystem in a significant way (MRAG, 2012).

Tiger Prawn Subfishery

Removal, modification and disturbance of the seabed biota by trawling is well documented. The extent and effects of these impacts on the ecosystem are not completely understood, although they have been studied extensively in Australia, (e.g. on the Great Barrier Reef, Poiner *et al.* 1998, in Griffiths *et al.*) and a more recently in the NPF (Haywood *et al.* 2005, Bustamante *et al.*, 2010).

There is a risk that by removing a species or a size range of the population, the food web dynamics may change. This may be due to an increase in prey species or competitive species, and possible declines of predators that rely on the species removed by trawling (Griffiths *et al.*, 2007). The tiger prawn subfishery generally processes and discards bycatch overboard at sea. Thus, besides removals, there is also the potential that discards provide additional food resources for sharks and birds, which may have the opposite effect on these species groups, and probably has flow-on effects through community.

At ERAEF level 1, SICA, the effects of removing target species and incidentally caught species were

assessed as minor, however, some major reductions in fishing effort and trawl footprint took place since this assessment. Currently, fishing in the NPF overall occurs in 1.6% annually (2.7% multiannual footprint) of the managed area and in tiger prawn subfishery, only for about 4 months each year and fishing occurs at night. Most effort is concentrated in the GoC (Groote area). It is likely that species composition was affected over the years by removing target and non-target species. Although tiger prawns are the primary target, historically, bycatch has been very high (30,000 t p.a. overall) and taxonomically diverse. The intensity of the impact was considered moderate as fishing is localised due to suitable habitat, while the consequence score was minor (Griffiths *et al.*, 2007), even at levels of fishing that were higher than today.

Discarding effects on ecological communities were also assessed at SICA and were thought to most likely affect distribution of community if scavengers and predators (e.g. sharks and trevally) are attracted to discard sites. The intensity was scored as major because high volumes of bycatch were discarded extensively (estimated 30,000 t per year). Consequence was scored as moderate because the fishery discards high volumes of diverse bycatch but localised and may cause more permanent changes in population size of scavenger species. Confidence was scored as high as extensive data documents discarding effects (Griffiths *et al.*, 2007). Since the ERAEF major reductions in fishing effort took place and the multiannual trawl footprint was reduced to only 2.7% overall for all three subfisheries (Pitcher *et al.*, 2016). The quantity of the discarded bycatch, therefore, has been reduced because of the reduction in fishing effort as well as reduction in bycatch to prawn ratio which was estimated in this MSC reassessment as about 2:1. This was estimated based on recent data from AFMA SO Program provided in Fry & Miller, 2016, and it might not be very accurate because AFMA SOs assess bycatch quantity based on subsamples and not entire catch. However, it is an indication that discarded bycatch has been reduced considerably from the 8:1 ratio estimated by Dell *et al.* (2009) based on Stobutzki *et al.* (2002) data.

Apart from the direct impact of trawls on the ecosystem, trawling may have indirect effects such as the suspension of fine sediments. A study by Hiddink *et al.* (in Haywood *et al.*, 2005) showed that the impacts of trawling were greatest in areas with low levels of natural disturbance, while the impact of trawling was small in areas with high rates of natural disturbance. The GoC, as well as the NPF managed area overall has a high incidence of cyclones and these major natural events represent a significant disturbance. Griffiths *et al.* (2007) assessed these effects at SICA under Habitat component. Substratum processes of fine sediment based habitats were considered to be most disturbed by contact with prawn trawl gear. Muddy sediments in particular were considered potentially likely to be resuspended in water column, with threat of translocation in strong current zones, alteration of sediment architecture for shallow infaunal species by mechanical action of gear on seafloor, and smothering of suspension feeding communities within the range of the gear activity. The intensity of these effects were scored as minor because if they occur, they are highly localised. The consequence score was minor because the area is prone to greater effects by natural disturbance phenomena (Griffiths *et al.*, 2007).

Griffiths *et al.* (in Bustamante *et al.* 2010, Appendix 9) used Ecopath with Ecosim model (EwE6) to explore the ecological effects of demersal trawling on the GoC ecosystem from 1970 to 2010. The authors explored the potential effects of the recent changed effort regimes from 2005-2010. The model was calibrated using time-series data of biomass, fishing mortality and catch for tiger prawns. The model positioned the main prawn species (tiger prawns) as relative low abundance, intermediate consumers. The authors found that tiger prawns could presumably play a keystone function in the ecosystem –i.e. they have a disproportionate + and - trophic effects despite their relative low biomass (Bustamante *et al.*, 2010).

The model described well the historical dynamics of trawling over the past 40 years showing clear biodiversity impacts by lowering the mean trophic levels of the catches (TL). The main impacts

occurred in the expansion 70s to 80s periods when the TL was the lowest. However, when fishing effort was reduced (in the mid to late 80s) the TL increased steadily to values in 2010 close to the ones estimated for the mid 70s (Bustamante *et al.*, 2010).

The simulated historical effects of trawling showed to be positive and negative impacts on relative biomass of biodiversity. The small sharks, banana prawns, mud crabs, large gastropods (conchs) and echinoids (urchins) were the most negatively affected functional groups with reductions up to 50% (small sharks). Conversely, tiger prawns (150%), sand crabs and the large shark groups increased. The evaluation of the 2005-2010 reductions of fishing showed to have very small effects in the overall biomass of all functional groups, with biomass variation of <20%, with similar groups responding positively and negatively (Bustamante *et al.*, 2010). Ecosystem modelling results suggest that the ecosystem in the GoC has been largely influenced by trawling, but due to the drastic reduction of fishing (from 286 vessels in 1981 to 52 vessels in 2009) these impacts on biomass removal and trophic levels have been reduced. The authors hold that the rapid responses to fishing reduction suggested that the model means the GoC ecosystem is resilient to fishing, but it does not mean the fishing does not have impacts (Bustamante *et al.*, 2010).

Dichmont *et al* (in Bustamante *et al.*, 2010, Appendix 10), modelled the effects of different spatial management scenarios that included various forms of closures to fishing while achieving the biodiversity or specific fisheries management objectives. As most of the fishery closures at the time of the study (as well as the current ones) were aimed at minimising the capture of small prawns and avoiding key habitats such as seagrass beds (Kenyon *et al.* 2005), Dichmont *et al.* study did not test those closures because it is difficult to separate their effects from other management options. The paper therefore tested spatial management options with objectives other than those for target species management, i.e. for ecosystem objectives (in Bustamante *et al.*, 2010). More exactly this was a Management Strategy Evaluation (MSE) extended from target species to ecosystem.

The range of spatial closures investigated in the study mentioned above included:

- mocked up large biodiversity-centric MPAs (note that the actual MPAs were introduced in 2012) where no prawn trawling is allowed,
- ecological risk assessment (ERA) closures aimed to reduce the number of non-target species that were assessed as being at risk (Griffiths *et al.* 2007, AFMA 2009),
- closures that have at their core the objective to reduce the overall impact of trawling on key taxa groups such as ETPs.

The different closures were assessed in terms of benthic and ecosystem impact while assuming effort was shifted with no economic or target species impact (maintaining a bio-economic model of management with tiger prawns at MEY). Although the closures used in this paper were examples only, they offer information of the likely outcome of the actual MPAs that have been introduced in 2012 (closing a higher area than the mocked-up ones in this study)

The main findings of the study were that either no or small changes in biomass were experienced for most functional groups in each closure scenario in relation to the base case scenario. These results also confirmed that most of the significant changes, both positive and negative occur in the main tiger fishing grounds, where most of the trawling for tiger-endavour prawns occurs. Negligible changes occurred in the inshore and offshore region where there is very little or no trawling. Despite the small changes detected across all scenarios, the relative biomass of prawns was slightly affected –e.g. adult tiger prawns were positively affected by some ERA closures but negatively by MPAs. In general, all closures tended to predict increases in top predator groups like sharks that in turn fed on secondary consumers, like prawns, which could explain the decrease on prawn biomass within MPAs (Dichmont *et al.*, in Bustamante *et al.*, 2010).

The results of the study have also shown that some groups are being more, nil or less affected by

trawling and confirmed that different groups respond spatially different among the scenarios. Some groups were predicted to have their biomass increased inside spatial closures like with sessile epibenthos, sea snakes, and sawfish while in others their predicted biomass decreases, as with echinoids, and bivalves for example. The authors also found that most groups that respond negatively to closures are those that are in general preys of secondary consumers and predatory groups like cephalopods and small crustaceans. Conversely, most top predatory groups increased their biomass inside and around closures as with rays and benthic carnivore fish. These findings are consistent with the expected underlying food web dynamics that is being imposed by trawling (Dichmont *et al.*, in Bustamante *et al.*, 2010). The same authors note that the imposed closures had in cases a clear spilling-over effects into the surrounding non-closed cells, like in the cases of the sea snakes and cephalopods (Dichmont *et al.*, in Bustamante *et al.*, 2010).

Ecosystem modelling studies (Griffiths *et al.*, in Bustamante *et al.*, 2010, Annex 9) have shown that even though prawn trawling clearly impacted the GoC ecosystem, the substantial reduction in the fishing effort and in trawl footprint led to changes in the positive direction. The fast response to these management actions shows the resilience of the ecosystem. The MSE for ecosystem impacts modeled scenarios (Dichmont *et al.*, in Bustamante *et al.*, 2010) have shown that the introduction of MPAs had the potential to protect biodiversity overall and especially some of the more susceptible ETPs such as sawfish and sea snakes, resulting in increased biomass in the MPAs closed areas. Currently, about 20% of the NPF managed area is closed to trawling in CMRs and MPAs, including previously trawled areas. This is much higher than the current annual and multiannual trawl footprint. Considering all the ecosystem impact research focused on the impacts from the tiger prawn subfishery and ERAEF assessments, there is evidence that the tiger prawn subfishery, at the current levels of activity, is highly unlikely to disrupt the key elements underlying ecosystem structure and function to a point where there would be a serious or irreversible harm.

White Banana Prawn Subfishery

At ERAEF level 1, SICA, the effects of removing target species and incidentally caught species in banana prawn fishery were assessed as minor, however, some major reductions in fishing effort and trawl footprint took place since this assessment. Currently, fishing in the NPF overall occurs in 1.6% annually (2.7% multiannual footprint) of the managed area and in white banana prawn subfishery, only for about 6 weeks each year. Most effort is concentrated in the eastern side of the Gulf of Carpentaria (Bold area) and fishing occurs day and night but localised due to targeting prawn schools. The bycatch quantity is lower than in the tiger prawn subfishery. The intensity of the impact was considered minor because studies have shown little detectable change in species composition (Stobutzki *et al.* 2003) even though prawn stock was fully fished (Griffiths *et al.*, 2007). Currently the fishing effort is even lower than at the time of the ERA and the gear does not make contact with the sea floor where the impacts of demersal trawling are usually most visible.

Discarding effects on ecological communities from banana fishery were also assessed at SICA and were thought to most likely affect distribution of community if scavengers and predators (e.g. sharks and trevally) are attracted to discard sites. The intensity was scored as moderate because high volumes of bycatch were discarded extensively but less than in the tiger prawn subfishery. Consequence was scored as minor because the discards are quickly consumed and changes in scavenger species populations are temporary. Confidence was scored as high as extensive data documents discarding effects (Griffiths *et al.*, 2007). Since the ERAEF, major reductions in fishing effort took place and the multiannual trawl footprint was reduced to only 2.7% overall for all three subfisheries (Pitcher *et al.*, 2016). The quantity of the discarded bycatch and the impact from this activity therefore, have been reduced.

Apart from the direct impact of trawls on the ecosystem, trawling may have indirect effects such as the suspension of fine sediments. White banana prawn subfishery is not likely to create suspension

of fine sediments and turbidity because the gear is deployed within five meters above the sea bottom.

Griffiths *et al.* (in Bustamante *et al.* 2010, Appendix 9) used Ecopath with Ecosim model (EwE6) to explore the ecological effects of demersal trawling on the GoC ecosystem from 1970 to 2010. The model was calibrated for tiger prawn subfishery. Ecosystem modelling results suggest that the ecosystem in the GoC has been largely influenced by prawn trawling, but due to the drastic reduction of fishing (from 286 vessels in 1981 to 52 vessels in 2009) the impacts on biomass removal and trophic levels have been reduced. The authors hold that the rapid responses to fishing reduction suggested that the model means the GoC ecosystem is resilient to fishing, but it does not mean the fishing does not have impacts (Bustamante *et al.*, 2010).

Considering that fishing intensity and trawl impacts are lower in the white banana prawn subfishery all the ecosystem impact research shows current impact are lower than in the past, plus the ERAEF assessments, there is evidence that the white banana prawn subfishery, is highly unlikely to disrupt the key elements underlying ecosystem structure and function to a point where there would be a serious or irreversible harm.

Red-legged Banana Prawn Subfishery

The current annual trawl footprint in the JBG is less than 1% (Pitcher *et al.*, 2016; Jarret *et al.*, 2015). Although the ecological risk from the red-legged banana subfishery on communities was not assessed at ERAEF level 1, SICA, separately, it was included in the assessments for the tiger prawn and banana prawn fisheries, red-legged banana prawn subfishery being active in both banana and tiger season. The fishing effort in this subfishery is much lower than in the other two subfishery and the risk from this subfishery to ecosystem is lower. This is evidence that the red-legged banana prawn subfishery, is highly unlikely to disrupt the key elements underlying ecosystem structure and function to a point where there would be a serious or irreversible harm.

3.4.9.2 Ecosystem management (P 2.5.2)

The NPF Management Plan defines long-term management objective consistent with achieving the outcomes expressed by MSC PI 2.5.1 in Objective 1, Ensure the utilisation of the fishery resources within the Northern Prawn Fishery is consistent with the principles of ecologically sustainable development and the exercise of the precautionary principle (AFMA, 2012a).

An important measure for ecosystem impact in the tiger prawn, white banana prawn and red-legged banana prawn subfishery is trawl footprint management. The monitoring of the footprint allows a risk-based approach to evaluating potential impacts on the ecosystem. Management strategies defined for each ecosystem component are in place, as presented in previous sections. These strategies combined together constitute a plan to mitigate impact on the ecosystem overall. In addition, different scenarios for a spatial management strategy have been evaluated (MSE for ecosystem impacts, Griffiths *et al.*, in Bustamante *et al.*, 2010, Annex 10) and the MPAs scenario predicted some of the best results for biodiversity overall and for ETP species such as sea snakes and sawfish. In 2012, extensive Commonwealth Marine Reserves (CMR) for biodiversity protection were implemented and the effects predicted by the spatial management study (or better due to the extent of areas closed) are likely to be achieved. As other spatial management scenarios did not yield better predictions, even though the CMR network is not a measure of the NPF management, according to the study, these are likely to achieve the ecosystem outcome required by the MSC standards.

Major indicators in ecosystem management are the ones for the extent of the trawl footprint and the annual catch of the target species that is maintained around their target reference point. In addition, byproduct, bycatch and ETP catch rates are monitored through logbook reporting, CMO, AFMA SO and NPF prawn monitoring programs. Monitoring trends in bycatch and byproduct species allows identification of changes in trophic structure. The strategy for ecosystem impacts is based on well-understood functional relationships especially between the tiger prawn subfishery, which produces

most impact, and the components and elements of the ecosystem. The focus on tiger prawn subfishery impacts is precautionary because the impacts from the other two subfisheries are lower. This plan provides for development of a full strategy that restrains impacts on the ecosystem to ensure the three subfisheries do not cause serious or irreversible harm. The ecosystem model of Dichmont *et al.*, (in Bustamante *et al.*, 2010, Annex 9) brings evidence that the fishery is highly unlikely to disrupt the key elements underlying ecosystem structure and function to a point where there would be a serious or irreversible harm.

The management strategy focuses on minimising impacts on ecosystem through maintaining the biomass levels of prawns and other retained species as well as minimizing bycatch, in order to minimise the potential for trophic perturbations. Other arrangements, such as gear restrictions, spatial and seasonal closures, a limited number of vessels, ongoing monitoring and research, further minimise the potential for ecosystem impacts through reducing potential impacts on the ecosystem components (i.e. retained non-target species, bycatch, ETP species and habitats). The NPF introduced measures to protect the ecosystem components early on, including closures to sensitive habitat, the use of TEDs and BRDs, ongoing monitoring programs. Ecosystem modelling indicates that the trawling activities in Gulf of Carpentaria in the last 40 years did not affect overall biodiversity and cannot be distinguished from other sources of variations in community structure (Dichmont *et al.*, in Bustamante *et al.*, 2010, Annex 9).

Evidence that the measures are being implemented successfully can be derived from VMS data that shows compliance with fishing effort and with various permanent and seasonal closures, compliance monitoring that shows there is no systematic non-compliance in the NPF, gear monitoring which assesses compliance with the legislated gear and gear modification.

3.4.9.3 Ecosystem Information (PI 2.5.3)

Information is adequate to broadly understand the key elements of the ecosystem and main interactions between the NPF subfisheries and these ecosystem elements can be inferred from existing information, and have been investigated in detail. As shown in sections above, the outcome from the main interactions of the subfisheries on each element: target, retained, bycatch and ETP species as well as habitat have been investigated in detail. The impacts of the NPF subfisheries on target, Bycatch, Retained and ETP species were identified and the main functions of these components in the ecosystem are understood. These functions have been also studied in multidisciplinary studies and the impacts on the ecosystem overall have been evaluated and sufficient information is available on the impacts of the fishery on the components and elements to allow the main consequences for the ecosystem to be inferred.

The main project to approach trawling effects on ecosystem (Bustamante *et al.*, 2010) developed a multidisciplinary approach to quantitatively evaluate the ecological effects of trawling on the ecosystem, and delivered analytical tools to evaluate such effects in spatially-explicit contexts under multiple management objectives. The project was focused on the benthic-pelagic ecosystem of the tiger prawn subfishery fishing grounds in the Gulf of Carpentaria (GoC). The overarching goal of this project was to deliver, to support the NPF management with evidence-based advice with regard to the spatial management of trawling impacts and to allow the evaluation of alternative spatial management options addressing fishing impacts, while achieving fisheries economic objectives, as well as other conservation and environmental management goals (Bustamante *et al.*, 2010).

This project determined and evaluated the likely effects of trawling on the biodiversity and some known ecological processes. For this, historical datasets were used and data from a survey conducted in 2005. During the survey samples along a trawling intensity gradient and across all regions of the south-western GoC affected by trawling, while controlling for environmental variability. Also,

information from all existing field surveys was used to in the construction of the food web, species distribution and risk assessment models (Bustamante *et al.*, 2010).

Ecopath with Ecosim and Ecospace software was used to develop a trophic mass-balance (food-web) model of the GoC ecosystem. The *Ecopath* model was constructed for 1990 and forecasts were run for a 20-year time periods. The model incorporated 53 functional or trophic groups based on similarities in diet, habitat, foraging behaviour, size, consumption and rates of production, as well as 14 fishing fleets for which landings and effort data were available.

The bioeconomic stock and ecological risk assessment models with the food web, effect of trawling and species distribution models, were integrated in a spatial management strategy evaluation framework (spatial MSE). The spatial MSE combined various tools designed for different objectives (e.g. stock, economics, risk, biomass, etc.), and it has the ability to evaluate multiple objectives, at multiple temporal, spatial and ecological scales.

The results from the scenarios simulated so far are considered as proof-of-concept for the delivery of an operational spatial management framework (Bustamante *et al.*, 2010). These have not been applied to manage the fishing or to conserve biodiversity yet, although the predicted effect of the MPAs scenario is likely to be similar to the effect of the actual MPAs and CMRs implemented in 2012.

Information continues to be collected on the impacts of the fishery on the key ecosystem components at a sufficient level to detect any increased risk and update the risk assessments. Fishers are required to report all retained species catches, effort, any ETP species interactions and fishing location in daily logbooks. Fishing activities (location and intensity) are also monitored by VMS. There is an integrated monitoring system in place that ensures any increases in risk are identified and investigated before serious or irreversible harm occurs. Information is sufficient to support the development of strategies to manage ecosystem impacts.

3.5 Principle Three (P3): Management

3.5.1 Legal and customary framework (PI 3.1.1)

As a matter of Australian domestic law, the Offshore Constitutional Settlement provides for the Australian states and the Northern Territory to manage fisheries out to 3 nautical miles from the coast, and for the Australian Government to manage fisheries from three to 200 nautical miles. The settlement is not set out in one single document but is found in the legislation that implements it, including fisheries legislation for South Australia. However, these default arrangements are frequently varied through instruments known as offshore constitutional settlement arrangements.

Australia is a signatory to a number of international agreements and conventions (which it applied within its EEZ), such as:

- *United Nations Convention on the Law of the Sea* (regulation of ocean space);
- *Convention on Biological Diversity and Agenda 21* (sustainable development and ecosystem based fisheries management);
- *Convention on International Trade in Endangered Species of Wild Fauna and Flora* (CITES; protection of threatened, endangered and protected species);
- *Code of Conduct for Responsible Fisheries* (standards of behaviour for responsible practices regarding sustainable development);
- *United Nations Fish Stocks Agreement*; and

- State Member of the *International Union for Conservation of Nature* (marine protected areas).

The Environment Protection and Biodiversity Conservation (EPBC) Act 1999⁴⁵ is the Australian Government's (hereafter referred to as the 'Commonwealth Government') central piece of environmental legislation. The EPBC Act is administered by the Commonwealth DoE and provides a legal framework to protect and manage nationally and internationally important flora, fauna, ecological communities and heritage places — defined in the EPBC Act as matters of national environmental significance. The DoE is responsible for acting on international obligations on a national level, by enacting policy and/or legislation to implement strategies to address those obligations.

The Commonwealth DoE, through the Commonwealth Minister, has a legislative responsibility to ensure that all managed fisheries undergo strategic environmental impact assessment before new management arrangements are brought into effect; and all fisheries in Australia from which product is exported undergo assessment to determine the extent to which management arrangements will ensure the fishery is managed in an ecologically sustainable way in the long term.

All Commonwealth managed fisheries conform to Commonwealth Government fisheries and environmental law, including the EPBC Act.

There are formalised cooperative arrangements for developing and implementing national policies and strategies in State jurisdictions. The Council of Australian Governments'⁴⁶ (COAG) Standing Councils are established to achieve COAG's strategic themes by pursuing and monitoring priority issues of national significance which require sustained, collaborative effort and address key areas of shared Commonwealth, State and Territory responsibility and funding.

COAG's Standing Council on Primary Industries⁴⁷ representation includes State, Territory and Commonwealth Ministers whose primary roles is to develop and implement policies and strategies for achieving agreed national approaches to biosecurity, productivity and sustainability of primary industries (including fisheries and forestry industries) and food security. It aims to encourage greater collaboration and promote continuous improvement in the investment of research and development of resources nationally.

The Northern Prawn Fishery is located in the Australian EEZ, but also inside the boundaries of the States of Northern Territory, Queensland and Western Australia. The fishery is managed by the Australian Fisheries Management Authority (AFMA)⁴⁸ in accordance with the Fisheries Management Act (FMA) of 1991 and Fisheries Management Regulations 1992, the Fisheries Administration Act 1991 and the Fisheries (Administration) Regulations 1992. Commonwealth-managed fisheries are also subject to aspects of the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) and the Environment Protection and Biodiversity Conservation Regulations 2000. The NPF commercial export fisheries have been assessed using the Australian National ESD Framework for Fisheries⁴⁹, in particular, the *Guidelines for the Ecologically Sustainable Management of Fisheries*, 2007⁵⁰. The ESD includes the principles of ecologically sustainable target and bycatch species, ecological viability of bycatch species, and impact of the broader marine ecosystem.

⁴⁵ http://www.austlii.edu.au/au/legis/cth/consol_act/epabca1999588/

⁴⁶ <https://www.coag.gov.au/>

⁴⁷ <http://www.mincos.gov.au/Pages/default.aspx>

⁴⁸ <http://www.afma.gov.au/>

⁴⁹ <http://www.environment.gov.au/marine/fisheries/commonwealth/northern-prawn>

⁵⁰ <https://www.environment.gov.au/system/files/resources/97ff9461-5ccf-49cb-9368-8bde5f243c0b/files/guidelines.pdf>

The above laws created a statutory authority model for fisheries management whereby day-to-day management of fisheries are vested with AFMA, with the broader fisheries policy, international negotiations and strategic issues being administered by DAFF⁵¹. The Fisheries Administration Act establishes AFMA to manage Commonwealth fisheries. The overall objectives of the FMA 1991 form the basis for the management of all Commonwealth fisheries. The key EPBC Act 1999 requirements that apply relate to the need for a strategic assessment of the fishery management arrangements, and the management of protected areas and species.

Key aspects of the policy framework for Commonwealth fisheries are articulated in:

- The AFMA Corporate Plan⁵²
- Commonwealth Fisheries Harvest Strategy Policy and Guidelines (DAFF, 2007)⁵³.

Sections 161 and 165 of the FMA provide appeal rights for decisions taken by AFMA through administrative means (internal AFMA review, appeal to the Administrative Appeals Tribunal and the Statutory Fishing Rights Allocation Review Panel) and judicial means through appeal to the Federal Court. Australian Fisheries Management Authority decisions to apply the precautionary principle have been upheld in a number of cases, following referral to the Administrative Appeals Tribunal (AAT) (Weier & Loke, 2007). Fishers are advised of their appeal rights and the processes involved. In addition to these processes, the consultation and advisory processes established by AFMA provide mechanisms for the airing and discussion of different perspectives on fisheries management issues by stakeholders. Legal advice on management and appeals is provided by legal expertise within AFMA and by external, independent legal advisers as required.

The consultation and decision making process in place actively seeks to avoid legal challenges. Four forms of dispute resolutions are as follows (Mark Lindsey Temple, AFMA, pers com, 14 February, 2017).

(1) Sections 161 and 165 of the FMA provide appeal rights for decisions taken by AFMA through administrative means (internal AFMA review, appeal to the Administrative Appeals Tribunal and the Statutory Fishing Rights Allocation Review Panel) and judicial means through appeal to the Federal Court. These dispute resolution mechanisms have been tested (Weier & Loke, 2007) and proven to be effective. Cases such as *Arno Blank vs AFMA*⁵⁴ challenged the application of the precautionary principle. AFMA's application of the precautionary principle was upheld.

(2) Plans of Management (made pursuant to section 17) where AFMA must, in writing, after consultation and after giving due consideration to any representations mentioned in subsection (3), determine plans of management for all fisheries. Before determining a plan of management for a fishery, AFMA must prepare a draft of the plan and, by public notice: (a) state that it intends to determine a plan of management in respect of the fishery; and (b) invite interested persons to make representations in connection with the draft plan by a date specified in the notice, not being less than one month after the date of publication of the notice in the Gazette;

(3) AFMA enters into with the NPF contain a dispute mechanism clause which encourages both AFMA and the NPF to enter into Alternative Dispute Resolution process in an attempt to settle any dispute with the view to avoiding a Tribunal or Court.

(4) Fishers are advised of their appeal rights and the processes involved. In addition to these processes, the consultation and advisory processes established by AFMA provide mechanisms for the airing and discussion of different perspectives on fisheries management and arguably serve to

⁵¹ <http://www.daff.gov.au/fisheries>

⁵² www.afma.gov.au/wp-content/uploads/2015/07/AFMA-2015-2018-Corporate-Plan.pdf

⁵³ <http://www.agriculture.gov.au/SiteCollectionDocuments/fisheries/domestic/hsp.pdf>

⁵⁴ <http://www.austlii.edu.au/au/cases/cth/AATA/2000/1027.html>

avoid potential legal disputes. Legal advice on management and appeals is provided by legal expertise within AFMA and by external, independent legal advisers as required. Historically one legal challenge was made to NPF 1989 Management Plan in relation to the compulsory reduction in effort within the. The main arguments were that the amendments to the plan to implement the reduction in effort were ultra vires, and the restructuring program represented an acquisition of rights on unjust terms under the constitution. The challenge was unsuccessful (Josh Fielding, AFMA, email of 21/12/2011, cited in MRAG, 2012).

A system or mechanism to formally commit to the legal rights created explicit or established by custom on people dependent on fishing for food (non-commercial use) is enshrined in the *Native Title Act*". This allows for special provision for 'traditional fishing' is made where they might apply in the contexts of both Commonwealth and State Fisheries Law. The Northern Prawn fishery is a specialist offshore commercial fishery. Indigenous rights are however considered in the context of The Aboriginal Land Act 1978 (NT) 12(1)⁵⁵ which empowers the Administrator to close the seas adjoining and within 2km of Aboriginal land to others who are not Aborigines entitled by tradition to enter and use the seas in accordance with that tradition. Before doing so he may (and in case of dispute he must) refer a proposed sea closure to the Aboriginal Land Commissioner. These issues are taken into account through NORMAC consultation processes and in the context of closed areas discussions. Once seas are closed it is an offence for a person to enter or remain on these seas without a permit issued by the relevant Land Council.

3.5.2 Roles and Responsibilities and Consultation (PI 3.1.2)

AFMA is a statutory authority with policy input being provided to the Minister via DAFF. All aspects of the fishery management system including the research, surveys, stock assessments, harvest strategies, and management controls are controlled by AFMA.

The Commonwealth model of fisheries management has a number of features that distinguish it from many other countries, the most prominent of which is the partnership approach with industry and other stakeholders. Under this model, the involvement of industry is recognised as being vital to successful fisheries management. For administrative purposes, AFMA has grouped the fishery resources in the Australian Fishing Zone into 21 fisheries that are identified by species, fishing method and/or area.

AFMA's responsibilities are shared between a Commission and the Chief Executive Officer:

- The Commission is responsible for domestic fisheries management.
- The Chief Executive Officer is responsible for foreign compliance, and for assisting the Commission and giving effect to its decisions.
- The Chief Executive Officer is responsible for the agency that supports these functions.

The CEO is also a Commissioner, and is appointed on a full-time basis. All other Commissioners are appointed on a part-time basis. Appointments are made by the Australian Government Minister responsible for fisheries.

Commissioners are appointed on the basis of their high level of expertise in one or more of the fields of fisheries management, fishing industry operations, science, natural resource management, economics, business or financial management, law, public sector administration or governance. Commissioners cannot hold any executive position in a fishing industry association, nor can they have a controlling interest or executive role in any entity holding a Commonwealth fishing

⁵⁵ http://www.austlii.edu.au/au/legis/nt/consol_act/ala126/s12.html

concession. The current eight Commissioners were appointed on 1 September 2016 for three year terms of office.

The Minister tends to set the policy framework (e.g., see the Ministerial Direction) – the Commissioners oversee the application of the framework in Commonwealth managed fisheries and for ensuring that adequate resources and expertise are available to meet AFMA's legislative obligations. The Commission has three committees to assist in the conduct of its business: the Finance and Audit Committee, the Research Committee and the Environment Committee. The outcomes of Commission meetings are reported to stakeholders as well as to the public through the AFMA website.

As part of AFMA's partnership approach to fisheries management, it has established Management Advisory Committees (MACs) for each major fishery that it manages. MACs are AFMA's main point of contact with client groups in each fishery and play an important role in helping AFMA to fulfil its legislative functions and pursue its objectives. The Committees provide advice to AFMA on a variety of issues, including on-going measures required to manage the fishery, the development of management plans, research priorities and projects for the fishery. The MACs are also charged with ensuring that processes are in place for industry and other interested stakeholders to receive advice from researchers in a form appropriate to the audience.

Roles and responsibilities and advice about operation and participation in MACs and Resource Assessment Groups (RAGs) are provided in:

- Guide to How MACs Work (AFMA, 2003)
- Fisheries Administration Paper (FMP) No.7 - Information and Advice for Industry Members on AFMA Committees (AFMA, 2011).
- Fisheries Advisory Councils, Fisheries Management Paper No 1, (AFMA, 2015a)
- Fisheries Administration Paper Series No. 12 Resource Assessment Groups - Roles, Responsibilities and Relationship with Management Advisory Committees (AFMA, 2015b)

The MACs are intended to complement the work of fishery managers by providing a broader perspective on management options and a wide range of expertise. MACs therefore provide a forum where issues relating to a fishery are discussed, problems identified and possible solutions developed. The outcomes of these deliberations determine the recommendations that the MAC will make to the AFMA Commission. AFMA's legislation limits the number of members on a MAC to ten, in addition to the Chairperson and an AFMA officer. Increasingly, and where appropriate, AFMA has included a broader range of interest groups in this consultative process. The AFMA Commission decides on a fishery-by-fishery basis whether membership of a MAC should also reflect these wider community interests. As a general rule, revised membership arrangements are considered upon expiry of terms of appointment of existing members.

The MAC that covers the management of the NPF is known as the Northern Prawn Management Advisory Committee (NORMAC). The ten statutory members of NORMAC comprise the Chairman, five from industry, one from the conservation community, a research member (currently the chair of the Northern Prawn Resource Assessment Group), an AFMA Member (currently the Fishery Senior Manager) and a State Government appointee (rotated between Northern Territory and Queensland).

Several other observers and invited guests may also attend from time to time. These include CSIRO scientists, a representative from ABARES and non NORMAC members of the fishing industry, indigenous interests and DoE. NORMAC provides a public forum, through annual meetings, for discussion on the development of the management regime for the NPF. The first meeting of

NORMAC was held in 1984. Minutes of NORMAC meetings are publicly available on the AFMA website⁵⁶.

As explained earlier, the NPF stock assessment process is reviewed by the NPRAG⁵⁷ which provides advice to NORMAC. RAGs are not a body of the MACs and operate independently from them, although the two groups work closely together. All advice presented by RAGs is given without bias. The MACs consider the advice of RAGs and provide recommendations to the Commission based on how the alternatives will contribute to meeting overall objectives for the particular fishery (risk management) and, ultimately, to the pursuit of AFMA's legislative objectives.

The main role of RAGs is to provide advice on the status of fish stocks, substocks, species (target and non-target), and on the impact of fishing on the marine environment. This includes providing advice to MAC research sub-committees on the type of information required for stock assessments. RAGs also evaluate alternative harvest options proposed by MACs, including impact over time of different harvest strategies; stock depletion or recovery rates; confidence levels for fishery assessments; and risks to the attainment of approved fishery objectives. RAGs coordinate, evaluate and regularly undertake fishery assessment activity in each fishery. They report their recommendations through the individual fishery MACs to the AFMA Commission on issues such as the setting of total allowable catches (TACs), stock rebuilding targets, biological reference points etc. In effect, the RAGs provide advice taking account of uncertainty and seek to identify the risks associated with the alternatives (risk assessment).

In addition to the opportunities for stakeholder engagement provided by the MACs and RAGs, AFMA provide opportunities for public comment on fisheries management plans; holds an annual public meeting; requires each MAC to hold an annual public meeting; and holds around half of AFMA's Commission meetings in regional centres providing opportunities for direct access to AFMA Commissioners by stakeholders and the general public.

A summary of assigned advisory roles and responsibilities is highlighted in the table below.

⁵⁶ <http://www.afma.gov.au/fisheries/committees/northern-prawn-management-advisory-committee/>

⁵⁷ <http://www.afma.gov.au/wp-content/uploads/2016/07/NPRAG-final-minutes-18-May-2016.pdf>

Table 28. Summary of advisory responsibilities between AFMA managers.

	Item/matter/issue	NORMAC⁵⁸	NPFI/AFMA⁵⁹	NPRAG⁶⁰
1.	Changes to harvest strategies	✓		
2.	Advice on the development and improvement of harvest strategies and ERA			✓
3.	TAC/E setting/decisions (within HSP)		✓□(decision rules)	
4.	TAC/E setting/decisions (outside HSP or decision rules)	✓		
5.	Stock assessment advice and RBC calculations including reference points			✓
6.	Future management decisions <ul style="list-style-type: none"> • input/output controls • new directions 	✓		
7.	Plan amendments	✓		
8.	ERA/ERM	✓		
9.	Review of fishery budget and levies and monitoring of expenditure reports		✓	
10.	Quarterly expenditure reports		✓ (AFMA to provide to NPFI)	
11.	Government Policy (for information to MAC or directly to stakeholders) <ul style="list-style-type: none"> • Ministerial Direction • NPOAs • OCS • Bycatch 	✓		
12.	Review of biological catch & effort and observer data to determine and monitor trends, issues, key target and byproduct / bycatch species monitoring and advice on data generally			✓
13.	Implementing the bycatch and discard program including TEDs and BRDs		✓	
14.	Crew Member Observer program		✓	
15.	Routine Management Issues <ul style="list-style-type: none"> • Directions • Setting season dates • Tiger season – in season management • Banana season – in season management 		✓	
16.	Public interest issues (AFMA or NPFI to deal with directly)		✓	

⁵⁸ Minutes and action through AFMA Management, Chairs report to the Commission

⁵⁹ Process to be determined for reporting / recommendations by NPFI to AFMA and elsewhere (e.g. RAG, MAC, wider consultation). Items referred to the Commission by AFMA Management on a case by case basis with feedback to NPFI.

⁶⁰ The timing of stock assessment and RBC calculations vis-à-vis RAG and MAC meetings is important for process – e.g. if changes to harvest strategy required.

17.	Research (with RAG)			✓
18.	Compliance plan and risk assessment		✓	
19.	Compliance issues		✓	
20.	E-log program		✓	
21.	Strategic research including the Plan	✓		
22.	Strategic assessment review	✓		
23.	MPAs	✓	✓ <input type="checkbox"/> (operational)	
24.	Auditing of trial program	✓ (reports)	✓	

Source: AFMA (2011), 'Above and Below the line'.

On key non specific Commonwealth fishery policy areas such as harvest strategy development and bycatch management plans, DAFF provide the opportunity for stakeholder consultation. Bodies consulted include government, the commercial fishing industry, environmental non-government organisations, the recreational fishing industry, state fisheries departments, scientific research organisations and government organisations. The formal process is for DAFF to provide a discussion paper. Throughout the consultation process, information about the review and how to make a submission is available online and in hardcopy on request. The review is advertised in several mediums including the Fisheries Research and Development Corporation's Fish Magazine and the AFMA website. The public consultation period is open for six weeks to give stakeholders the opportunity to consider their submissions and provide input. DAFF consulted government, the commercial fishing industry, environmental non-government organisations, the recreational fishing industry, state fisheries departments, scientific research organisations and government organisations. The department also developed a discussion paper for public consultation, as part of the review process. The discussion paper was released in November 2012 for a 6-week public consultation period

A summary of the submissions made is available on

<http://www.agriculture.gov.au/SiteCollectionDocuments/fisheries/domestic/harvest-strategy-policy/hspsummary.pdf>, and the details of submissions made are available on http://www.agriculture.gov.au/fisheries/domestic/harvest_strategy_policy/review-submissions

A final report on the review outcomes is available on:

<http://www.agriculture.gov.au/SiteCollectionDocuments/fisheries/environment/bycatch/report-harvest-strategy.pdf>

Discussions with various indigenous groups have focused around area closures (including protected area closures), cultural heritage issues including sacred sites, arrangements for NPF skippers and crew to access aboriginal owned land and more recently as part of co-management, exchanges on the NPF management arrangements and cultural heritage training which is being undertaken as part of the NPF pre-season briefings. The NPF Directions and Closures booklet (AFMA, 2017) specifically includes information that has been developed in conjunction with indigenous groups on accessing aboriginal owned land and closed seas, and includes a number of closures that have been implemented taking into account indigenous interests (e.g., the protected area closures in Arnhem Bay, Dalumba Bay and Port Essington. There has also been considerable interaction on issues such as the development of proposed Indigenous Protected Areas in the Wellesley Island area. There have been two attendances by indigenous representatives at NORMAC on this issue in the past three years, and NPMI also participated in the Carpentaria Land Council Indigenous Protected Area (CLC IPA) working group on this issue (Jarrett, 2016, pers com). As part of the co-management arrangements with AFMA, NPMI is a member of the Dhimurru and Yirralka IPA Advisory Groups as the representative for the NPF.

The NPF industry have also been involved in a Fisheries Research and Development Corporation (FRDC) project aimed in improving engagement between the Northern Prawn industry and indigenous groups as part of the NPF co-management approach (Jarrett & Barwick, 2010). The project has been very successful and a key output is that representatives of the Wellesley Island group and the Carpentaria Land Council attend the NPF pre-season briefings which provides an opportunity for the indigenous groups to get a better understanding of the management arrangements in the NPF, and to provide our skippers with cultural heritage training and provide information on issues of cultural importance to them.

3.5.3 Long Term Objectives (PI 3.1.3)

Clear long-term objectives are explicit in Australia's Commonwealth environmental and fisheries laws.

Commonwealth Fisheries Management Act, 1991⁶¹ requires that all State Governments conform to the following objectives:

- (a) ensuring, through proper conservation and management measures, that the living resources of the Australian Fishing Zone (AFZ) are not endangered by over-exploitation; and
- (b) achieving the optimum utilisation of the living resources of the AFZ; and
- (c) ensuring that conservation and management measures in the AFZ and the high seas implement Australia's obligations under international agreements that deal with fish stocks.

The following principles are *principles of ecologically sustainable development as defined in the Act*:

- (a) decision-making processes should effectively integrate both long-term and short-term economic, environmental, social and equity considerations;
- (b) if there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation;
- (c) the principle of inter-generational equity—that the present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations;
- (d) the conservation of biological diversity and ecological integrity should be a fundamental consideration in decision-making; and
- (e) improved valuation, pricing and incentive mechanisms should be promoted.

The National Strategy for Ecologically Sustainable Development (DoE, 1992a) requires that fisheries management agencies throughout Australia to adopt a fisheries ecosystem management framework which will provide a more holistic and sustainable approach to management of aquatic resources. Governments will seek to enhance the decision-making capacity of management authorities, resource users and individuals, in particular through enabling them to make decisions that are based on knowledge of the likely consequences for the resource and the environment. Elements of a fisheries ecosystem management approach include: data collection and research on fish stocks and environmental factors to enhance management on an ecosystem basis; steps to address cross-sectoral issues between coastal management, total catchment management and fisheries management; awareness and education campaigns, for both users and the general public; and development of strategic management plans, framed within the principles of ESD, in conjunction with rationalisation of fishing capacity and over exploited fisheries. The principle objectives of the strategy are:

⁶¹ Fisheries Management Act (Commonwealth), Available at https://www.comlaw.gov.au/Details/C2014C00258/Html/Text#_Toc390691611

- to ensure that fisheries management agencies work within a framework of resource stewardship
- to develop national guidelines for state of the aquatic environment reporting
- to disseminate information on the principles of ESD to fishers and the wider community

State Governments are then required to review, and where necessary amend, fisheries legislation to ensure it provides the basis for managing the fishery resource in ways which are consistent with the principles of ESD; conduct a review of fishing fleet capacity by fisheries management authorities; examine mechanisms for addressing the prioritisation of scientific and economic research activities to help research agencies coordinate their programs and direct their scarce resources to areas of greatest importance; cooperatively work to resolve management boundaries between the Commonwealth and the States/Territories, and between adjoining States and Territories, on a biological/ecological basis; seek to involve representatives from the fisheries industry in discussions on prioritisation of research and resolution of management boundaries; seek to formalise international commitments covering fishing on the high seas, driftnetting, reductions in land-based sources of marine pollution, shipping standards and implementation of the United Nations Convention on the Law of the Sea.

The Intergovernmental Agreement on the Environment, 1992 (DoE, 1992b) requires that where there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation. In the application of the precautionary principle, public and private decisions should be guided by: careful evaluation to avoid, wherever practicable, serious or irreversible damage to the environment; and an assessment of the risk-weighted consequences of various options.

The Environment Protection and Biodiversity Conservation Act 1999 (the EPBC Act) (DoE, 1999) is the Australian Government's central piece of environmental legislation, and provides a legal framework to protect and manage nationally and internationally important flora, fauna, ecological communities and heritage places — defined in the EPBC Act as matters of national environmental significance. Its objectives are:

- to provide for the protection of the environment, especially those aspects of the environment that are matters of national environmental significance; and
- to promote ecologically sustainable development through the conservation and ecologically sustainable use of natural resources;
- to apply the precautionary principle in decision making
- to promote the conservation of biodiversity;
- to provide for the protection and conservation of heritage; and
- to promote a co-operative approach to the protection and management of the environment involving governments, the community, landholders and Indigenous peoples; and
- to assist in the co-operative implementation of Australia's international environmental responsibilities; and
- to recognise the role of Indigenous people in the conservation and ecologically sustainable use of Australia's biodiversity; and
- to promote the use of Indigenous people's knowledge of biodiversity with the involvement of, and in co-operation with, the owners of the knowledge.

The long-term objectives that must be pursued by AFMA in the management of Commonwealth fisheries are prescribed in the Fisheries Management Act 1991. These are:

- (a) implementing efficient and cost-effective fisheries management on behalf of the Commonwealth; and

- (b) ensuring that the exploitation of fisheries resources and the carrying on of any related activities are conducted in a manner consistent with the principles of ecologically sustainable development (which include the exercise of the precautionary principle), in particular the need to have regard to the impact of fishing activities on non-target species and the long-term sustainability of the marine environment; and
- (c) maximising the net economic returns to the Australian community from the management of Australian fisheries; and
- (d) ensuring accountability to the fishing industry and to the Australian community in AFMA's management of fisheries resources; and
- (e) achieving government targets in relation to the recovery of the costs of AFMA.

In addition, the Act specifies that the Minister, AFMA and Joint Authorities are to have regard to the objectives of:

- (a) ensuring, through proper conservation and management measures, that the living resources of the AFZ are not endangered by over-exploitation; and
- (b) achieving the optimum utilisation of the living resources of the AFZ; and
- (c) ensuring that conservation and management measures in the AFZ and the high seas implement Australia's obligations under international agreements that deal with fish stocks; and

To assist AFMA in the application of these objectives, the Australian Government has also agreed a *Commonwealth Fisheries Harvest Strategy Policy and Guidelines* ("the Policy") (DAFF, 2007).

The overarching harvest strategy policy was created by DAFF in close cooperation with AFMA, DSEWPac (formerly DEWHA), supported by a Steering Committee comprising ABARES, the Commonwealth Fisheries Association (CFA) and independent experts.

The objective of the Policy is:

The sustainable and profitable utilization of Australia's Commonwealth Fisheries in perpetuity through the implementation of harvest strategies that maintain key commercial stocks at ecologically sustainable levels and within this context, maximize the economic returns to the Australian community.

The Policy sets out preferred targets for the management of fish stocks as well as explicit guidance on the level of risk acceptable to the Australian Government. The Policy requires that "harvest strategies for key commercial stocks taken in Australia's Commonwealth fisheries ... be designed to pursue maximum economic yield from the fishery and ensure those stocks remain above levels at which risk to the stock is unacceptably high". More explicitly, the Policy requires that harvest strategies seek to:

- Maintain fish stocks, on average, at a target biomass point (B_{targ}) equal to the stock size required to produce maximum economic yield (B_{MEY});
- Ensure fish stocks will remain above a biomass level where risk to the stock is regarded as too high (B_{lim}) (or proxy); and
- Ensure that the stock stays above the limit biomass level at least 90% of the time.

The Policy also requires that harvest strategies take into account ecosystem interactions. For example, it notes that "one consideration is the relationship the species has with others in the food web or community, particularly if the harvested species is a keystone species. In such circumstances the biomass reference points described above may be increased to take account of a species' importance to the maintenance of the food web or community".

The primary management instrument for most fisheries is a statutory fishery management plan developed under the FMA. Fishery level objectives, as specified in management plans, are the same as the longer term strategic objectives specified in the FMA. While shorter-term fishery specific objectives can be inferred, or identified from various management documents, they are not collated in any coherent form. Each Plan incorporates measures that seek to achieve stock sustainability, maximising net economic returns and application of the EAFM.

All Commonwealth fisheries are also required to comply with relevant requirements of the EPBC Act. The objectives of the Act are as follows:

The objectives of the EPBC Act are to:

- provide for the protection of the environment, especially [matters of national environmental significance](#)
- [conserve Australian biodiversity](#)
- provide a streamlined national environmental [assessment and approvals process](#)
- enhance the protection and management of important natural and [cultural places](#)
- [control the international movement of plants and animals \(wildlife\), wildlife specimens and products made or derived from wildlife](#)
- promote ecologically sustainable development through the conservation and ecologically sustainable use of natural resources

One of the main provisions of the Act relating to fisheries is the strategic assessment process. Environmental Guidelines for Ecologically Sustainable Management of Fisheries (DEWR, 2007) includes the principles consistent with the FMA Firstly that:

The fishery shall be conducted at catch levels that maintain ecologically stock levels at an agreed point or range with acceptable levels of probability. The objective is subdivided into assessment, management response and information, all of which are entirely consistent with the scoring PIs as set out in MSC principle 1;

Secondly, fishing operations should be managed to minimise their impact on the structure, productivity, function and biological diversity of the ecosystem. The guidelines contain core objectives, accompanied by stipulated measurable indicators, which are consistent with MSC principle 2.

- The fishery is conducted in a manner that does not threaten bycatch species.
- The fishery is conducted in a manner that avoids mortality of, or injuries to, endangered, threatened or protected species and avoids or minimises impacts on threatened ecological communities
- The fishery is conducted, in a manner that minimises the impact of fishing operations on the ecosystem generally.

Each of these objectives contains associated performance indicators on information requirements, assessments and management responses.

3.5.4 Incentives for sustainable fishing (PI 3.1.4)

The management system actively and explicitly considers and reviews management policy and procedures to ensure they are not contributing to unsustainable fishing practices. AFMA has implemented a flexible management framework which focusses on a combination of input controls, Statutory Fishing Rights (SFRs) allocated under the relevant fisheries management plan, along with output controls. These collectively provide the explicit management target for the NPF is MEY,

which seeks to optimize economic returns (Kompas *et al.*, 2010; Kompas & Grafton, 2011). The rights of fishers to access the resource are in the form of. Transferable SFRs provide commercial fishers with security and flexibility with regard to the access to the stocks. Fishing permits, which are generally also transferable, provide less security being subject to annual renewal, however in practice fishing permits have not been revoked, apart from where they have been replaced by SFRs or removed as part of a structural adjustment process. Conditions can be placed on SFRs and on fishing permits implementing management measures in addition to the primary control on catch or gear Government policy (DAFF, 2003). Historically, structural adjustment programs have been undertaken in order to address significant overcapacity issues and to ensure that such overcapacity does not pose a risk to the sustainability of fish stocks. The NPF has seen three successive buy-back schemes implemented (Section 3.5.2).

Management costs are recovered from fishers in line with the Government's cost recovery policy as articulated in the Cost Recovery Impact Statement (CRIS) (AFMA, 2016b) and levy income and expenditure summaries provided in AFMA (2016c). Research (including stock assessment), data collection and AFMA management costs are funded predominantly by industry and government. AFMA is responsible for compliance costs. The sum total of levy contributed to from the NPF is around AUD 2 million.

Regular stock status and economic assessments (ABARE, 2016, Bath & Green, 2016) are undertaken of the indicators including the gross value of production, cost of management, financial performance (indicators including profit at full equity, cash operating surplus and return on investment), determination of major cost increases, regional economic impacts and economic rent. This assessment demonstrates adherence to free market practices.

3.5.5 Fishery specific management objectives (PI 3.2.1)

The fishery currently implements the fisheries specific objectives through the Fishery Management Plan, 1995 (The Plan), supported by the Harvest Strategy for the Northern Prawn Fishery under Input Controls (Dichmont *et al.*, 2014).

The two core objectives of the Plan are:

- that the objectives pursued by the Minister in the administration of the Act, and by AFMA in the performance of its functions, are met in relation to the Northern Prawn Fishery; and
- that the incidental catch of non-target commercial and other species in that Fishery is reduced to a minimum.

The objectives stated in the Harvest Strategy are:

- Objective 1: Ensure the utilisation of the fishery resources within the Northern Prawn Fishery is consistent with the principles of ecologically sustainable development and the exercise of the precautionary principle.
- Objective 2: Maximise economic efficiency in the utilisation of the fisheries resources within the Northern Prawn Fishery.
- Objective 3: Implement efficient and cost effective management of the Fishery.
- Objective 4: Effectively communicate and consult with AFMA, the fishing industry, other marine resource users and the broader community.
- Objective 5: Ensure that the incidental catch of non-target commercial and other species in the NPF is reduced to a minimum.

The measures by which the objectives of this plan are to be attained include:

- developing and implementing appropriate management measures (including directions referred to in subsection 17 (5A) of the Act) in relation to the Northern Prawn Fishery; and
- implementing an effective program of surveillance for the Northern Prawn Fishery to ensure compliance with this plan; and
- promoting research that is relevant to the Northern Prawn Fishery; and
- preparing an annual budget of costs associated with managing the Northern Prawn Fishery; and
- setting and collecting levies and fees in relation to the Northern Prawn Fishery; and
- collecting data that can be used to assess the status of the Northern Prawn Fishery; and
- monitoring the impact of catching operations in the fishery on ecologically related species and implementing any practical strategies that are necessary to minimise the impact of those operations on those species; and

The Strategy contains references to use of measurable indicators:

- Indicators (data from the fishery)
- Monitoring (agreed protocols to get data)
- Reference points (targets and limits)
- Method of assessment (e.g. stock assessment, Catch per Unit of Effort (CPUE) standardisation)
- Decision rules (agreed rules for setting catch levels)

The operational objective of this Harvest Strategy is to attain long term MEY from the tiger prawn fishery. The objective of MEY can be considered equivalent to the objective of maximising the net present value of the flow of profits in the fishery over an indefinite period. For the NPF, MEY is assumed to be achieved over a seven-year period. The dynamic path to MEY is calculated as the effort level and associated catch in each year over a seven-year projection period that leads to a long run sustainable yield that maximises profits over time. Achievement of this objective is underlined by Target and Limit Reference Point, $EY/EM_{EY} = 1$, and $0.5S_{MSY}$. These are underlined by a strong catch monitoring system.

Bycatch management (MRAG, 2012) has historically relied on the use of Environmental Risk Assessments to assess the potential impact of the fishery, and underlined by a series of technological gear mitigation measures, as well as spatial and temporal approaches. These measures achieved more than a 50% reduction of bycatch since 1998.

The aims of this Bycatch and Discarding Work Plan for the NPF are to develop strategies that will:

- Respond to high ecological risks assessed through AFMA's Ecological Risk Assessment for the Effect of Fishing (ERAEF) and other assessment processes;
- Avoid interactions with species listed under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act);
- Reduce discarding of target species to as close to zero as practically possible; and
- Minimise overall bycatch in the fishery over the long-term.

A revised Bycatch Strategy (NPFI, 2015) seeks to achieve a 30% reduction. P2 outcomes (Table 14) include a reduction on small fish and sea snake bycatch, strengthening data, the application of effective bycatch reduction devices, addressing ETP interactions. Actions include Industry engagement to develop innovative options and/or gear modifications for testing, trialing robust, light-weight and crew-safe BRDs and/or gear modifications, investigating the feasibility of spatial and temporal approach to reducing bycatch, reviewing data collection requirements and observer

protocols in the NPF, streamlining the gear directions, continuing to develop and implement training for CMOs in the collecting and recording of valuable scientific data; Compiling and reporting CMO, TEP and bycatch data to NORMAC, and CSIRO to completing sustainability assessment of bycatch species. Each of these management actions and outcomes contains performance indicators.

The operationalisation of these strategies is supported by the NPF Industry Code of Practice, the *Northern Prawn Fishery Directions and Closures* (AFMA, 2017), formerly referred to as the Northern Prawn Fishery Operational Information Booklet, and the Bycatch and Discarding Workplan (2014-2016, AFMA, 2014a).

Objectives defined in the Code include:

- Set conservation and management measures designed to ensure sustainability of fishery resources at optimal levels
- Cooperate with researchers and managers in the collection of timely and reliable catch statistics and other information needed for the management of the fishery
- Minimise catching of non-target species, the incidental catching of non-utilised species, marine animals and turtles, benthic impacts and the discarding of waste product associated with fishing activities as prescribed in the NPF Bycatch Action Plan.
- Participate in the development and adoption of technology, fishing gear and fishing practices for continued improvements in the sustainability of fishery resources and the marine ecosystem
- Minimise discards of prawns except when the safety of the trawler is threatened
- Ensure that crews observe regulations that prohibit the disposal of waste at sea
- Record and report loss and recovery of fishing gear
- Ensure crews understand shipboard procedures for the disposal of waste engine oil
- Use non-ozone depleting refrigerants in trawlers' freezers and alternatives to Halons in firefighting equipment
- Ensure that fishing operations are conducted with due regard to the USL Code governing the safety of those on board

AFMA assesses the sustainability of the NPF bycatch, published in CSIRO reports (i.e. Fry *et al.*, 2015). AFMA also submits quarterly EPT monitoring reports to DoEE⁶².

The effectiveness of the Plan and supporting strategies are summarised by:

- (a) The status of economic efficiency of the Northern Prawn Fishery (Bath and Green, 2015); and
- (b) The status of the biological resources and environmental conditions in the Northern Prawn Fishery area (ABRARES, 2016); and
- (c) The cost effectiveness of the management arrangements for the Northern Prawn Fishery (AFMA, 2016b).

3.5.6 Decision-Making Processes (PI 3.2.2)

The Australian Government delegates AFMA to implement management decisions in respect to all Commonwealth Fisheries (Government of Australia, 1991). Decisions on the implementation of the policy are taken by the AFMA Commission, following advice from NORMAC, NPRAG, as well as AFMA officers. The AFMA Commission reports on its decisions directly back to the MAC and to stakeholders through media such as the regular AFMA Update (available on the AFMA website). AFMA Commission meeting records are not made public. However, NORMAC will always receive

⁶² Fava S, AFMA (pers com, February, 2016)

a letter from the Commission outlining any decisions made on NORMAC recommendations, including explanations as to acceptance or rejecting of NORMAC recommendations (Josh Fielding, AFMA, email of 21/12/2011, cited in MRAG, 2012).

The harvest strategies and control rules incorporate a precautionary approach to the decision-making process by requiring a review when the target reference level is not met. This ensures that any warning signs are recognised and investigated / addressed in their early stages. The frequency of evaluation (both annually and in-season) and review means that management action to investigate and, where required, alleviate adverse impacts on stocks is always taken before the performance indicators reach the limit reference level.

The application of the research, monitoring and evaluation within the NPF Management Plan, Harvest Strategy, Bycatch Sustainability Assessment and Bycatch Strategy provides a good tool to assess the relative risks to target species, bycatch, ETP species and habitats, initiating when appropriate, actions to deal with at risk species and assemblages. Examples of precautionary actions include controlling the trawl footprint, regulating fishing to take account of real time variations in prawn size, temporal and spatial closures; and the voluntary code.

AFMA, CSIRO and NPFI provide a comprehensive range of reports which confirm fishery performance and how management has responded to findings from recommendations emerging from research, monitoring, evaluation and review activity. (<http://www.afma.gov.au/fisheries/northern-prawn-fishery> and <http://npfindustry.com.au/publications/>). These include stock status reports; catch data including target species, byproduct (retained species), bycatch and ETP species; benthic impact assessments; BRD Assessments; Ecological Risk Assessments; Sustainability assessment reports, Observer reports and risk assessment and mitigation of sea snakes.

Explanations are provided for actions or lack of actions by the organisations tasked with implementation. Failure to achieve the management reference levels is discussed at NORMAC and advice provided to AFMA. AFMA provide responses through the MAC how information is reviewed and the management decisions made (See Northern Prawn Management Advisory Committee past meetings (<http://www.afma.gov.au/fisheries/committees/northern-prawn-management-advisory-committee/normac-past-meetings/>)). It then becomes the responsibility of AFMA to rectify failure to achieve specific management outcomes. As part of co-management functions, NPFI is responsible for implementing supporting activities such as ensuring the accuracy, timeliness and dissemination of the fishery catch and effort, gear and economic data; managing the CMO program; coordinating pre-season briefing of fishers to ensure operators are aware of all the rules regulating the fishery and that they are following best practice and undertaking essential reporting and advising AFMA on operational matters in the fishery, including the timing of fishing seasons, the setting of fishing gear limits and research priorities.

The Harvest Strategy, Bycatch and Discards Workplan and Bycatch Strategy 2015 contain monitoring and performance indicators and provided the basis for incorporating relevant recommendations emerging from research, monitoring, evaluation and review activity.

The consultation and advisory processes ensure that the management system in the fishery acts proactively to avoid legal disputes. The co-management system allows for some delegation of responsibilities and the partnership approach between AFMA and the NPFI actively works towards avoiding disputes. In addition, licence conditions provide for a system of dispute resolution in the event that the prescribed licence holder is not satisfied with the conditions (Part 8 161-162 of the Fisheries Management Act). No legal challenges or judicial decisions have taken place in the NPF. An appeals procedure exists to the Federal Court for Statutory Fishing Rights Allocations, but has not been tested.

3.5.7 Compliance and enforcement (PI 3.2.3)

The management system takes a risk-based approach to compliance (AFMA, 2015c). Compliance risk assessments are undertaken by the Operations Management Committee (AFMA, 2015d), and compliance plans are developed for each Commonwealth fishery (AFMA, 2015c). Primary compliance tools include vessel monitoring systems on all vessels, prior to landing-reports, catch disposal records and fish receiver records. At-sea and in-port vessel inspection, fish receiver inspections, trip and landing inspections are carried out.

AFMA compliance is subject to both internal (AFMA, 2015c) and external review (ANAO, 2013) and demonstrated to have been effective.

3.5.8 Compliance resourcing

AFMA adopts a centralised model for its domestic compliance programme and delivers its programme from Canberra and Darwin. Key components of the programme include:

- compliance intelligence—collection, analysis and reporting of intelligence information to support the compliance function;
- risk assessment and planning—a biennial risk assessment process to assist in the targeted planning of compliance activities;
- communications—education and awareness activities to increase rates of voluntary compliance with fisheries management requirements;
- compliance monitoring—incorporating a planned general deterrence program, targeted activities addressing key identified compliance risks, and special operations to address specific issues or fishing operators; and
- enforcement—seeking to affect a timely and appropriate response to non-compliance.

Fisheries Officers (FO) undertake regular land and sea patrols using a compliance delivery model supported by a risk assessment process and associated operational planning framework. The NPF uses VMS as support to its monitoring activity and a combination of at sea patrols and port inspections.

AFMA has more recently improved its actions by increasing its resourcing of the intelligence function, through development of intelligence reports and analytical tools to support the risk-based compliance approach and case management system to help ensure consistency in enforcement action

The Operations Division reviews the compliance risk assessments each year. The risk assessment process can also be triggered by the introduction of new supporting legislation⁶³ in a fishery / resource or the identification of any new major issues that would require FSG managers to assess their compliance program.

The compliance risk assessment process identifies modes of offending, compliance counter measures and risks and relies on a weight-of-evidence approach, considering information available from specialist units, trends and issues identified by inspectors and priorities set AFMA.

The prioritised risks that are the focus of the 2016-17 program are:

- failure to have a Vessel Monitoring System (VMS) system operating at all times, ^[1]_[SEP]
- closure monitoring, and ^[1]_[SEP]
- Effective application of BRDs and TEDs
- Recording ETP interactions ^[1]_[SEP]

⁶³ 'Supporting legislation' refers to any Regulation or Gazette that would allow non-compliance with the management framework to be detected and prosecuted with a reasonable chance of securing a conviction.

The OMC is responsible for the allocation of resources and the day-to-day direction of AFMA's national compliance programme. Importantly, the OMC will be constantly balancing resources and making tradeoffs between risk treatment (proactive), investigation/monitoring (reactive) and general deterrence (routine) programs.

The allocated resources and compliance strategies (i.e. monitoring, surveillance and education activities), specifies planned hours and staff allocated to key compliance tasks and duties. This planning and delivery process allows for more-targeted, effective and relevant compliance service in terms of both cost and activities.

There is also flexibility within the region to allocate additional resources to respond to changes, such as the need for a planned tactical operation in response to fresh intelligence. Redirecting existing resources or seeking additional resources from other areas or units may achieve this. Similarly, changing priorities and resourcing on a local level can involve reducing planned delivery of compliance services to ensure resources are directed to where they are most needed.

FOs are formally appointed pursuant to the FMA, which clearly sets out their powers to enforce fisheries legislation, enter and search premises, obtain information and inspect catches. FOs are highly trained; they must have a thorough knowledge of the legislation they are responsible for enforcing and follow a strict protocol for undertaking their duties in accordance with FMA and in recording information relating to the number and type of contacts, offences detected and sanctions applied.

3.5.8.1 **Operational planning**

Compliance staff utilise a number of formal monitoring and surveillance activities and control mechanisms in the NPF.

Fisheries legislation forms the one component of the control system for commercial fisheries in the NPF, and these are applied through Licence conditions. The NPF is subject to controls under:

- Fisheries Management Act, 1991 (Commonwealth)
- Fisheries Management Regulations (Commonwealth), 1992
- The EPBC Act (export exemptions);
- The Northern Prawn Management Plan, 1995 and
- Licensing Conditions.

A description of the control measures in place is provided in Table 29.

Table 29. Description of the control measures and instruments of implementation in the NPF

Measure	Description	Instrument
Limited Entry	Entry is limited through restricting the number of Statutory Fishing Rights (SFR). Maximum number of SFRs: <ul style="list-style-type: none"> • 52 Class B (Boats) SFRs • 35,479 Class A (Gear) SFRs 	Northern Prawn Fishery Management Plan 1995
Catch limits	No TAC for target species Decision rules (total catch and catch rate) for target species apply. If the decision rules are triggered in any season, the fishery	Northern Prawn Fishery Management Plan 1995 NPF Direction No. 172

Measure	Description	Instrument												
	closes early (detailed in the NPF Harvest Strategy) Catch limits for by-product species													
Spatial restrictions	Areas closed to fishing through spatial management.	Northern Prawn Fishery Regulation 1995 NPF Direction No. 169 and NPF Direction No. 171												
Gear Controls	Restrictions on net configurations and gear SFR values (unit length)	Northern Prawn Fishery Management Plan 1995 NPF Direction No. 07.												
	<table><tr><th>Gear type</th><th>SFR headrope value</th><th>SFR footrope value</th></tr><tr><td>Twin trawl</td><td>9.0 cm</td><td>10.3 cm</td></tr><tr><td>Quad or tongue trawl</td><td>8.1 cm</td><td>9.31 cm</td></tr><tr><td>Triple gear</td><td>8.1 cm</td><td>9.31 cm</td></tr></table>		Gear type	SFR headrope value	SFR footrope value	Twin trawl	9.0 cm	10.3 cm	Quad or tongue trawl	8.1 cm	9.31 cm	Triple gear	8.1 cm	9.31 cm
	Gear type		SFR headrope value	SFR footrope value										
	Twin trawl		9.0 cm	10.3 cm										
	Quad or tongue trawl		8.1 cm	9.31 cm										
Triple gear	8.1 cm	9.31 cm												
Bycatch Reduction Devices (BRDs)	It is compulsory that all nets rigged for fishing in the NPF are fitted with BRDs and TEDs for the entire fishing year. Approved BRDs include: <ul style="list-style-type: none">• Square Mesh Codend• Square Mesh Panel• Fisheye• Yarrow Fisheye• Radial Escape Section• Popeye Fishbox	NPF Directions No. 150 and 174 (gear direction)												
Prohibited species	Threatened, endangered and protected species are prohibited under the EPBC Act. Additional species are prohibited under the NPF Management Plan and NPF Directions.	NPF Direction No. 172 Environment Protection and Biodiversity Conservation (EPBC) Act 1999 Northern Prawn Fishery Regulation 1995												
Reporting	Compulsory logbook reporting and electronic monitoring of all catch, bycatch and by-product species.	Fisheries Management Act 1991 EPBC Act 1999												

Measure	Description	Instrument
	All interactions with threatened, endangered and protected species must be reported to the Department of the Environment and Energy as per the EPBC Act.	Northern Prawn Fishery Regulation 1995

FOs deliver compliance activities directed at commercial fisheries through attendance at pre-season briefings with the masters of the licenced fishing boats and pre-season inspections, as well as at-sea inspections and investigations resulting from suspected breaches detected intelligence and VMS.

Target actions for the NPF comprises:

- Update operating guidelines
- Meet with license holders prior to the commencement of the season and clarify issues relating to gear requirements, and disseminate details of legislative changes for the coming season
- Establish liaison and contact with industry through one to one meetings with licence holders, through attending industry meetings and meetings with Fishery policy and research staff
- Inspect nets and headline length to ensure compliance with the technical regulations.

Boardings take place at sea, where the primary activity is to gear configurations. Ad hoc monitoring occurs on land to check on violations, as well as regular landing inspections. Actions may be determined as part of a regular review or through intelligence provided by industry.

The Division has also implemented an initiative called Crimfish⁶⁴, whereby the community can report instances of suspected illegal fishing. The Fishwatch phone line provides a confidential quick and easy way to report any suspicious activity to Departmental compliance staff.

3.5.8.2 Enforcement measures

The Fisheries Management Act 1991 and regulations allow for a range of enforcement measures. These measures (or tools) can be used in combination, separately or for particular types of incidents in order to achieve the most appropriate outcome. AFMA will use the range of measures available in its “toolbox” in order to achieve the most efficient and cost effective outcome.

Warnings

Verbal or written warnings may be given by a fisheries officer where:^[SEP]the impact caused by an offence is minimal^[SEP]the breach of a legislative instrument or regulation is of a minor technical nature a warning is fair and appropriate^[SEP]the matter is one which can quickly and simply be addressed.

Warnings are used in the circumstance of a minor event. In deciding whether a warning is an adequate response the fisheries officer must have regard to the principles contained in the Policy. Warnings may also be contained in a caution. Warnings (verbal or written) will be recorded for future reference.

Cautions

Written cautions may be given by a fisheries officer where:

⁶⁴ <http://www.afma.gov.au/monitoring-enforcement/report-illegal-fishing-activity/>

- the impact caused by an offence is minor
- the breach of a legislative instrument or regulation is minor or a “first occurrence”
- a caution is fair and appropriate
- the matter is one which can quickly and simply be put right

it is appropriate to advise the responsible party that a repeat occurrence will lead to more serious action being taken.

Cautions are used for more serious matters and only if the officer believes there to be prima facie evidence of an offence. In deciding whether a caution is an adequate response the fisheries officer must have regard to the principles contained in the Policy. Where a caution is not complied with in the period specified further enforcement measures may be pursued.

Observer Compliance Notices (OCN)

An OCN is a non-statutory means of providing a person with clear written notice of an apparent breach of the observer requirements under the FM Act and Fisheries Management Regulations 1992. The OCN will detail the actions which need to be undertaken by that person to rectify the situation. It also gives notice that further enforcement action may follow, especially if the situation is not rectified within the specified time. Failure to comply with an OCN is not in itself an offence but rather a form of caution.

Commonwealth Fisheries Infringement Notices (CFINs)

The regulations provide for infringement notices to be issued for breaches of fisheries management rules. These infringement notices require payment of the fine within a specified timeframe.

The Policy considerations for issuing a Commonwealth Fisheries Infringement Notice (CFIN) rather than prosecution are:

- the offence is one that may be dealt with by imposition of a fine under the FM Act
- the nature of the incident, whether it is well defined or not
- the severity of the impact
- the evidence discloses a prima facie case against the person with reasonable prospects of success
- the previous history of the person the culpability of the person
- notification of the incident to AFMA, voluntary action to mitigate the impacts and a commitment to prevent future incidents.

Amendments to fishing concession conditions

Longer term action may be required to address ongoing non-compliance. Amendment to concession conditions can be used where there is a need to take additional action arising from a breach of the legislation or legislative instruments. Amendments represent an alternative to other enforcement action to achieve compliance with the FM Act. Amendments to licence conditions are subject to appeal provisions under the FM Act. Failure to comply with fishing concession conditions is an offence. Generally new or alterations to existing conditions will be subject to AFMA’s regulatory review process.

Directions by fisheries officers

Fisheries officers (under section 84 of the FM Act) may direct that various actions are undertaken; these being:

that fishing activity ceases^[17] that a boat be taken to a particular place that a boat stops to allow an at sea boarding.

Directions will be used where there is imminent risk of severe impacts or there are other reasonable grounds for doing so. Such reasonable grounds may include (but are not limited to) where further inspection of a boat is required for investigation of detected (or suspected) offences, or where it will directly assist in ensuring compliance for future fishing (e.g. to repair fishing gear or a VMS unit). However, as there are no appeal provisions, these powers should only be used where consideration has been given to the likely consequences of such a direction.

Failure to comply with an instruction from a fisheries officer, without reasonable excuse, is an offence.

Suspension or cancellation of fishing concessions

Pursuant to sections 38 and 39 of the FM Act, fishing concessions may be suspended or cancelled under certain circumstances where:

a fee, levy, charge or other moneys has not been paid by the due date there are reasonable grounds that a condition has been breached

there are reasonable grounds false or misleading information has been furnished to AFMA

in accordance with a condition on the concession certain international sanctions have been applied and are not complied with.

Since, in most cases, this would result in ceasing of fishing activity and resultant loss of income, suspension or cancellation will be used in those circumstances that pose an unacceptable impact or where there is an attitude of non-compliance or evidence of a deliberate attempt to gain financial advantage from non-compliance.

he CEO or other delegate will, when exercising this enforcement measure, give the person a reasonable opportunity to show cause in writing why the power should not be exercised. Suspension or cancellation should only be used for serious offences²⁰.

Failure to comply with a suspension or cancellation of a fishing concession is an offence.

Prosecution

Prosecutions will be initiated, consistent with the principles and criteria of the Policy, where there is evidence of prima facie breaches of the FM Act (or other relevant Commonwealth Acts) for offences on a case-by-case basis, where prosecution is, in the opinion of the OMC, the most appropriate response to achieve personal and/or public deterrence.

A number of factors will be taken into account in considering whether an offence is serious enough to warrant suspension or cancellation of a fishing concession or quota. Examples of serious offences include:

- fishing without a valid licence, authorisation or permit [SEP]
- failing to maintain accurate records of catch and catch-related data or serious misreporting of catch [SEP]
- fishing in a closed area, fishing during a closed season or fishing without quota where no action is taken to cover outstanding catches [SEP]
- directed fishing for a stock that is subject to a moratorium or for which fishing is prohibited [SEP]
- using prohibited gear [SEP]
- falsifying or concealing the markings, identity or registration of a fishing boat [SEP]
- concealing, tampering with or disposing of evidence relating to an investigation

- multiple violations which together constitute a serious disregard of conservation and management measures or [SEP]
- such other violations as identified on a case by case basis. [SEP]

Minor would cover offences for which infringement notices are issued (may include a fine) but no further action is taken. Typically, this may include minor deviations from legislation that are unintentional in nature.

Major relates to offences which are referred (along with a brief of evidence) to the department of public prosecutions, it is then in their discretion to pursue through the court (Steve Bolton, pers com, AFMA, January, 2017).

Offences are specified in Section 95 of the FMA, 1991 and incorporated into the Fisheries Management Regulations (1992). Offences are determined on a per unit system, with penalty units specified for each offence and up to a maximum of up to 250 points (Index to Offences, Fisheries Management Regulations, 1992). The current assigned value assigned per unit is AUD 180/unit.

In March 2016 AFMA inspected 31 vessels and in July 2016 AFMA inspected 41 vessels. The inspections focused on educating operators of regulations including closures and reporting of interactions with Threatened, Endangered and Protected Species and on adherence to specifications for turtle excluder devices (TEDs) and bycatch reduction devices. The fishing gear was largely compliant with minor corrections rectified prior to the opening of the prawn seasons. Throughout both seasons the vessels were continuously monitored by AFMA's vessel monitoring system to ensure operators did not fish inside closure areas (Scott Clementz, AFMA Compliance, pers com, 19 January, 2017).

In 2015, a total of 12 infringement notices were issued to three separate operators. The infringement notices were issued due to non-compliance with specifications related to TEDs and/or failure to appropriately mark the length of gear. In each incident, the non-compliance was corrected immediately (S. Clementz, pers com, 19 Jan 2017). Offences where infringement notices were issued were assessed as minor (Shane Fava, AFMA, pers com, 18 January, 2017).

In 2015, one operator was proven guilty of four offences for contravening conditions of a fishing concession in 2013. For the same incident, the fishing concession holder was also proven guilty of four offences. No convictions were recorded however the operator entered into a good behaviour bond of \$2,000 for a period of two years and the concession holder entered into a good behaviour bond of \$5,000 for a period of three years (S. Clementz, pers com, 19 Jan 2017).

In 2013, one operator was convicted of four offences for failure to use appropriate Bycatch Reduction Devices whilst fishing in the Northern Prawn Fishery during October 2012. The operator entered into good behaviour bonds totaling \$4,000 for a period of three years. The magistrate also ordered the forfeiture of \$28,000 of the proceeds of the catch which was seized in relation to the offences.

Fishing companies implement their own strict codes on non-compliance, with zero tolerance and the threat of instant dismissal in the event of an offence. Industry companies have their own disciplinary management systems in place. Any detected irregularity is acted upon, and reported to AFMA. Any evidence of systematic non-compliance by individual skippers, or one off clear abuses result in dismissal (Austral/Raptis, NPFI stakeholder meeting, 14 February, 2017).

3.5.9 Research Plan (PI 3.2.4)

A five-year Research Plan (2014-2018) has been published (AFMA, 2014b) and was implemented from the start of 2014.

Research activities cover the following areas (AFMA, 2005):

- Effects of trawling
- Monitoring
- Stock assessment
- Fisheries Management

Key strategic research priorities include:

- Collect information to inform annual RAG assessment to set the Total Allowable Effort (TAE) for tiger, common and red-legged banana prawns in accordance with NPF harvest strategies
- Provide key data used to set TAE through at-sea monitoring projects (i.e. recruitment and spawning surveys)
- Undertake annual analysis of CMO and Scientific Observer data to confirm it meets criteria for use in monitoring populations of Endangered, Threatened, and Protected (ETP) and at-risk species
- Undertake a Sustainability Assessment of Fishing Effects (SAFE) assessment for the Joseph Bonaparte Gulf subfishery.

The research priorities for the NPF are reviewed annually by the Research Advisory Group (NPRAG) and the Management Advisory Committee (NORMAC) and included in an Annual Research Statement.

The NPFRAG and NORMAC need to ensure that the research plan includes prioritised, cost effective research and information required to support management the application of the harvest strategy and Bycatch Action Plan.

Research priorities are then pursued by research providers, often in partnership with industry and/or fisheries managers with the help of the below research advisory bodies: The AFMA Research Committee (ARC) which considers essential stock assessment type research for funding by AFMA in the following financial year; and the Commonwealth Fisheries Research Advisory Body (ComFRAB) which considers Commonwealth fisheries research priorities for potential Fisheries Research and Development Corporation (FRDC) funding two years hence) - the FRDC research cycle is an 18 months' cycle compared to the ARC which is a 12 months' cycle.

The Research Plan is available on the website and disseminated to interested parties

(http://www.afma.gov.au/wp-content/uploads/2014/12/NPF_Five_Year_Strategic_Research_Plan_FINAL1.pdf). The Results of the Plan are disseminated through research papers published on the AFMA Website and the NPFI <http://npfindustry.com.au/publications/>

Examples of research reports include:

[Monitoring interactions with bycatch species using crew member observer data in the NPF](http://www.afma.gov.au/wp-content/uploads/2014/02/CSIRO-Monitoring-Interactions-with-bycatch-using-CMO-dataJune15.pdf). Available at <http://www.afma.gov.au/wp-content/uploads/2014/02/CSIRO-Monitoring-Interactions-with-bycatch-using-CMO-dataJune15.pdf>

And the following are available on the NPFI website (<http://npfindustry.com.au>).

- Benthic Impacts Assessment Study
- Annual Sustainability Report: 2008
- BRD-Assessment-Final-Report
- TED and BRD benefits study
- Ecological Risk Assessment

- Ecological Risk Management 2009
- Long term monitoring program for the NPF
- NPF-Bycatch-Workplan 2011-2013
- Observer report – fisheye testing aboard Rosen C
- Documenting history of NPF closures report
- Risk assessment and mitigation for sea snakes
- Sustainability assessment of fishing effects (safe) report
- Testing of Popeye BRD report

3.5.10 Monitoring and management performance evaluation (PI 3.2.5)

The Australia Government commissioned two independent reviews of the core Acts (EPBC Act and FMA) governing the environment and fisheries (Hawke, 2009, and Borthwick, 2012). The Borthwick review also included reviews of policy settings, recasting AFMA's objectives, fisheries management plans, the Minister's powers to vary fisheries management plans, integrating fisheries and environmental assessments, Research, fisheries management and industry levies, Offshore Constitutional Settlements (OCS), Recreational Fishing, Aquaculture, Compliance and enforcement and Co-management. The Government response to the Borthwick Review was announced in March 2013 (Australia Government, 2013). DAFF thereafter initiated a public consultation process (DAFF (2012/2013), followed by specific Reports on Harvest Strategy and Bycatch management strategy (DAFF 2013a, DAFF 2013b). Thereafter, this prompted NPF to revise their fishery specific harvest (Dichmont *et al.*, 2014), and bycatch management strategies (NPMI, 2015).

In addition, AFMA's management system is subject to internal and external performance evaluation including (Nick Rayns, AFMA, January 2017):

Internal peer reviews, which include:

- The requirement to report in AFMA's Annual Report on overall performance against the legislative objectives, statutory requirements and financial reporting, the effectiveness of internal controls and adequacy of systems; and the Authority's risk management processes;
- AFMA and the MAC to periodically assess the effectiveness of the management measures taken to achieve the objectives of this Management Plan by reference to the performance criteria specified in the Plan
- An AFMA MAC/RAG Workshop focusing on managing conflicts of interest, the Productivity Commission review of commercial fisheries management, the regulatory outlook etc.
- AFMA and NORMAC developing performance measures and responses to avoid overcapitalisation and encourage autonomous structural adjustment in the NPF
- NPF research proposals reviewed by the AFMA Research Committee and those for FRDC funding by the Commonwealth Research Advisory Committee
- The NPF harvest strategy remains consistent with the Australian Government's Harvest Strategy Policy
- Review of AFMA's ERA-ERM Framework – new Guidelines for fisheries have been drafted and will be finalised by 30 June 2017; and
- AFMA also has an internal quality assurance program to determine whether Compliance best practice has been followed

External reviews, which include:

- Questioning by the Senate Standing Committee on Rural and Regional Affairs and Transport in Senate Estimates hearings (three times/year);

- Annual reporting of NPF performance against protected species and export approval requirements under the EPBC Act consistent with the Guidelines for the Ecologically Sustainable Management of Fisheries (See below);
- The Australian Bureau of Agricultural and Resource Economics and Sciences (ABARES) annual reports (last published late 2016) on the ecological and economic sustainability of fisheries managed by AFMA;
- US biennial review and accreditation of fishing gear to meet Turtle Excluder Device requirements;
- The draft Productivity Commission review of commercial fisheries regulation in Australia which has made a number of draft recommendations relevant to AFMA (the final report is due to be completed shortly);
- The Australian National Audit Office periodic reviews of aspects of AFMA's performance. This includes an audit of AFMA's risk management procedures which is currently underway.

CSIRO's internal and external review procedures (Buckworth and Hutton, pers com 14th February, 2017) comprise the following:

- Internal sensitivity test procedures of research paper outputs
- paper reviews by 2 scientists and principal scientific officer to sign off
- A 5 yearly CSIRO Science Review of research methodologies, using independent experts
- External review of journal papers
- RAG member response to papers

All FRDC funded research papers are also subject to external review.

The ANAO regularly reviews the AFMA Compliance Programme (ANAO, 2013a), and these recommendations are adopted into the AFMA Compliance Programme (AFMA 2016-2017).

The implementation of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) requires the Australian Government to assess the environmental performance of fisheries and promote ecologically sustainable management. The independent assessment of all export and all Australian Government managed fisheries is required. These assessments ensure that, over time, fisheries are managed in an ecologically sustainable way. The Assessment (DoE, 2013) is available at DoEE website, Assessment of the Northern Prawn Fishery. Available at <http://www.environment.gov.au/marine/fisheries/commonwealth/northern-prawn;>

The Accreditation of the NPF (Government of Australia, 2013) is available at <http://www.environment.gov.au/system/files/pages/d13c64f2-0564-49b6-9abd-c06aed4f3fc8/files/part13-2013.pdf>

4. Evaluation Procedure

4.1 Harmonised Fishery Assessment

The targeted stocks have not been the subject of another MSC assessment. The P1 and P2 outcomes of the Northern Prawn Fishery assessment are therefore not harmonised with any other fishery. There are some commonalities for P3 with the MSC assessed Australian Blue Grenadier Fishery, also managed by AFMA

4.2 Previous assessments

A previous MSC assessment for the Northern Prawn Fishery was undertaken in 2011/2012 and certificate issued on 7 November 2012.

4.3 Assessment Methodologies

This fishery was assessed using MSC Certification Requirements version 1.3, and the report has correspondingly been produced using version 1.3 of the MSC Full Assessment Reporting Template. The default assessment tree was used without adjustments.

4.4 Evaluation Processes and Techniques

Site Visits

The announcement for the site visit was posted onto the MSC website on 20 December, 2016. The site visit commenced on 12th February, 2017 in Brisbane, and was completed on 14th February. The announcement for the site visit was posted onto the MSC website on 20 December, 2016. The site visit commenced on 13th February, 2017 in Brisbane, and was completed on 14th February. Meetings fisheries scientists took place at the offices of CSIRO, Oceans and Atmosphere, Dutton Park, Brisbane and with AFMA, NPFI and other stakeholders at the Riverview Hotel, Brisbane. Documents were presented by fishery representatives and fisheries scientists and most also available on the AFMA website (<http://www.afma.gov.au/fisheries/northern-prawn-fishery/>).

Some email exchanges relating to specific management issues have been ongoing since the date of the announcement.

Assessors took the decision to conduct a remote SICA audit to assess the status of red endeavour prawns (*Metapenaeus ensis*). The announcement was made on 2 May, 2017. Information to support the SICA was collected at a scheduled meeting of the NPRAG on 11 May, 2017.

Table 30. Participants at meetings during the field inspections

	Name	Affiliation	Issues	Location
1.	Day 1: Opening meeting CSIRO Ecosciences			
	Trevor Hutton	CSIRO	P1	Brisbane
	Gary Fry	CSIRO	P2	Brisbane
	Rik Buckworth	Sea Sense/NPRAG	P1	Brisbane
	Richard Banks	MRAG	P3, P2, P1	Brisbane
	Kevin McLoughlin	MRAG	P1	Brisbane
	Mihaela Zaharia	MRAG	P2	Brisbane
	Antonio Hervas	ASI		Brisbane
	Heiko Seilert	ASI		Brisbane
2.	Day 1: University of Queensland			
	P2 meeting			
	Garry Fry	CSIRO	P2	Brisbane
	Mihaela Zaharia	MRAG	P2	Brisbane
	Richard Banks	MRAG	P2	Brisbane
	Antonio Hervas	ASI		Brisbane
	Heiko Seilert	ASI		Brisbane
3.	P1 meeting			
	Rik Buckworth	Sea Sense	P1	Brisbane
	Trevor Hutton	CSIRO	P1	Brisbane
	Roy Deng	CSIRO	P1	Brisbane
	Kevin McLoughlin	MRAG	P1	Brisbane
4	Day 1: Fishery Managers meeting			
	Phil Robson	A Raptis & Sons	P1, P2 and P3	Brisbane
	Arthur Raptis	A Raptis & Sons	P1, P2 and P3	Brisbane
	Jamie Ball	Tropic Ocean Prawns	P1, P2 and P3	Brisbane
	Tony Murray	MTC	P1, P2 and P3	Brisbane
	Greg Albert	Madang Contractors	P1, P2 and P3	Brisbane
	Neal Harris	Austfish	P1, P2 and P3	Brisbane
	Ron Earle	Tropic Ocean Prawns	P1, P2 and P3	Brisbane
	Annie Jarrett	NPFI	P1, P2 and P3	Brisbane
	Adrianne Laird	NPFI	P1, P2 and P3	Brisbane
	Bryan Van Wyk	Austral Fisheries	P1, P2 and P3	Brisbane
	Andy Prendergast	Austral Fisheries	P1, P2 and P3	Brisbane
	David Carter	Austral Fisheries	P1, P2 and P3	Brisbane
	Richard Banks	MRAG	P3, P2, P1	Brisbane
	Kevin McLoughlin	MRAG	P1	Brisbane
	Mihaela Zaharia	MRAG	P2	Brisbane
	Antonio Hervas	ASI		Brisbane
	Heiko Seilert	ASI		Brisbane

5.	Day 2: NORMAC Briefing			
	Annie Jarrett	NPFI	P1, P2 and P3	Brisbane
	Phil Robson	A Raptis & Sons	P1, P2 and P3	Brisbane
	Arthur Raptis	A Raptis & Sons	P1, P2 and P3	Brisbane
	Greg Albert	Mandang Contractors	P1, P2 and P3	Brisbane
	Adrianne Laird	NPFI	P1, P2 and P3	Brisbane
	Ron Earle	Tropic Ocean Prawns	P1, P2 and P3	Brisbane
	Nigel Abery	AFMA	P1, P2 and P3	Brisbane
	Abul Bari	AFMA	P1, P2 and P3	Brisbane
	Stephen Eves	AFMA	P1, P2 and P3	Brisbane
	Stuart Richey	NORMAC Chair	P1, P2 and P3	Brisbane
	Steve Bolton	AFMA	P1, P2 and P3	Brisbane
	David Carter	Austral Fisheries	P1, P2 and P3	Brisbane
	Andy Prendergast	Austral Fisheries	P1, P2 and P3	Brisbane
	Bryan Van Wyk	Austral Fisheries	P1, P2 and P3	Brisbane
	Trevor Hutton	CSIRO	P1, P2 and P3	Brisbane
	Claire Van der Geest	NORMAC/ Enviro Rep	P1, P2 and P3	Brisbane
	Rik Buckworth	Sea Sense	P1, P2 and P3	Brisbane
	Rob Kenyon	CSIRO	P1, P2 and P3	Brisbane
	Ian Knuckey	NORMAC	P1, P2 and P3	Brisbane
	Richard Banks	MRAG	P3, P2, P1	Brisbane
	Kevin McLoughlin	MRAG	P1	Brisbane
	Mihaela Zaharia	MRAG	P2	Brisbane
	Antonio Hervas	ASI		Brisbane
	Heiko Seilert	ASI		Brisbane

Table 31. Scoring elements

Component	Scoring elements	Main/not main	Data-deficient or not
P 1	Brown tiger prawn (<i>Penaeus esculentus</i>)	na	
P 1	Grooved tiger prawn (<i>P. semisulcatus</i>)	na	
P 1	Blue endeavour prawn (<i>Metapenaeus endeavouri</i>)	na	
P 1	Red endeavour prawn (<i>M. ensis</i>)	na	
P 1	White banana prawns (<i>Fenneropenaeus merguensis</i>);	na	
P 1	Red-legged banana prawns (<i>Fenneropenaeus indicus</i>)	na	
Tiger Prawn Subfishery (brown tiger prawn, grooved tiger prawn, blue endeavour prawn and red endeavour prawn)			
P 2 Retained	Grooved tiger prawn (<i>P. semisulcatus</i>)	Main	Not data deficient
P 2 Retained	Brown tiger prawn (<i>Penaeus esculentus</i>)	Main	Not data deficient
P 2 Retained	Blue endeavour prawn (<i>Metapenaeus endeavouri</i>)	Main	Not data deficient
P 2 Retained	Red endeavour prawn (<i>M. ensis</i>)	Not main	Not data deficient
P 2 Retained	Red-legged banana prawns (<i>Fenneropenaeus indicus</i>)	Not main	Not data deficient
P 2 Retained	Bugs (<i>Thenus parindicus</i> and <i>T. australiensis</i>)	Not main	Not data deficient
P2 Retained	Other minor retained species	Not main	Not data deficient
P2 Bycatch	Leiognathidae	Main	Not data deficient
P2 Bycatch	Mullidae	Main	Not data deficient
P2 Bycatch	Bathysauridae	Not main	Not data deficient
P2 Bycatch	Synodontidae	Not main	Not data deficient
P2 Bycatch	Sillaginidae	Not main	Not data deficient
P2 Bycatch	<i>Nemipterus spp.</i>	Not main	Not data deficient
P2 Bycatch	<i>Polydactylus multiradiatus</i>	Not main	Not data deficient
P2 Bycatch	Other minor bycatch species	Not main	Not data deficient

P2 ETP	Loggerhead turtle (<i>Caretta caretta</i>)	ETP	
P2 ETP	Green turtle (<i>Chelonia mydas</i>)	ETP	
P2 ETP	Leathery turtle (<i>Dermochelys coriacea</i>)	ETP	
P2 ETP	Flatback turtle (<i>Natator depressus</i>)	ETP	
P2 ETP	Olive Ridley turtle (<i>Lepidochelys olivacea</i>)	ETP	
P2 ETP	Hawksbill turtle (<i>Eretmochelys imbricata</i>)	ETP	
P2 ETP	Spine-tailed sea snake (<i>Aipysurus eydouxii</i>)	ETP	
P2 ETP	Olive sea snake (<i>Aipysurus laevis</i>)	ETP	
P2 ETP	Stokes' sea snake (<i>Astrotia stokesii</i>)	ETP	
P2 ETP	Olive-headed sea snake (<i>Disteira major</i>)	ETP	
P2 ETP	Elegant sea snake (<i>Hydrophis elegans</i>)	ETP	
P2 ETP	Spotted sea snake (<i>Hydrophis ornatus</i>)	ETP	
P2 ETP	Spine-bellied sea snake (<i>Lapemis curtus</i> (<i>L. hardwickii</i>))	ETP	
P2 ETP	Common dolphin (<i>Delphinus delphis</i>)	ETP	
P2 ETP	Narrow sawfish (<i>Anoxypristis cuspidata</i>)	ETP	
P2 ETP	Dwarf sawfish (<i>Pristis clavata</i>)	ETP	
P2 ETP	Green sawfish (<i>Pristis zijsron</i>)	ETP	
P2 ETP	(<i>Trachyrhampus longirostris</i>)	ETP	
P2 ETP	(<i>Hippocampus histrix</i>)	ETP	
P2 Habitat	Inner shelf- soft sediments- mixed fauna	Main	Not data deficient
P2 Habitat	Seagrass meadows	Not main	Not data deficient
P2 Habitat	Coral reef	Not main	Not data deficient
P2 Ecosystem	Inshore and open water tropical	Main	Not data deficient
White banana prawn subfishery (white banana prawn UoA)			

P 2 Retained	No species with percentage contributions over 0.5% of bycatch biomass	N/A	N/A
P 2 Bycatch	Sciaenidae	Not main	Not data deficient
P 2 Bycatch	<i>Setipinna tenuifilis</i>	Not main	Not data deficient
P 2 Bycatch	<i>Carcharhinus spp.</i>	Not main	Not data deficient
P2 Bycatch	<i>Loxodon spp.</i>	Not main	Not data deficient
P2 Bycatch	<i>Rhizoprionodon spp.</i>	Not main	Not data deficient
P 2 Bycatch	<i>Polydactylus nigripinnis</i>	Not main	Not data deficient
P 2 Bycatch	<i>Harpadon translucens</i>	Not main	Not data deficient
P2 Bycatch	Other bycatch species	Not main	Not data deficient
P2 ETP	Green turtle (<i>Chelonia mydas</i>)	ETP	
P2 ETP	Leathery turtle (<i>Dermochelys coriacea</i>)	ETP	
P2 ETP	Flatback turtle (<i>Natator depressus</i>)	ETP	
P2 ETP	Olive Ridley turtle (<i>Lepidochelys olivacea</i>)	ETP	
P2 ETP	Spine-tailed sea snake (<i>Aipysurus eydouxii</i>)	ETP	
P2 ETP	Olive sea snake (<i>Aipysurus laevis</i>)	ETP	
P2 ETP	Stokes' sea snake (<i>Astrotia stokesii</i>)	ETP	
P2 ETP	Olive-headed sea snake (<i>Disteira major</i>)	ETP	
P2 ETP	Elegant sea snake (<i>Hydrophis elegans</i>)	ETP	
P2 ETP	Spotted sea snake (<i>Hydrophis ornatus</i>)	ETP	
P2 ETP	Spine-bellied sea snake (<i>Lapemis curtus</i> (<i>L. hardwickii</i>))	ETP	
P2 ETP	Narrow sawfish (<i>Anoxypristis cuspidata</i>)	ETP	
P2 ETP	Dwarf sawfish (<i>Pristis clavata</i>)	ETP	
P2 ETP	Green sawfish (<i>Pristis zijsron</i>)	ETP	
P2 Habitat	Inner shelf- soft sediments- mixed fauna	Main	Not data deficient

P2 Habitat	Seagrass meadows	Not main	Not data deficient
P2 Habitat	Coral reef	Not main	Not data deficient
P2 Habitat	Mangroves	Not main	Not data deficient
P2 Ecosystem	Inshore and open water tropical	Main	Not data deficient
Red-legged Banana Subfishery (red-legged banana UoA)			
P 2 Retained	White banana prawns (<i>Fenneropenaeus merguensis</i>);	Main	Not data deficient
P2 Retained	Blue endeavour prawn (<i>Metapenaeus endeavouri</i>)	Not main	Not data deficient
P2 Retained	Other minor retained species	Not main	Not data deficient
P 2 Bycatch	Sciaenidae	main	Not data deficient
P2 Bycatch	<i>Setipinna tenuifilis</i>	Not main	Not data deficient
P2 Bycatch	<i>Polydactylus nigripinnis</i>	Not main	Not data deficient
P2 Bycatch	<i>Harpadon translucens</i>	Not main	Not data deficient
P2 Bycatch	<i>Neotrygon annotata</i>	Not main	Not data deficient
P2 Bycatch	Other minor bycatch species	Not main	Not data deficient
P2 ETP	Flatback turtle (<i>Natator depressus</i>)	ETP	
P2 ETP	Spine-tailed sea snake (<i>Aipysurus eydouxii</i>)	ETP	
P2 ETP	Olive sea snake (<i>Aipysurus laevis</i>)	ETP	
P2 ETP	Stokes' sea snake (<i>Astrotia stokesii</i>)	ETP	
P2 ETP	Olive-headed sea snake (<i>Disteira major</i>)	ETP	
P2 ETP	Elegant sea snake (<i>Hydrophis elegans</i>)	ETP	
P2 ETP	Spotted sea snake (<i>Hydrophis ornatus</i>)	ETP	
P2 ETP	Spine-bellied sea snake (<i>Lapemis curtus</i> (<i>L. hardwickii</i>))	ETP	
P2 ETP	Common dolphin (<i>Delphinus delphis</i>)	ETP	
P2 ETP	Narrow sawfish (<i>Anoxypristis cuspidata</i>)	ETP	

P2 ETP	Green sawfish (<i>Pristis zijsron</i>)	ETP	
P2 Habitat	Inner shelf- soft sediments- mixed fauna	Main	Not data deficient
P2 Habitat	Seagrass meadows	Not main	Not data deficient
P2 Habitat	Coral reef	Not main	Not data deficient
P2 Ecosystem	Inshore and open water tropical	Main	Not data deficient

5. Traceability within the Fishery

All licence holders and members of the NPFI are members of the client group, and eligible to use the MSC logo.

Fishing does not occur beyond the Northern Prawn Fishery fishing area. Restricted area fishing and monitoring through VMS provides assurance that the vessels do not fish out of area. There are no other fisheries that overlap and land tiger, endeavor and banana prawns in the fishing area.

The prawn catch is unloaded into a seawater hopper as it comes onboard. After sorting from the hopper, they enter a grader, which separates the prawns by individual species and grade size. Prawn species groups comprise: tiger prawns including Brown tiger prawn (*Penaeus esculentus*) and Grooved tiger prawn (*P. semisulcatus*), banana prawns, including White banana prawns (*Fenneropenaeus merguensis*) and Red-legged banana prawns (*Fenneropenaeus indicus*) and endeavour prawns including Blue endeavour prawn (*Metapenaeus endeavouri*) and Red endeavour prawn (*M. ensis*). They are then sorted by hand to ensure quality control of grading, and subsequently boxed (into 3, 5 & 10 kg boxes and random weight bulkpack boxes) and then snap frozen, onboard, ready-for-distribution. Boxes may be offloaded onto a mothership/carrier or on landing, and palletised and sent to cold storage for distribution. The boxed prawns remain as prepared in transshipment and offloading.

Catch information is recorded on logbooks after each haul, and submitted on landing to the AFMA. The information available specifically contains reference to the vessel, species caught (estimated catch (kg), round weight, time and date of haul, and location). The vessels are also required to submit an unloading sheet. The labels will have a space to designate the certified prawn species. These data are also cross-checked from cold store receiving records. Tick boxes are ticked on each carton with text or crayon showing date of catch, grade, species, vessel name, and vessel establishment number.

At each unload point, an accurate record is provided and signed off by the skipper of the vessel. Each box is labeled and packed at sea with a clearly visible MSC logo ensuring there is no substitution at any point along the supply chain. The unload report is cross referenced with the final storage report to ensure what came off the vessel matches with what is put into store.

The fishery retains a number of other species, king prawn, black tiger prawn, squid, cuttlefish and bugs. King prawns and black tiger prawn are easily distinguishable and are graded separately from the other prawn species and the other non-prawn species cannot be confused with the certified product. There is no realistic opportunity for non-certified product to mix with the certified prawns, so the risk to traceability is low onboard the fishing vessels. Therefore, the fishing vessels do not require CoC.

Product is unloaded at the Darwin, Gove, Karumba, Weipa, Wyndham, Townsville, and Cairns port facilities. Numerous cold storage facilities exist in these ports, and are too numerous to list. At unload all species are separated and stored on separate pallets.

There is minimal risk of contamination with other prawn product as most of the ports are not shared with any other fishery. In one case, Cairns, products are offloaded from both the NPF and Queensland East Coast and stored in the same cold stores. East Coast boxes are clearly marked 'EC' and stored separately. All product sourced from MSC fisheries is marked in respective accounting systems with GoC in the item code.

Product is stacked into pallets, loaded onto freezer trucks for transport and delivered to the wholesaler's freezers. Product is either sold and processed by the vessel owners or on-sold at point of unload to 3rd parties (these 3rd parties include wholesalers, retailers, processors or marketing & sales agencies). Transfer of ownership is confirmed via a sales invoice. The owners maintain a record of all product inventories until sold on.

When ownership transfers on usually, but not exclusively, when reaching the wholesaler freezers. Again, the unloaded product is palletized and transported by freezer trucks to the wholesaler's storage freezers.

There is a small proportion of licence holders that sell directly into retail and restaurant trade. This business only accounts for around 5% of total sales. In this case, the licence holder will store the product in their storage space and distribute from that point. Uncertified product cannot be mixed with the prawn species from other fisheries.

The risk of a compromised CoC is low for cold storage facilities. All cold stores in the Northern Territories and Queensland are export approved by the Australian Quarantine and Inspection Service (AQIS). The approval covers cold storage facilities and the prawn travels under export chain of custody with transfer certificates. In any of the cases the wholesalers, retailers and restaurants must have CoC to use the MSC logo.

The product is delivered in a number of ways:

- Ownership of the product may change at the wharf, but only when sold to a third party. Some of the companies are vertically integrated. Product from fishing vessels is delivered by truck to other cold storage facilities, usually owned by the parent companies on pallets containing product from individual vessels. The companies maintain detailed records of product received from each fishing vessel. Pallets contain product by species from a vessel trip (lot) and lots or segments of lots travel together. Lots of certified product would stay segregated from uncertified product through cold storage and transport.
- The product is shipped by truck or container to these cold storage facilities in Australia. The risk of a compromised CoC is low for cold storage facilities. Information from the new transport or cold storage is added to the previous information, so that a complete record travels with each shipment, allowing tracking back to the fishery. The boxes of frozen product remain sealed, and no transformation of product occurs. Therefore, cold storage facilities would not require CoC. Receivers of the products are primarily wholesalers, but also include restaurants and supermarkets. Change of ownership occurs upon sale to wholesalers, retailers and restaurants. All wholesalers, retailers and restaurants must have CoC to use the MSC logo.
- Some product, which is labeled as 'soft and broken' is sent to a number of countries for peeling. These include Vietnam, Thailand, Malaysia and China. Ownership of product during transit to the factory is the product owners (either vessel owners or 3rd party marketing agents who have purchased the product from vessel owners). MSC Certification covers the product until it reaches Asia provided it stays in the same format as packed on the vessel. The MSC logo or MSC claim can only be used from this point onwards if the processing plant also holds MSC Chain of Custody. The product may be sold within Asia under the clients trade name or returned back to Australia, again under the clients trade name.
- The product is packed according to fishery origin into 1 kg packs. The product is never

actually “sold” to the factory, just contract processed, and always remains a company product. Chain of Custody (CoC) will begin at the point of first sale or shipment and therefore this, or any other custom processor, shall obtain MSC CoC certification prior to handling these products as certified.

CoC starts after the first point of sale from any members of the client group, or at offload at the wharf and then, to cold store distributors or secondary processing or sale to the general public, whichever comes first. That is, each buyer and each repacker, each secondary processor, and each seller of prawns to the public must have CoC.

All NPF prawn trawlers fishing from Queensland and Northern Territory ports are members of NPFI, and will be eligible to be covered by the MSC fisheries certificate. Under these requirements, no risk accrues from other fishers participating in the certification.

5.1 Points of landing

The ports of landing are restricted to Darwin, Gove, Karumba, Weipa, Wyndham, Townsville, and Cairns. The fishery uses cold storage facilities in a number of locations throughout Australia.

5.2 Eligibility to enter chains of custody

Prawns caught from the certified fishery by vessels in the client group are eligible to enter the chain of custody. The actual eligibility date is either the publication date of the public comment draft report, or the issue date of the new certificate if the latter is before the expiration of the current certificate.

6. Evaluation Results

6.1 Principle Level Scores

Table 32. Final Principle Scores

Final Principle Scores	
Brown Tiger Prawn	
Principle	Score
Principle 1 – Target Species	100
Principle 2 – Ecosystem	94.3
Principle 3 – Management System	100
Grooved Tiger Prawn	
Principle	Score
Principle 1 – Target Species	100
Principle 2 – Ecosystem	94.3
Principle 3 – Management System	100
Blue Endeavour Prawn	
Principle	Score
Principle 1 – Target Species	97.5
Principle 2 – Ecosystem	94.3
Principle 3 – Management System	100
Red Endeavour Prawn	
Principle	Score
Principle 1 – Target Species	82.1
Principle 2 – Ecosystem	95
Principle 3 – Management System	100

White Banana Prawn	
Principle	Score
Principle 1 – Target Species	81.9
Principle 2 – Ecosystem	97
Principle 3 – Management System	100
Red-legged Banana Prawn	
Principle	Score
Principle 1 – Target Species	80
Principle 2 – Ecosystem	95.7
Principle 3 – Management System	100

6.2 Summary of Scores

Brown Tiger Prawn

Table 33. Summary of Scores

Prin- ciple	Wt (L1)	Component	Wt (L2)	PI No.	Performance Indicator (PI)	Wt (L3)	Weight in			Score	Contribution to Principle Score	
						Either		Or			Either	Or
One	1	Outcome	0.5	1.1.1	Stock status	0.5	0.25	0.333	0.1667	100	25.00	16.67
				1.1.2	Reference points	0.5	0.25	0.333	0.1667	100	25.00	16.67
				1.1.3	Stock rebuilding			0.333	0.1667	N/A		
		Management	0.5	1.2.1	Harvest strategy	0.25	0.125			100	12.50	12.50
				1.2.	Harvest control rules & tools	0.25	0.125			100	12.50	12.50
				1.2.	Information & monitoring	0.25	0.125			100	12.50	12.50
				1.2.	Assessment of stock status	0.25	0.125			100	12.50	12.50
Two	1	Retained species	0.2	2.1.	Outcome	0.333	0.0667			90	6.00	6.00
				2.1.	Management	0.333	0.0667			95	6.33	6.33
				2.1.	Information	0.333	0.0667			100	6.67	6.67
		Bycatch species	0.2	2.2.	Outcome	0.333	0.0667			100	6.67	6.67
				2.2.	Management	0.333	0.0667			100	6.67	6.67
				2.2.	Information	0.333	0.0667			100	6.67	6.67
		ETP species	0.2	2.3.	Outcome	0.333	0.0667			90	6.00	6.00
				2.3.	Management	0.333	0.0667			95	6.33	6.33
				2.3.	Information	0.333	0.0667			85	5.67	5.67
		Habitats	0.2	2.4.	Outcome	0.333	0.0667			80	5.33	5.33
				2.4.	Management	0.333	0.0667			100	6.67	6.67
				2.4.	Information	0.333	0.0667			80	5.33	5.33
		Ecosystem	0.2	2.5.	Outcome	0.333	0.0667			100	6.67	6.67
				2.5.	Management	0.333	0.0667			100	6.67	6.67
				2.5.	Information	0.333	0.0667			100	6.67	6.67
Three	1	Governance and policy	0.5	3.1.1	Legal & customary framework	0.25	0.125			100	12.50	
				3.1.2	Consultation, roles &	0.25	0.125			100	12.50	
				3.1.3	Long term objectives	0.25	0.125			100	12.50	
				3.1.4	Incentives for sustainable fishing	0.25	0.125			100	12.50	
		Fishery specific management system	0.5	3.2.	Fishery specific objectives	0.2	0.1			100	10.00	
				3.2.	Decision making processes	0.2	0.1			100	10.00	
				3.2.	Compliance & enforcement	0.2	0.1			100	10.00	
				3.2.4	Research plan	0.2	0.1			100	10.00	
				3.2.5	Management performance	0.2	0.1			100	10.00	
					Overall weighted Principle-level scores						Either	Or
					Principle 1 - Target species	Stock rebuilding PI not scored					100.0	
						Stock rebuilding PI scored						
					Principle 2 - Ecosystem						94.3	
					Principle 3 - Management						100.0	

Grooved Tiger Prawn

Table 34. Summary of Score

Prin- ciple	Wt (L1)	Component	Wt (L2)	PI No.	Performance Indicator (PI)	Wt (L3)	Weight in			Score	Contribution to Principle Score		
						Either		Or			Either	Or	
One	1	Outcome	0.5	1.1.1	Stock status	0.5	0.25	0.333	0.1667	100	25.00	16.67	
				1.1.2	Reference points	0.5	0.25	0.333	0.1667	100	25.00	16.67	
				1.1.3	Stock rebuilding			0.333	0.1667	N/A			
		Management	0.5	1.2.1	Harvest strategy	0.25	0.125			100	12.50	12.50	
				1.2.	Harvest control rules & tools	0.25	0.125			100	12.50	12.50	
				1.2.	Information & monitoring	0.25	0.125			100	12.50	12.50	
				1.2.	Assessment of stock status	0.25	0.125			100	12.50	12.50	
Two	1	Retained species	0.2	2.1.	Outcome	0.333	0.0667			90	6.00	6.00	
				2.1.	Management	0.333	0.0667			95	6.33	6.33	
				2.1.	Information	0.333	0.0667			100	6.67	6.67	
		Bycatch species	0.2	2.2.	Outcome	0.333	0.0667			100	6.67	6.67	
				2.2.	Management	0.333	0.0667			100	6.67	6.67	
				2.2.	Information	0.333	0.0667			100	6.67	6.67	
		ETP species	0.2	2.3.	Outcome	0.333	0.0667			90	6.00	6.00	
				2.3.	Management	0.333	0.0667			95	6.33	6.33	
				2.3.	Information	0.333	0.0667			85	5.67	5.67	
		Habitats	0.2	2.4.	Outcome	0.333	0.0667			80	5.33	5.33	
				2.4.	Management	0.333	0.0667			100	6.67	6.67	
				2.4.	Information	0.333	0.0667			80	5.33	5.33	
		Ecosystem	0.2	2.5.	Outcome	0.333	0.0667			100	6.67	6.67	
				2.5.	Management	0.333	0.0667			100	6.67	6.67	
				2.5.	Information	0.333	0.0667			100	6.67	6.67	
Three	1	Governance and policy	0.5	3.1.1	Legal & customary framework	0.25	0.125			100	12.50		
				3.1.2	Consultation, roles &	0.25	0.125			100	12.50		
				3.1.3	Long term objectives	0.25	0.125			100	12.50		
				3.1.4	Incentives for sustainable fishing	0.25	0.125			100	12.50		
		Fishery specific management system	0.5	3.2.	Fishery specific objectives	0.2	0.1			100	10.00		
				3.2.	Decision making processes	0.2	0.1			100	10.00		
				3.2.	Compliance & enforcement	0.2	0.1			100	10.00		
				3.2.4	Research plan	0.2	0.1			100	10.00		
				3.2.5	Management performance	0.2	0.1			100	10.00		
					Overall weighted Principle-level scores							Either	Or
					Principle 1 - Target species	Stock rebuilding PI not scored					100.0		
						Stock rebuilding PI scored							
					Principle 2 - Ecosystem						94.3		
					Principle 3 - Management						100.0		

Blue Endeavour Prawn

Table 35. Summary of Score

Prin- ciple	Wt (L1)	Component	Wt (L2)	PI No.	Performance Indicator (PI)	Wt (L3)	Weight in			Score	Contribution to Principle Score	
						Either		Or			Either	Or
One	1	Outcome	0.5	1.1.1	Stock status	0.5	0.25	0.333	0.1667	90	22.50	15.00
				1.1.2	Reference points	0.5	0.25	0.333	0.1667	100	25.00	16.67
				1.1.3	Stock rebuilding			0.333	0.1667	N/A		
		Management	0.5	1.2.1	Harvest strategy	0.25	0.125			100	12.50	12.50
				1.2.	Harvest control rules & tools	0.25	0.125			100	12.50	12.50
				1.2.	Information & monitoring	0.25	0.125			100	12.50	12.50
				1.2.	Assessment of stock status	0.25	0.125			100	12.50	12.50
Two	1	Retained species	0.2	2.1.	Outcome	0.333	0.0667			90	6.00	6.00
				2.1.	Management	0.333	0.0667			95	6.33	6.33
				2.1.	Information	0.333	0.0667			100	6.67	6.67
		Bycatch species	0.2	2.2.	Outcome	0.333	0.0667			100	6.67	6.67
				2.2.	Management	0.333	0.0667			100	6.67	6.67
				2.2.	Information	0.333	0.0667			100	6.67	6.67
		ETP species	0.2	2.3.	Outcome	0.333	0.0667			90	6.00	6.00
				2.3.	Management	0.333	0.0667			95	6.33	6.33
				2.3.	Information	0.333	0.0667			85	5.67	5.67
		Habitats	0.2	2.4.	Outcome	0.333	0.0667			80	5.33	5.33
				2.4.	Management	0.333	0.0667			100	6.67	6.67
				2.4.	Information	0.333	0.0667			80	5.33	5.33
		Ecosystem	0.2	2.5.	Outcome	0.333	0.0667			100	6.67	6.67
				2.5.	Management	0.333	0.0667			100	6.67	6.67
				2.5.	Information	0.333	0.0667			100	6.67	6.67
Three	1	Governance and policy	0.5	3.1.1	Legal & customary framework	0.25	0.125			100	12.50	
				3.1.2	Consultation, roles &	0.25	0.125			100	12.50	
				3.1.3	Long term objectives	0.25	0.125			100	12.50	
				3.1.4	Incentives for sustainable fishing	0.25	0.125			100	12.50	
		Fishery specific management system	0.5	3.2.	Fishery specific objectives	0.2	0.1			100	10.00	
				3.2.	Decision making processes	0.2	0.1			100	10.00	
				3.2.	Compliance & enforcement	0.2	0.1			100	10.00	
				3.2.4	Research plan	0.2	0.1			100	10.00	
				3.2.5	Management performance	0.2	0.1			100	10.00	
					Overall weighted Principle-level scores						Either	Or
					Principle 1 - Target species	Stock rebuilding PI not scored				97.5		
						Stock rebuilding PI scored						
					Principle 2 - Ecosystem						94.3	
					Principle 3 - Management						100.0	

Red Endeavour Prawn

Table 36. Summary of Score

Prin- ciple	Wt (L1)	Component	Wt (L2)	PI No.	Performance Indicator (PI)	Wt (L3)	Weight in			Score	Contribution to Principle Score	
						Either		Or			Either	Or
One	1	Outcome	0.5	1.1.1	Stock status	0.5	0.25	0.333	0.1667	96	24.00	16.00
				1.1.2	Reference points	0.5	0.25	0.333	0.1667	80	20.00	13.33
				1.1.3	Stock rebuilding			0.333	0.1667	N/A		
		Management	0.5	1.2.1	Harvest strategy	0.25	0.125			70	8.75	8.75
				1.2.	Harvest control rules & tools	0.25	0.125			75	9.38	9.38
				1.2.	Information & monitoring	0.25	0.125			80	10.00	10.00
				1.2.	Assessment of stock status	0.25	0.125			80	10.00	10.00
Two	1	Retained species	0.2	2.1.	Outcome	0.333	0.0667			95	6.33	6.33
				2.1.	Management	0.333	0.0667			100	6.67	6.67
				2.1.	Information	0.333	0.0667			100	6.67	6.67
		Bycatch species	0.2	2.2.	Outcome	0.333	0.0667			100	6.67	6.67
				2.2.	Management	0.333	0.0667			100	6.67	6.67
				2.2.	Information	0.333	0.0667			100	6.67	6.67
		ETP species	0.2	2.3.	Outcome	0.333	0.0667			90	6.00	6.00
				2.3.	Management	0.333	0.0667			95	6.33	6.33
				2.3.	Information	0.333	0.0667			85	5.67	5.67
		Habitats	0.2	2.4.	Outcome	0.333	0.0667			80	5.33	5.33
				2.4.	Management	0.333	0.0667			100	6.67	6.67
				2.4.	Information	0.333	0.0667			80	5.33	5.33
		Ecosystem	0.2	2.5.	Outcome	0.333	0.0667			100	6.67	6.67
				2.5.	Management	0.333	0.0667			100	6.67	6.67
				2.5.	Information	0.333	0.0667			100	6.67	6.67
Three	1	Governance and policy	0.5	3.1.1	Legal & customary framework	0.25	0.125			100	12.50	
				3.1.2	Consultation, roles &	0.25	0.125			100	12.50	
				3.1.3	Long term objectives	0.25	0.125			100	12.50	
				3.1.4	Incentives for sustainable fishing	0.25	0.125			100	12.50	
		Fishery specific management system	0.5	3.2.	Fishery specific objectives	0.2	0.1			100	10.00	
				3.2.	Decision making processes	0.2	0.1			100	10.00	
				3.2.	Compliance & enforcement	0.2	0.1			100	10.00	
				3.2.4	Research plan	0.2	0.1			100	10.00	
				3.2.5	Management performance	0.2	0.1			100	10.00	
					Overall weighted Principle-level scores						Either	Or
					Principle 1 - Target species	Stock rebuilding PI not scored				82.1		
						Stock rebuilding PI scored						
					Principle 2 - Ecosystem					95.0		
					Principle 3 - Management					100.0		

White Banana Prawn

Table 37. Summary of Score

Prin- ciple	Wt (L1)	Component	Wt (L2)	PI No.	Performance Indicator (PI)	Wt (L3)	Weight in			Score	Contribution to Principle Score	
						<u>Either</u>		<u>Or</u>			<u>Either</u>	<u>Or</u>
One	1	Outcome	0.5	1.1.1	Stock status	0.5	0.25	0.333	0.1667	80	20.00	13.33
				1.1.2	Reference points	0.5	0.25	0.333	0.1667	80	20.00	13.33
				1.1.3	Stock rebuilding			0.333	0.1667	N/A		
		Management	0.5	1.2.1	Harvest strategy	0.25	0.125			85	10.63	10.63
				1.2.	Harvest control rules & tools	0.25	0.125			80	10.00	10.00
				1.2.	Information & monitoring	0.25	0.125			90	11.25	11.25
				1.2.	Assessment of stock status	0.25	0.125			80	10.00	10.00
Two	1	Retained species	0.2	2.1.	Outcome	0.333	0.0667			100	6.67	6.67
				2.1.	Management	0.333	0.0667			100	6.67	6.67
				2.1.	Information	0.333	0.0667			100	6.67	6.67
		Bycatch species	0.2	2.2.	Outcome	0.333	0.0667			100	6.67	6.67
				2.2.	Management	0.333	0.0667			100	6.67	6.67
				2.2.	Information	0.333	0.0667			100	6.67	6.67
		ETP species	0.2	2.3.	Outcome	0.333	0.0667			95	6.33	6.33
				2.3.	Management	0.333	0.0667			95	6.33	6.33
				2.3.	Information	0.333	0.0667			85	5.67	5.67
		Habitats	0.2	2.4.	Outcome	0.333	0.0667			100	6.67	6.67
				2.4.	Management	0.333	0.0667			100	6.67	6.67
				2.4.	Information	0.333	0.0667			80	5.33	5.33
		Ecosystem	0.2	2.5.	Outcome	0.333	0.0667			100	6.67	6.67
				2.5.	Management	0.333	0.0667			100	6.67	6.67
				2.5.	Information	0.333	0.0667			100	6.67	6.67
Three	1	Governance and policy	0.5	3.1.1	Legal & customary framework	0.25	0.125			100	12.50	
				3.1.2	Consultation, roles &	0.25	0.125			100	12.50	
				3.1.3	Long term objectives	0.25	0.125			100	12.50	
				3.1.4	Incentives for sustainable fishing	0.25	0.125			100	12.50	
		Fishery specific management system	0.5	3.2.	Fishery specific objectives	0.2	0.1			100	10.00	
				3.2.	Decision making processes	0.2	0.1			100	10.00	
				3.2.	Compliance & enforcement	0.2	0.1			100	10.00	
				3.2.4	Research plan	0.2	0.1			100	10.00	
				3.2.5	Management performance	0.2	0.1			100	10.00	
					Overall weighted Principle-level scores						Either	Or
					Principle 1 - Target species	Stock rebuilding PI not scored				81.9		
						Stock rebuilding PI scored						
					Principle 2 - Ecosystem						97.0	
					Principle 3 - Management						100.0	

Red-legged Banana Prawn

Table 38. Summary of Score

Prin- ciple	Wt (L1)	Component	Wt (L2)	PI No.	Performance Indicator (PI)	Wt (L3)	Weight in			Score	Contribution to Principle Score		
						<u>Either</u>		<u>Or</u>			<u>Either</u>	<u>Or</u>	
One	1	Outcome	0.5	1.1.1	Stock status	0.5	0.25	0.333	0.1667	80	20.00	13.33	
				1.1.2	Reference points	0.5	0.25	0.333	0.1667	80	20.00	13.33	
				1.1.3	Stock rebuilding			0.333	0.1667	N/A			
		Management	0.5	1.2.1	Harvest strategy	0.25	0.125			90	11.25	11.25	
				1.2.	Harvest control rules & tools	0.25	0.125			65	8.13	8.13	
				1.2.	Information & monitoring	0.25	0.125			80	10.00	10.00	
				1.2.	Assessment of stock status	0.25	0.125			85	10.63	10.63	
Two	1	Retained species	0.2	2.1.	Outcome	0.333	0.0667			100	6.67	6.67	
				2.1.	Management	0.333	0.0667			100	6.67	6.67	
				2.1.	Information	0.333	0.0667			100	6.67	6.67	
		Bycatch species	0.2	2.2.	Outcome	0.333	0.0667			100	6.67	6.67	
				2.2.	Management	0.333	0.0667			100	6.67	6.67	
				2.2.	Information	0.333	0.0667			100	6.67	6.67	
		ETP species	0.2	2.3.	Outcome	0.333	0.0667			95	6.33	6.33	
				2.3.	Management	0.333	0.0667			95	6.33	6.33	
				2.3.	Information	0.333	0.0667			85	5.67	5.67	
		Habitats	0.2	2.4.	Outcome	0.333	0.0667			80	5.33	5.33	
				2.4.	Management	0.333	0.0667			100	6.67	6.67	
				2.4.	Information	0.333	0.0667			80	5.33	5.33	
		Ecosystem	0.2	2.5.	Outcome	0.333	0.0667			100	6.67	6.67	
				2.5.	Management	0.333	0.0667			100	6.67	6.67	
				2.5.	Information	0.333	0.0667			100	6.67	6.67	
Three	1	Governance and policy	0.5	3.1.1	Legal & customary framework	0.25	0.125			100	12.50		
				3.1.2	Consultation, roles &	0.25	0.125			100	12.50		
				3.1.3	Long term objectives	0.25	0.125			100	12.50		
				3.1.4	Incentives for sustainable fishing	0.25	0.125			100	12.50		
		Fishery specific management system	0.5	3.2.	Fishery specific objectives	0.2	0.1			100	10.00		
				3.2.	Decision making processes	0.2	0.1			100	10.00		
				3.2.	Compliance & enforcement	0.2	0.1			100	10.00		
				3.2.4	Research plan	0.2	0.1			100	10.00		
				3.2.5	Management performance	0.2	0.1			100	10.00		
					Overall weighted Principle-level scores							Either	Or
					Principle 1 - Target species	Stock rebuilding PI not scored					80.0		
						Stock rebuilding PI scored							
					Principle 2 - Ecosystem							95.7	
					Principle 3 - Management							100.0	

6.3 Summary of Conditions

Three conditions are set against the NPF at reassessment (Table 39). No conditions were raised in relation to Principle 1 for the original certification of the fishery. Two of these conditions relate to red endeavour prawn and result from changes in the Northern Prawn Fishery harvest strategy since the original assessment. The third condition relates to red-legged banana prawn and results from uncertainty in recent stock assessment.

Table 39. Summary of Conditions

Number	UoA	PI and SI	Condition
1	Red endeavour prawn	1.2.1 SIa	By the fourth surveillance audit, demonstrate that the harvest strategy for red endeavour prawn is responsive to the state of the stock and the elements of the harvest strategy work together towards achieving stock management objectives reflected in PI 1.1.1 SG80.
2	Red endeavour prawn	1.2.2 SIa	By the fourth surveillance audit, demonstrate that well defined HCRs are in place that ensure that the exploitation rate is reduced as the PRI is approached, are expected to keep the stock fluctuating around a target level consistent with (or above) MSY.
3	Red-legged banana prawn	1.2.2 SIb and SIc	SIa: By the fourth surveillance audit, provide evidence that the HCRs take into account the main uncertainties. SIb: By the fourth surveillance audit, demonstrate that available evidence indicates that the tools in use are appropriate and effective in achieving the exploitation levels required under the HCRs.

6.4 Recommendations

No recommendations have been proposed for this re-assessment.

6.5 Determination, Formal Conclusion and Agreement

The fishery attained a score of 80 or more against each of the MSC Principles and did not score less than 60 against any Indicators. The assessment team concluded that the Australia Northern Prawn fishery should therefore be recertified according to the Marine Stewardship Council Principles and Criteria for Sustainable Fisheries.

Following this Recommendation of the assessment team, and review by stakeholders and peer-reviewers, **a decision is hereby made by the MRAG Americas Certification Decision Making Process to recertify the Australia Northern Prawn fishery** according to the Marine Stewardship Council Principles and Criteria for Sustainable Fisheries.

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7. Appendices

7.1 Appendix 1: Performance Indicator Scores and Rationales

7.1.1 Principle One: Target Species (P1)

Brown tiger prawn (*Penaeus esculentus*)

Evaluation Table for PI 1.1.1

PI 1.1.1		The stock is at a level which maintains high productivity and has a low probability of recruitment overfishing		
Scoring Issue		SG 60	SG 80	SG 100
a	Guide post	It is likely that the stock is above the point where recruitment would be impaired.	It is highly likely that the stock is above the point where recruitment would be impaired.	There is a high degree of certainty that the stock is above the point where recruitment would be impaired.
	Met?	Y	Y	Y
	Justification	<p>Because prawn annual recruitment is highly variable compared to longer-lived species, the limit reference point is the moving average of S_Y/S_{MSY} over the most recent 5 years. The most recent assessment of the status of brown tiger prawn (Buckworth <i>et al.</i>, 2016) shows that stock status is above the LRP ($S_{2011-2015}/S_{MSY}=122\%$) and also above the TRP ($S_{2015}/S_{MEY}=162\%$). The stock is also above the LRP over the range of sensitivities examined (106-137%). Effort in 2015 was also well below that at E_{MSY} indicating that overfishing is not occurring (Table 3, Figure 5). SG60 and SG80 requirements are met.</p> <p>There is a high degree of certainty that the stock is above the point where recruitment would be impaired, meeting SG100.</p>		
b	Guide post		The stock is at or fluctuating around its target reference point.	There is a high degree of certainty that the stock has been fluctuating around its target reference point, or has been above its target reference point, over recent years.
	Met?		Y	Y
	Justification	<p>The most recent assessment of the status of brown tiger prawn (Buckworth <i>et al.</i>, 2016) shows that stock status is above the TRP ($S_{2015}/S_{MEY}=162\%$; 136-162% over the range of sensitivities) (Figure 5).</p> <p>There is a high degree of certainty that the stock has been around the TRP over recent years. SG80 and SG100 requirements are met.</p>		
References		<p>Buckworth, R.C., Deng, R.A., Hutton, T., Upston, J., Miller, M. and Pascoe, S. (2016). Status of the Northern Prawn Fishery Tiger Prawn Fishery at the end of 2015, with an estimated TAE for 2016. Report to the Australian Fisheries Management Authority, September 2016. CSIRO. Brisbane.</p> <p>Patterson, H., Noriega, R., Georgeson, L., Stobutzki, I. & Curtotti, R. (2016), Fishery status reports 2016, Australian Bureau of Agricultural and Resource Economics and Sciences, Canberra.</p>		

PI 1.1.1	The stock is at a level which maintains high productivity and has a low probability of recruitment overfishing		
Stock Status relative to Reference Points			
	Type of reference point	Value of reference point	Current stock status relative to reference point
Target reference point	S _{MEY}	S ₂₀₁₅ /S _{MEY} > 100%	S ₂₀₁₅ /S _{MEY} = 162%
Limit reference point	0.5S _{MSY}	S ₂₀₁₁₋₂₀₁₅ /S _{MSY} > 50%	S ₂₀₁₁₋₂₀₁₅ /S _{MSY} = 122%
OVERALL PERFORMANCE INDICATOR SCORE:			100
CONDITION NUMBER (if relevant):			

Brown tiger prawn (*Penaeus esculentus*)

Evaluation Table for PI 1.1.2

PI 1.1.2	Limit and target reference points are appropriate for the stock		
Scoring Issue	SG 60	SG 80	SG 100
a	Guide post	Generic limit and target reference points are based on justifiable and reasonable practice appropriate for the species category.	Reference points are appropriate for the stock and can be estimated.
	Met?	Y	Y
	Justification	<p>The tiger prawn subfishery is managed under a Maximum Economic Yield (MEY) strategy designed to optimise the economic return from the fishery. This is typically achieved at a spawning biomass level (S_{MEY}) that is higher than the biomass that produces the Maximum Sustainable Yield (S_{MSY}), and in this respect, is a more precautionary approach than is normally applied in many prawn/shrimp fisheries.</p> <p>Biomass reference points for the harvest control rules are consistent with Australia's Harvest Strategy Policy (DAFF, 2007). The target reference point is S_{MEY} (spawning biomass at MEY). There is also an effort reference point relating to the biomass reference points, E_{MEY} (effort at maximum economic yield). The limit reference point is the average of S_Y/S_{MSY} over 5 most recent years = 0.5.</p> <p>There is a state-of-the-art stock assessment to evaluate these reference values. The stock assessment also considers the status of the stock with respect to S_{MSY}, the default MSC TRP.</p>	

PI 1.1.2		Limit and target reference points are appropriate for the stock		
		The reference points are appropriate for the stock and can be estimated, meeting SG60 and SG80 requirements.		
b	Guide post		The limit reference point is set above the level at which there is an appreciable risk of impairing reproductive capacity.	The limit reference point is set above the level at which there is an appreciable risk of impairing reproductive capacity following consideration of precautionary issues.
	Met?		Y	Y
	Justification	The limit reference point is the average of S_Y/S_{MSY} over 5 most recent years = 0.5. A moving average used to account for year-to-year variability in abundance that could cause rapid changes in management responses. This LRP accords with the default MSC LRP. Brown tiger prawns were previously assessed as depleted but have since recovered and at all stage have been above the LRP. The LRP is above the level at which there is an appreciable risk of impairing reproductive capacity and is precautionary. SG80 and SG100 requirements are met.		
c	Guide post		The target reference point is such that the stock is maintained at a level consistent with B_{MSY} or some measure or surrogate with similar intent or outcome.	The target reference point is such that the stock is maintained at a level consistent with B_{MSY} or some measure or surrogate with similar intent or outcome, or a higher level, and takes into account relevant precautionary issues such as the ecological role of the stock with a high degree of certainty.
	Met?		Y	Y
	Justification	The target reference point is S_{MEY} (spawning biomass at MEY). There is also an effort reference point relating to the biomass reference points, E_{MEY} (effort at maximum economic yield). The target reference point is well estimated and designed to maintain the stock at a level consistent with B_{MSY} (and a higher level, at B_{MEY}) and considers relevant precautionary issues such as the ecological role of the stock with a high degree of certainty. SG80 and SG100 are met.		
d	Guide post		For key low trophic level stocks, the target reference point takes into account the ecological role of the stock.	
	Met?		Not relevant	
	Justification	Because this species is a scavenger that feeds on a wide variety of detritus, small animals and plants (e.g., Foraminifera), it comprises only a very small proportion of many species of penaeid, Carid and Sergistid shrimps that occupy similar feeding niches in the food web. As such it is not considered to be a species that holds a key role in ensuring diversity and stability in the ecosystem i.e. it is not considered a key LTL species.		
References		DAFF (2007). Commonwealth Fishery Harvest Strategy, Policy and Guidelines. http://www.agriculture.gov.au/fisheries/domestic/harvest_strategy_policy .		

PI 1.1.2	Limit and target reference points are appropriate for the stock	
	Dichmont, C.M., Jarrett, A., Hill, F., and Brown, M. (2014). Harvest Strategy for the Northern Prawn Fishery under Input Controls 2014. Report to the Australian Fisheries Management Authority, Project 2006/828. CSIRO. Brisbane. 32 p.	
OVERALL PERFORMANCE INDICATOR SCORE:		100
CONDITION NUMBER (if relevant):		

Brown tiger prawn (*Penaeus esculentus*)

Evaluation Table for PI 1.1.3

PI 1.1.3		Where the stock is depleted, there is evidence of stock rebuilding within a specified timeframe		
Scoring Issue		SG 60	SG 80	SG 100
a	Guide post	Where stocks are depleted rebuilding strategies, which have a reasonable expectation of success, are in place.		Where stocks are depleted, strategies are demonstrated to be rebuilding stocks continuously and there is strong evidence that rebuilding will be complete within the specified timeframe.
	Met?	(Y/N)		(Y/N)
	Justification	[Note: Insert as much text as required to justify the SG level achieved for this scoring issue]		
b	Guide post	A rebuilding timeframe is specified for the depleted stock that is the shorter of 30 years or 3 times its generation time. For cases where 3 generations is less than 5 years, the rebuilding timeframe is up to 5 years.	A rebuilding timeframe is specified for the depleted stock that is the shorter of 20 years or 2 times its generation time. For cases where 2 generations is less than 5 years, the rebuilding timeframe is up to 5 years.	The shortest practicable rebuilding timeframe is specified which does not exceed one generation time for the depleted stock.
	Met?	(Y/N)	(Y/N)	(Y/N)
	Justification	[Note: Insert as much text as required to justify the SG level achieved for this scoring issue]		
c	Guide post	Monitoring is in place to determine whether the rebuilding strategies are effective in rebuilding the stock within a specified timeframe.	There is evidence that they are rebuilding stocks, or it is highly likely based on simulation modelling or previous performance that they will be able to rebuild	

PI 1.1.3		Where the stock is depleted, there is evidence of stock rebuilding within a specified timeframe		
			the stock within a specified timeframe.	
	Met?	(Y/N)	(Y/N)	
	Justification			
References				
OVERALL PERFORMANCE INDICATOR SCORE:				NA
CONDITION NUMBER (if relevant):				

Brown tiger prawn (*Penaeus esculentus*)

Evaluation Table for PI 1.2.1

PI 1.2.1		There is a robust and precautionary harvest strategy in place		
Scoring Issue		SG 60	SG 80	SG 100
a	Guide post	The harvest strategy is expected to achieve stock management objectives reflected in the target and limit reference points.	The harvest strategy is responsive to the state of the stock and the elements of the harvest strategy work together towards achieving management objectives reflected in the target and limit reference points.	The harvest strategy is responsive to the state of the stock and is designed to achieve stock management objectives reflected in the target and limit reference points.
	Met?	Y	Y	Y
	Justification	<p>The harvest strategy (HS) is based on input controls (Dichmont <i>et al.</i>, 2014). The HS is compliant with the Commonwealth of Australia's Legislative requirements and is aimed at realizing the objectives of the NPF Management Plan 1995 that includes "Ensure the utilization of the fishery resources is consistent with the principles of ecologically sustainable development and the exercise of the precautionary principle." The operational objective of the HS is to attain long-term maximum economic yield (MEY) from the tiger prawn subfishery. MEY is calculated as the effort level in each year over a 7-year projection period that creates the biggest difference between the total revenue generated from tiger and endeavour prawns and the total costs of fishing for the tiger prawn fishery as a whole.</p> <p>The harvest strategy for brown tiger prawns includes:</p> <ol style="list-style-type: none"> Indicators (data from the fishery) Monitoring (agreed protocols to get data) Reference points (target and limit) 		

PI 1.2.1		There is a robust and precautionary harvest strategy in place		
		<p>4. Decision rules (agreed rules for setting input controls)</p> <p>The HS is designed to be responsive to the state of the stock and achieve objectives reflected in the target and limit reference points. SG60, SG80 and SG100 requirements are met.</p>		
b	Guide post	The harvest strategy is likely to work based on prior experience or plausible argument.	The harvest strategy may not have been fully tested but evidence exists that it is achieving its objectives.	The performance of the harvest strategy has been fully evaluated and evidence exists to show that it is achieving its objectives including being clearly able to maintain stocks at target levels.
	Met?	Y	Y	Y
	Justification	The HS has been tested using the NPF Management Strategy Evaluation (Dichmont <i>et al.</i> , 2008 and Dichmont <i>et al.</i> , 2012a, and Dichmont <i>et al.</i> , 2014). Regular assessments provide evidence that the HS is achieving its objectives and maintaining the stock at target levels. SG60, SG80 and SG100 are met.		
c	Guide post	Monitoring is in place that is expected to determine whether the harvest strategy is working.		
	Met?	Y		
	Justification	There is a high level of monitoring and data collection for the NPF. There is an ongoing assessment program to evaluate how the harvest strategy is working. SG60 is met.		
d	Guide post			The harvest strategy is periodically reviewed and improved as necessary.
	Met?			Y
	Justification	The harvest strategy is periodically reviewed and improved as necessary. There have been several adjustments to the HS since its adoption, most recently in 2014. Detailed information on review processes is given at PI 3.2.5. SG100 is met.		
e	Guide post	It is likely that shark finning is not taking place.	It is highly likely that shark finning is not taking place.	There is a high degree of certainty that shark finning is not taking place.
	Met?	Not relevant	Not relevant	Not relevant
	Justification	Sharks are not a target species.		
References		Dichmont, C.M., Deng, A., Punt, A.E., Ellis, N., Venables, W.N., Kompas, T., Ye, Y., Zhou, S., Bishop, J. (2008). Beyond biological performance measures in Management Strategy Evaluation: Bringing in economics and the effects of trawling on the benthos. Fisheries Research 94: 238-250.		

PI 1.2.1	There is a robust and precautionary harvest strategy in place	
	<p>Dichmont, C.M., Deng, R.A., Punt, A.E., Venables, W., Hutton, T. (2012). From input to output controls in a short-lived species: the case of the Northern Prawn Fishery. Marine and Freshwater Research, 2012, 63, 727–739.</p> <p>Dichmont, C.M., Jarrett, A., Hill, F., and Brown, M. (2014). Harvest Strategy for the Northern Prawn Fishery under Input Controls 2014. Report to the Australian Fisheries Management Authority, Project 2006/828. CSIRO. Brisbane. 32 p.</p> <p>Australia Government, Northern Prawn Fishery Management Plan, 1995. Available at https://www.legislation.gov.au/Details/F2012C00160.</p>	
OVERALL PERFORMANCE INDICATOR SCORE:		100
CONDITION NUMBER (if relevant):		

Brown tiger prawn (*Penaeus esculentus*)

Evaluation Table for PI 1.2.2

PI 1.2.2		There are well defined and effective harvest control rules in place		
Scoring Issue		SG 60	SG 80	SG 100
a	Guide post	Generally understood harvest rules are in place that are consistent with the harvest strategy and which act to reduce the exploitation rate as limit reference points are approached.	Well defined harvest control rules are in place that are consistent with the harvest strategy and ensure that the exploitation rate is reduced as limit reference points are approached.	
	Met?	Y	Y	
	Justification	The harvest strategy contains a comprehensive set of control rules that feed into HS actions, including no target fishing if the LRP is triggered as well as changes to fishing effort to achieve MEY through the use of spatial and temporal closures and gear restrictions. The flow chart for the use of the LRP is seen in Figure 13 and the control rules are in Box 1. There is also a 350kg/day trigger in place, which if met, results in closure of the fishery. This trigger applies to all target species of the tiger prawn subfishery. The trigger is set at the break-even point, where costs equal revenue. SG60 and SG80 requirements are met.		
b	Guide post		The selection of the harvest control rules takes into account the main uncertainties.	The design of the harvest control rules takes into account a wide range of uncertainties.
	Met?		Y	Y

PI 1.2.2		There are well defined and effective harvest control rules in place		
	Justification	The control rules were part of the MSE reported in 1.2.1 that includes testing of the design of the rules. Assessments examine the sensitivity of management performance to a wide range of uncertainties. Information on the uncertainties examined is provided in Section 3.3.12.1 of the report. An evaluation of stock assessment methods and management strategies for the fishery was carried out by Dichmont et. al. (2006a); Dichmont et. al. (2006b); Dichmont et. al. (2006c); and Dichmont et. al. (2008). Buckworth et al. (2016) provides an overview of recent developments with the tiger prawn subfishery assessment that account for uncertainties. SG80 and SG100 requirements are met.		
c	Guide post	There is some evidence that tools used to implement harvest control rules are appropriate and effective in controlling exploitation.	Available evidence indicates that the tools in use are appropriate and effective in achieving the exploitation levels required under the harvest control rules.	Evidence clearly shows that the tools in use are effective in achieving the exploitation levels required under the harvest control rules.
	Met?	Y	Y	Y
	Justification	Following a period of overfishing in the late 1990s, a rebuilding strategy based on the control rules was implemented in 2003 and was successful. Recent assessments provide evidence that ongoing exploitation levels are appropriate. SG60, SG80 and SG100 requirements are met.		
References		<p>Buckworth, R.C., Deng, R.A., Hutton, T., Upston, J., Miller, M. and Pascoe, S. (2016). Status of the Northern Prawn Fishery Tiger Prawn Fishery at the end of 2015, with an estimated TAE for 2016. Report to the Australian Fisheries Management Authority, September 2016. CSIRO. Brisbane.</p> <p>Dichmont, C.M., Jarrett, A., Hill, F., and Brown, M. (2014). Harvest Strategy for the Northern Prawn Fishery under Input Controls 2014. Report to the Australian Fisheries Management Authority, Project 2006/828. CSIRO. Brisbane. 32 p.</p> <p>Dichmont, C.M., Deng, A., Punt, A.E., Ellis, N., Venables, W.N., Kompas, T., Ye, Y., Zhou, S., Bishop, J. (2008). Beyond biological performance measures in Management Strategy Evaluation: Bringing in economics and the effects of trawling on the benthos. Fisheries Research 94: 238-250.</p> <p>Dichmont, C. M., Deng, A., Punt, A. E., Venables, W., & Haddon, M. (2006a). Management strategies for short- lived species: The case of the Northern Prawn Fishery 1. Accounting for multiples species, spatial structure and implementation uncertainty when evaluating risk. Fisheries Research 82, 204-230.</p> <p>Dichmont, C. M., Deng, A., Punt, A. E., Venables, W., & Haddon, M. (2006b). Management strategies for short- lived species: The case of Australia's Northern Prawn Fishery 2. Choosing appropriate management strategies using input controls. Fisheries Research 82, 221-234.</p> <p>Dichmont, C. M., Deng, A., Punt, A. E., Venables, W., & Haddon, M. (2006c). Management strategies for short- lived species: The case of Australia's Northern Prawn Fishery 3. Factors affecting management and estimation performance. Fisheries Research 82, 235-245.</p>		
OVERALL PERFORMANCE INDICATOR SCORE:				100
CONDITION NUMBER (if relevant):				

Brown tiger prawn (*Penaeus esculentus*)

Evaluation Table for PI 1.2.3

PI 1.2.3		Relevant information is collected to support the harvest strategy		
Scoring Issue		SG 60	SG 80	SG 100
a	Guide post	Some relevant information related to stock structure, stock productivity and fleet composition is available to support the harvest strategy.	Sufficient relevant information related to stock structure, stock productivity, fleet composition and other data is available to support the harvest strategy.	A comprehensive range of information (on stock structure, stock productivity, fleet composition, stock abundance, fishery removals and other information such as environmental information), including some that may not be directly related to the current harvest strategy, is available.
	Met?	Y	Y	Y
	Justification	There is a comprehensive data collection program for the NPF to ensure reliable information is available on which to base management decisions. This includes fishery independent surveys (both at the time of prawn recruitment (“recruitment” surveys) and at the time of peak spawning (“spawning” surveys), daily catch and effort logbooks, seasonal landing returns, VMS data and economic surveys (see Figure 16). Vessel gear details are also collected which tracks changes in gear and technology in the fishery. The NPF also has a crew member observer programme and a scientific observer programme. Environmental information includes general climatic observations through the Australian meteorological network, oceanographic observations during past research cruises and the annual “recruitment” and “spawning” survey cruises. SG60, SG80 and SG100 requirements are met.		
b	Guide post	Stock abundance and fishery removals are monitored and at least one indicator is available and monitored with sufficient frequency to support the harvest control rule.	Stock abundance and fishery removals are regularly monitored at a level of accuracy and coverage consistent with the harvest control rule, and one or more indicators are available and monitored with sufficient frequency to support the harvest control rule.	All information required by the harvest control rule is monitored with high frequency and a high degree of certainty, and there is a good understanding of inherent uncertainties in the information [data] and the robustness of assessment and management to this uncertainty.
	Met?	Y	Y	Y
	Justification	The information collected is used in the regular stock assessments, and fed in real time into the HS decision making process that determines the length of closures and the appropriate fishing effort level to achieve the TRP. A well-established research program has examined uncertainties in the data. There is a good understanding of uncertainties in the information that has been tested through sensitivity analyses in the stock assessment. Dichmont <i>et al.</i> (2010) provides a review of data used in the stock assessment. SG60, SG80 and SG100 requirements are met.		
c	Guide post		There is good information on all other fishery removals from the stock.	
	Met?		Y	

PI 1.2.3		Relevant information is collected to support the harvest strategy	
	Justification	The client vessels are the only prawn trawlers operating across the region and catches from the fishery are representative of total removals. SG80 requirements are met	
References		<p>Bishop, J. and Die, D. (2001). Final report: accuracy of catch and effort data for the northern prawn fishery. CSIRO Marine Research.</p> <p>Dichmont, C.M., Deng, A.R., Punt, A.E., Venables, W.N., Pascoe, S., Zhou, S., Kompas, T., Kenyon, R., Bishop, J., van der Velde, T., Kienzle, M., Hutton, T., Plagányi, E., Miller, M., Donovan, A., Ye, Y. (2010). Developing techniques to estimate total allowable catches for the NPF major prawn species. FRDC Project No. 2007/018.</p> <p>Dichmont, C.M., Jarrett, A., Hill, F., and Brown, M. (2014). Harvest Strategy for the Northern Prawn Fishery under Input Controls 2014. Report to the Australian Fisheries Management Authority, Project 2006/828. CSIRO. Brisbane. 32 p.</p> <p>Kenyon, R.A., Deng, R., Donovan, A., van der Velde, T. and Fry, G. (2016). An integrated monitoring program for the Northern Prawn Fishery 2015/18. Report to the Australian Fisheries Management Authority, Project 2015/0810. CSIRO. Brisbane.</p>	
OVERALL PERFORMANCE INDICATOR SCORE:			100

Brown tiger prawn (*Penaeus esculentus*)

Evaluation Table for PI 1.2.4

PI 1.2.4		There is an adequate assessment of the stock status		
Scoring Issue		SG 60	SG 80	SG 100
a	Guide post		The assessment is appropriate for the stock and for the harvest control rule.	The assessment is appropriate for the stock and for the harvest control rule and takes into account the major features relevant to the biology of the species and the nature of the fishery.
	Met?		Y	Y
	Justification	Brown and grooved tiger prawns are assessed using a size- structured population dynamics model which operates on a weekly time-step (Dichmont <i>et al.</i> , 2010). The parameters of this multi-species model are estimated using data on catches, catch-rates, length-frequency data from surveys and the fishery, survey indices and tag release-recapture data. The estimates include annual recruitment, fishery and survey selection patterns, parameters which define the size-transition matrix, and recruitment patterns. The results from the multi-species stock assessment form part of the basis for evaluating the time-series of catches (by species) and levels of fishing effort (by fishing strategy) which maximize net present value. The bio-economic model (including blue endeavour prawns as well as the two tiger prawns) takes into account costs which are proportional to catches, and those which are proportional to fishing effort, as well as fixed costs. The fit of the model to the data inputs is good, and the sensitivity of the results has been examined by changing the assumptions regarding the values for the economic parameters of the bio-economic model as well as those on which the assessment is based (Punt <i>et al.</i> , 2010). Assessments are updated with the most recently available data every		

PI 1.2.4		There is an adequate assessment of the stock status		
		two years. The assessments are appropriate to the prawn stocks and account for the biology of the species and the fishery. SG80 and SG100 requirements are met.		
b	Guide post	The assessment estimates stock status relative to reference points.		
	Met?	Y		
	Justification	The assessment estimates stock status relative to the target and limit reference points as well as several other indicators relevant to management. SG60 is met.		
c	Guide post	The assessment identifies major sources of uncertainty.	The assessment takes uncertainty into account.	The assessment takes into account uncertainty and is evaluating stock status relative to reference points in a probabilistic way.
	Met?	Y	Y	Y
	Justification	Sensitivity tests in the stock assessment have been carried out that indicate relative robustness to assumptions and different types of assessment techniques. These are taken into account in assessing stock status. Scenarios examined to estimate the changes in MSY and MEY-related outputs include: model estimates fishing patterns; an alternative fishing power series; alternative fishing patterns; different assessment models; setting different natural mortalities in the biological model. Outputs of the latest sensitivity tests are detailed in Buckworth <i>et al.</i> (2016). Punt <i>et al.</i> (2010) provides detail on the size-structures model used for tiger prawns. A key output of the stock assessment model is the time-trajectory of spawning stock size with 90% confidence intervals (Figure 8 of Punt <i>et al.</i> , 2010). SG60, SG80 and SG100 requirements are met		
d	Guide post			The assessment has been tested and shown to be robust. Alternative hypotheses and assessment approaches have been rigorously explored.
	Met?			Y
	Justification	The assessment has been tested and shown to be robust. The assessment model used has evolved over time and a range of approaches have been undertaken. An evaluation of stock assessment methods and management strategies for the NPF was carried out by Dichmont <i>et al.</i> (2006a); Dichmont <i>et al.</i> (2006b); Dichmont <i>et al.</i> (2006c); and Dichmont <i>et al.</i> (2008) using the MSE. These assessment procedures investigated captured a range from very simple (a linear regression of log-catch-rate on time) to fairly complicated (an age- and stock-based assessment model), and two forms of decision rule. Buckworth <i>et al.</i> (2016) provides an overview of recent developments with the tiger prawn subfishery assessment. Various model improvements have been made based on a retrospective study of model performance (Deng <i>et al.</i> , 2015). SG100 is met.		
e	Guide post		The assessment of stock status is subject to peer review.	The assessment has been internally and externally peer reviewed.
	Met?		Y	Y

PI 1.2.4		There is an adequate assessment of the stock status
	Justification	<p>The stock assessment is carried out by the Commonwealth Scientific Industrial Research Organization (CSIRO) under contract from the Australian Fisheries Management Authority (AFMA). It is conducted by a team of data, information and stock assessment specialists including part-time input from a world-renowned expert from the University of Washington. Modelling results are then reviewed by the NPRAG, which is comprised of scientists, economists, fishery managers, fishing representatives, and environmentalists. Peer-group review of the actual assessments is provided by two independent stock assessment experts within the RAG. The methods and results of the assessments are also published in peer-reviewed scientific journals. The assessment was externally peer-reviewed in 2002 by an independent stock assessment expert who concluded that the assessment was world-class but also recommended the inclusion of fishery dependent data; a recommendation that has been followed. SG80 and SG100 are met.</p>
	References	<p>Buckworth, R.C., Deng, R.A., Plagányi, E.E., Punt, A., Upston, J., Pascoe, S., Miller, M., T. Hutton, T., Lawrence, E., and W. Venables (2015). Northern Prawn Fishery RAG Assessments 2013-15. Final Report to the Australian Fisheries Management Authority, Research Project 2013/0005, June 2015. CSIRO. Brisbane. 177 p.</p> <p>Buckworth, R.C., Deng, R.A., Hutton, T., Upston, J., Miller, M. and Pascoe, S. (2016). Status of the Northern Prawn Fishery Tiger Prawn Fishery at the end of 2015, with an estimated TAE for 2016. Report to the Australian Fisheries Management Authority, September 2016. CSIRO. Brisbane.</p> <p>Dichmont, C.M., Deng, A.R., Punt, A.E., Venables, W.N., Pascoe, S., Zhou, S., Kompas, T., Kenyon, R., Bishop, J., van der Velde, T., Kienzie, M., Hutton, T., Plagányi, E., Miller, M., Donovan, A., Ye, Y. (2010). Developing techniques to estimate total allowable catches for the NPF major prawn species. FRDC Project No. 2007/018.</p> <p>Punt, A. E., Deng, R. A., Dichmont, C. M., Kompas, T., Venables, W. N., Zhou, S., <i>et al.</i> (2010). Integrating size-structured assessment and bio-economic management advice in Australia's Northern Prawn Fishery. ICES Journal of marine Sciences 76, 1985-1801.</p> <p>Dichmont, C.M., Deng, A., Punt, A.E., Ellis, N., Venables, W.N., Kompas, T., Ye, Y., Zhou, S., Bishop, J. (2008). Beyond biological performance measures in Management Strategy Evaluation: Bringing in economics and the effects of trawling on the benthos. Fisheries Research 94: 238-250.</p> <p>Dichmont, C. M., Deng, A., Punt, A. E., Venables, W., & Haddon, M. (2006a). Management strategies for short- lived species: The case of the Northern Prawn Fishery 1. Accounting for multiples species, spatial structure and implementation uncertainty when evaluating risk. Fisheries Research 82, 204-230.</p> <p>Dichmont, C. M., Deng, A., Punt, A. E., Venables, W., & Haddon, M. (2006b). Management strategies for short- lived species: The case of Australia's Northern Prawn Fishery 2. Choosing appropriate management strategies using input controls. Fisheries Research 82, 221-234.</p> <p>Dichmont, C. M., Deng, A., Punt, A. E., Venables, W., & Haddon, M. (2006c). Management strategies for short- lived species: The case of Australia's Northern Prawn Fishery 3. Factors affecting management and estimation performance. Fisheries Research 82, 235-245.</p> <p>Deng, R. A., Punt, A. E., Dichmont, C. M., Buckworth, R. C., Burrige, C.Y. (2015). Improving catch-predictions for tiger prawns in the Australian northern prawn fishery. ICES J Mar Sci (2015) 72 (1): 117-129.</p>
OVERALL PERFORMANCE INDICATOR SCORE:		100
CONDITION NUMBER (if relevant):		

(Reference: CR 27.19.1)

Grooved tiger prawn (*P. semisulcatus*)

Evaluation Table for PI 1.1.1

PI 1.1.1		The stock is at a level which maintains high productivity and has a low probability of recruitment overfishing		
Scoring Issue		SG 60	SG 80	SG 100
a	Guide post	It is likely that the stock is above the point where recruitment would be impaired.	It is highly likely that the stock is above the point where recruitment would be impaired.	There is a high degree of certainty that the stock is above the point where recruitment would be impaired.
	Met?	Y	Y	Y
	Justification	The limit reference point for grooved tiger prawn is the moving average of S_Y/S_{MSY} over the most recent 5 years. The most recent assessment of the status of grooved tiger prawn (Buckworth <i>et al.</i> , 2016) shows that stock status is above the LRP ($S_{2011-2015}/S_{MSY}=114\%$) and also above the TRP ($S_{2015}/S_{MEY}=171\%$). The stock is also above the LRP over the range of sensitivities examined (103-145%). Effort in 2015 was close to that for E_{MEY} (99%) and E_{MSY} (82%) indicating that overfishing is not occurring (Table 4 and Figure 6). SG60 and SG80 requirements are met. There is a high degree of certainty that the stock is above the point where recruitment would be impaired, meeting SG100.		
b	Guide post		The stock is at or fluctuating around its target reference point.	There is a high degree of certainty that the stock has been fluctuating around its target reference point, or has been above its target reference point, over recent years.
	Met?		Y	Y
	Justification	The most recent assessment of the status of grooved tiger prawn (Buckworth <i>et al.</i> , 2016) shows that stock status is above the TRP ($S_{2015}/S_{MEY}=171\%$; 152-196% over the range of sensitivities) (Figure 6). There is a high degree of certainty that the stock has been around the TRP over recent years. SG80 and SG100 requirements are met.		
References		Buckworth, R.C., Deng, R.A., Hutton, T., Upston, J., Miller, M. and Pascoe, S. (2016). Status of the Northern Prawn Fishery Tiger Prawn Fishery at the end of 2015, with an estimated TAE for 2016. Report to the Australian Fisheries Management Authority, September 2016. CSIRO. Brisbane. Patterson, H., Noriega, R., Georgeson, L., Stobutzki, I. & Curtotti, R. (2016), Fishery status reports 2016, Australian Bureau of Agricultural and Resource Economics and Sciences, Canberra.		
Stock Status relative to Reference Points				
	Type of reference point	Value of reference point	Current stock status relative to reference point	

PI 1.1.1	The stock is at a level which maintains high productivity and has a low probability of recruitment overfishing		
Target reference point	S_{MEY}	$S_{2015}/S_{MEY} > 100\%$	$S_{2015}/S_{MEY} = 171\%$
Limit reference point	$0.5S_{MSY}$	$S_{2011-2015}/S_{MSY} > 50\%$	$S_{2011-2015}/S_{MSY} = 114\%$
OVERALL PERFORMANCE INDICATOR SCORE:			100
CONDITION NUMBER (if relevant):			

Grooved tiger prawn (*P. semisulcatus*)

Evaluation Table for PI 1.1.2

PI 1.1.2	Limit and target reference points are appropriate for the stock		
Scoring Issue	SG 60	SG 80	SG 100
a	Guide post	Generic limit and target reference points are based on justifiable and reasonable practice appropriate for the species category.	Reference points are appropriate for the stock and can be estimated.
	Met?	Y	Y
	Justification	<p>The tiger prawn subfishery is managed under a Maximum Economic Yield (MEY) strategy designed to optimise the economic return from the fishery. This is typically achieved at a spawning biomass level (S_{MEY}) that is higher than the biomass that produces the Maximum Sustainable Yield (S_{MSY}), and in this respect, is a more precautionary approach than is normally applied in many prawn/shrimp fisheries.</p> <p>Biomass reference points for the harvest control rules are consistent with Australia's Harvest Strategy Policy (DAFF, 2007). The target reference point is S_{MEY} (spawning biomass at MEY). There is also an effort reference point relating to the biomass reference points, E_{MEY} (effort at maximum economic yield). The limit reference point is the average of S_Y/S_{MSY} over 5 most recent years = 0.5.</p> <p>There is a state-of-the-art stock assessment to evaluate these reference values. The stock assessment also considers the status of the stock with respect to S_{MSY}, the default MSC TRP.</p> <p>The reference points are appropriate for the stock and can be estimated, meeting SG60 and SG80.</p>	
b	Guide post	The limit reference point is set above the level at which there is an	The limit reference point is set above the level at which there is an appreciable risk of impairing

PI 1.1.2		Limit and target reference points are appropriate for the stock			
			appreciable risk of impairing reproductive capacity.	reproductive capacity following consideration of precautionary issues.	
	Met?		Y	Y	
	Justification	The limit reference point is the average of S_Y/S_{MSY} over 5 most recent years = 0.5. A moving average used to account for year-to-year variability in abundance that could cause rapid changes in management responses. This LRP accords with the default MSC LRP. The assessment indicates that over the history of the fishery the stock has declined below the TRP but has recovered. The LRP is above the level at which there is an appreciable risk of impairing reproductive capacity and is precautionary.SG80 and SG100 are met.			
c	Guide post		The target reference point is such that the stock is maintained at a level consistent with B_{MSY} or some measure or surrogate with similar intent or outcome.	The target reference point is such that the stock is maintained at a level consistent with B_{MSY} or some measure or surrogate with similar intent or outcome, or a higher level, and takes into account relevant precautionary issues such as the ecological role of the stock with a high degree of certainty.	
	Met?		Y	Y	
	Justification	The target reference point is S_{MEY} (spawning biomass at MEY). There is also an effort reference point relating to the biomass reference points, E_{MEY} (effort at maximum economic yield). The target reference point is well estimated and designed to maintain the stock at a level consistent with B_{MSY} (and a higher level, at B_{MEY}) and considers relevant precautionary issues such as the ecological role of the stock with a high degree of certainty. SG80 and SG100 are met.			
d	Guide post		For key low trophic level stocks, the target reference point takes into account the ecological role of the stock.		
	Met?		Not relevant		
	Justification	Because this species is a scavenger that feeds on a wide variety of detritus, small animals and plants (e.g., Foraminifera), it comprises only a very small proportion of many species of penaeid, Carid and Sergistid shrimps that occupy similar feeding niches in the food web. As such it is not considered to be a species that holds a key role in ensuring diversity and stability in the ecosystem i.e. it is not considered a key LTL species.			
References		DAFF (2007). Commonwealth Fishery Harvest Strategy, Policy and Guidelines. http://www.agriculture.gov.au/fisheries/domestic/harvest_strategy_policy . Dichmont, C.M., Jarrett, A., Hill, F., and Brown, M. (2014). Harvest Strategy for the Northern Prawn Fishery under Input Controls 2014. Report to the Australian Fisheries Management Authority, Project 2006/828. CSIRO. Brisbane. 32 p.			
OVERALL PERFORMANCE INDICATOR SCORE:					100

Grooved tiger prawn (*P. semisulcatus*)

Evaluation Table for PI 1.1.3

PI 1.1.3		Where the stock is depleted, there is evidence of stock rebuilding within a specified timeframe		
Scoring Issue		SG 60	SG 80	SG 100
a	Guide post	Where stocks are depleted rebuilding strategies, which have a reasonable expectation of success, are in place.		Where stocks are depleted, strategies are demonstrated to be rebuilding stocks continuously and there is strong evidence that rebuilding will be complete within the specified timeframe.
	Met?	(Y/N)		(Y/N)
	Justification	[Note: Insert as much text as required to justify the SG level achieved for this scoring issue]		
b	Guide post	A rebuilding timeframe is specified for the depleted stock that is the shorter of 30 years or 3 times its generation time. For cases where 3 generations is less than 5 years, the rebuilding timeframe is up to 5 years.	A rebuilding timeframe is specified for the depleted stock that is the shorter of 20 years or 2 times its generation time. For cases where 2 generations is less than 5 years, the rebuilding timeframe is up to 5 years.	The shortest practicable rebuilding timeframe is specified which does not exceed one generation time for the depleted stock.
	Met?	(Y/N)	(Y/N)	(Y/N)
	Justification	[Note: Insert as much text as required to justify the SG level achieved for this scoring issue]		
c	Guide post	Monitoring is in place to determine whether the rebuilding strategies are effective in rebuilding the stock within a specified timeframe.	There is evidence that they are rebuilding stocks, or it is highly likely based on simulation modelling or previous performance that they will be able to rebuild the stock within a specified timeframe.	
	Met?	(Y/N)	(Y/N)	
	Justification			
References				

PI 1.1.3	Where the stock is depleted, there is evidence of stock rebuilding within a specified timeframe	
OVERALL PERFORMANCE INDICATOR SCORE:		NA
CONDITION NUMBER (if relevant):		

Grooved tiger prawn (*P. semisulcatus*)

Evaluation Table for PI 1.2.1

PI 1.2.1		There is a robust and precautionary harvest strategy in place		
Scoring Issue		SG 60	SG 80	SG 100
a	Guide post	The harvest strategy is expected to achieve stock management objectives reflected in the target and limit reference points.	The harvest strategy is responsive to the state of the stock and the elements of the harvest strategy work together towards achieving management objectives reflected in the target and limit reference points.	The harvest strategy is responsive to the state of the stock and is designed to achieve stock management objectives reflected in the target and limit reference points.
	Met?	Y	Y	Y
	Justification	<p>The harvest strategy (HS) is based on input controls (Dichmont <i>et al.</i>, 2014). The HS is compliant with the Commonwealth of Australia's Legislative requirements and is aimed at realizing the objectives of the NPF Management Plan 1995 that includes "Ensure the utilization of the fishery resources is consistent with the principles of ecologically sustainable development and the exercise of the precautionary principle." The operational objective of the HS is to attain long-term maximum economic yield (MEY) from the tiger prawn subfishery. MEY is calculated as the effort level in each year over a 7-year projection period that creates the biggest difference between the total revenue generated from tiger and endeavour prawns and the total costs of fishing for the tiger prawn fishery as a whole.</p> <p>The harvest strategy for grooved tiger prawns includes:</p> <ol style="list-style-type: none"> 1. Indicators (data from the fishery) 2. Monitoring (agreed protocols to get data) 3. Reference points (target and limit) 4. Decision rules (agreed rules for setting input controls) <p>The HS is designed to be responsive to the state of the stock and achieve objectives reflected in the target and limit reference points. SG60, SG80 and SG100 requirements are met.</p>		
b	Guide post	The harvest strategy is likely to work based on prior experience or plausible argument.	The harvest strategy may not have been fully tested but evidence exists that it is achieving its objectives.	The performance of the harvest strategy has been fully evaluated and evidence exists to show that it is achieving its objectives including

PI 1.2.1		There is a robust and precautionary harvest strategy in place		
				being clearly able to maintain stocks at target levels.
	Met?	Y	Y	Y
	Justification	The HS has been tested using the NPF Management Strategy Evaluation (Dichmont <i>et al.</i> , 2006a, Dichmont <i>et al.</i> , 2006b, Dichmont <i>et al.</i> , 2006c, Dichmont <i>et al.</i> , 2008, and Dichmont <i>et al.</i> , 2012a). Regular assessments provide evidence that the HS is achieving its objectives and maintaining the stock at target levels. SG60, SG80 and SG100 requirements are met.		
c	Guide post	Monitoring is in place that is expected to determine whether the harvest strategy is working.		
	Met?	Y		
	Justification	There is a high level of monitoring and data collection for the NPF. There is an ongoing assessment program to evaluate how the harvest strategy is working. SG60 is met		
d	Guide post			The harvest strategy is periodically reviewed and improved as necessary.
	Met?			Y
	Justification	The harvest strategy is periodically reviewed and improved as necessary. There have been several adjustments to the HS since its adoption, most recently in 2014. Detailed information on review processes is given at PI 3.2.5.. SG100 is met.		
e	Guide post	It is likely that shark finning is not taking place.	It is highly likely that shark finning is not taking place.	There is a high degree of certainty that shark finning is not taking place.
	Met?	Not relevant	Not relevant	Not relevant
	Justification	Sharks are not a target species.		
References		<p>Dichmont, C.M., Deng, A., Punt, A.E., Ellis, N., Venables, W.N., Kompas, T., Ye, Y., Zhou, S., Bishop, J. (2008). Beyond biological performance measures in Management Strategy Evaluation: Bringing in economics and the effects of trawling on the benthos. <i>Fisheries Research</i> 94: 238-250.</p> <p>Dichmont, C.M., Deng, R.A., Punt, A.E., Venables, W., Hutton, T. (2012). From input to output controls in a short-lived species: the case of the Northern Prawn Fishery. <i>Marine and Freshwater Research</i>, 2012, 63, 727–739.</p> <p>Dichmont, C.M., Jarrett, A., Hill, F., and Brown, M. (2014). Harvest Strategy for the Northern Prawn Fishery under Input Controls 2014. Report to the Australian Fisheries Management Authority, Project 2006/828. CSIRO. Brisbane. 32 p.</p> <p>Australia Government, Northern Prawn Fishery Management Plan, 1995. Available at https://www.legislation.gov.au/Details/F2012C00160.</p>		

PI 1.2.1	There is a robust and precautionary harvest strategy in place	
OVERALL PERFORMANCE INDICATOR SCORE:		100
CONDITION NUMBER (if relevant):		

Grooved tiger prawn (*P. semisulcatus*)

Evaluation Table for PI 1.2.2

PI 1.2.2		There are well defined and effective harvest control rules in place		
Scoring Issue		SG 60	SG 80	SG 100
a	Guide post	Generally understood harvest rules are in place that are consistent with the harvest strategy and which act to reduce the exploitation rate as limit reference points are approached.	Well defined harvest control rules are in place that are consistent with the harvest strategy and ensure that the exploitation rate is reduced as limit reference points are approached.	
	Met?	Y	Y	
	Justification	<p>The harvest strategy contains a comprehensive set of control rules that feed into HS actions, including no target fishing if the LRP is triggered as well as changes to fishing effort to achieve MEY through the use of spatial and temporal closures and gear modifications. The flow chart for the use of the LRP is seen in Figure 13 and the control rules are in Box 1.</p> <p>The harvest control rules are well defined and ensure that the exploitation rate is reduced as limit reference points are approached.</p> <p>There is also a 350kg/day trigger in place, which if met, results in closure of the fishery. This trigger applies to all target species of the tiger prawn subfishery. The trigger is set at the break-even point, where costs equal revenue.</p> <p>SG60 and SG80 are met.</p>		
b	Guide post		The selection of the harvest control rules takes into account the main uncertainties.	The design of the harvest control rules takes into account a wide range of uncertainties.
	Met?		Y	Y
	Justification	<p>The control rules were part of the MSE reported in 1.2.1 that includes testing of the design of the rules. Assessments examine the sensitivity of management performance to a wide range of uncertainties. Information on the uncertainties examined is provided in Section 3.3.12.1 of the report. An evaluation of stock assessment methods and management strategies for the fishery was carried out by Dichmont <i>et al.</i> (2006a); Dichmont <i>et al.</i> (2006b); Dichmont <i>et al.</i> (2006c); and Dichmont <i>et al.</i> (2008). Buckworth <i>et al.</i> (2016) provides an overview of</p>		

PI 1.2.2		There are well defined and effective harvest control rules in place		
		recent developments with the tiger prawn subfishery assessment that account for uncertainties. SG80 and SG100 requirements are met.		
c	Guide post	There is some evidence that tools used to implement harvest control rules are appropriate and effective in controlling exploitation.	Available evidence indicates that the tools in use are appropriate and effective in achieving the exploitation levels required under the harvest control rules.	Evidence clearly shows that the tools in use are effective in achieving the exploitation levels required under the harvest control rules.
	Met?	Y	Y	Y
	Justification	Following a period of overfishing in the late 1990s, a rebuilding strategy based on the control rules was implemented in 2003 and was successful. Recent assessments provide evidence that ongoing exploitation levels are appropriate. SG60, SG80 and SG100 requirements are met.		
References		<p>Buckworth, R.C., Deng, R.A., Hutton, T., Upston, J., Miller, M. and Pascoe, S. (2016). Status of the Northern Prawn Fishery Tiger Prawn Fishery at the end of 2015, with an estimated TAE for 2016. Report to the Australian Fisheries Management Authority, September 2016. CSIRO. Brisbane.</p> <p>Dichmont, C.M., Jarrett, A., Hill, F., and Brown, M. (2014). Harvest Strategy for the Northern Prawn Fishery under Input Controls 2014. Report to the Australian Fisheries Management Authority, Project 2006/828. CSIRO. Brisbane. 32 p.</p> <p>Dichmont, C.M., Deng, A., Punt, A.E., Ellis, N., Venables, W.N., Kompas, T., Ye, Y., Zhou, S., Bishop, J. (2008). Beyond biological performance measures in Management Strategy Evaluation: Bringing in economics and the effects of trawling on the benthos. Fisheries Research 94: 238-250.</p> <p>Dichmont, C. M., Deng, A., Punt, A. E., Venables, W., & Haddon, M. (2006a). Management strategies for short- lived species: The case of the Northern Prawn Fishery 1. Accounting for multiples species, spatial structure and implementation uncertainty when evaluating risk. Fisheries Research 82, 204-230.</p> <p>Dichmont, C. M., Deng, A., Punt, A. E., Venables, W., & Haddon, M. (2006b). Management strategies for short- lived species: The case of Australia's Northern Prawn Fishery 2. Choosing appropriate management strategies using input controls. Fisheries Research 82, 221-234.</p> <p>Dichmont, C. M., Deng, A., Punt, A. E., Venables, W., & Haddon, M. (2006c). Management strategies for short- lived species: The case of Australia's Northern Prawn Fishery 3. Factors affecting management and estimation performance. Fisheries Research 82, 235-245.</p>		
OVERALL PERFORMANCE INDICATOR SCORE:				100
CONDITION NUMBER (if relevant):				

Grooved tiger prawn (*P. semisulcatus*)

Evaluation Table for PI 1.2.3

PI 1.2.3		Relevant information is collected to support the harvest strategy		
Scoring Issue		SG 60	SG 80	SG 100
a	Guide post	Some relevant information related to stock structure, stock productivity and fleet composition is available to support the harvest strategy.	Sufficient relevant information related to stock structure, stock productivity, fleet composition and other data is available to support the harvest strategy.	A comprehensive range of information (on stock structure, stock productivity, fleet composition, stock abundance, fishery removals and other information such as environmental information), including some that may not be directly related to the current harvest strategy, is available.
	Met?	Y	Y	Y
	Justification	There is a comprehensive data collection program for the NPF to ensure reliable information is available on which to base management decisions. This includes fishery independent surveys (both at the time of prawn recruitment (“recruitment” surveys) and at the time of peak spawning (“spawning” surveys), daily catch and effort logbooks, seasonal landing returns, VMS data and economic surveys (see Figure 16). Vessel gear details are also collected which tracks changes in gear and technology in the fishery. The NPF also has a crew member observer programme and a scientific observer programme. Environmental information includes general climatic observations through the Australian meteorological network, oceanographic observations during past research cruises and the annual “recruitment” and “spawning” survey cruises. Dichmont <i>et al.</i> (2010) provides a review of data used in the stock assessment. SG60, SG80 and SG100 requirements are met.		
b	Guide post	Stock abundance and fishery removals are monitored and at least one indicator is available and monitored with sufficient frequency to support the harvest control rule.	Stock abundance and fishery removals are regularly monitored at a level of accuracy and coverage consistent with the harvest control rule, and one or more indicators are available and monitored with sufficient frequency to support the harvest control rule.	All information required by the harvest control rule is monitored with high frequency and a high degree of certainty, and there is a good understanding of inherent uncertainties in the information [data] and the robustness of assessment and management to this uncertainty.
	Met?	Y	Y	Y
	Justification	The information collected is used in the regular stock assessments, and fed in real time into the HS decision making process that determines the length of closures and the appropriate fishing effort level to achieve the TRP. A well-established research program has examined uncertainties in the data. There is a good understanding of uncertainties in the information that has been tested through sensitivity analyses in the stock assessment. All information required by the harvest control rules is monitored with high frequency and a high degree of certainty. SG60, SG80 and SG100 requirements are met.		
c	Guide post		There is good information on all other fishery removals from the stock.	
	Met?		Y	

PI 1.2.3		Relevant information is collected to support the harvest strategy
	Justification	The client vessels are the only prawn trawlers operating across the region and catches from the fishery are representative of total removals. SG80 is met.
	References	<p>Dichmont, C.M., Jarrett, A., Hill, F., and Brown, M. (2014). Harvest Strategy for the Northern Prawn Fishery under Input Controls 2014. Report to the Australian Fisheries Management Authority, Project 2006/828. CSIRO. Brisbane. 32 p.</p> <p>Dichmont, C.M., Deng, A.R., Punt, A.E., Venables, W.N., Pascoe, S., Zhou, S., Kompas, T., Kenyon, R., Bishop, J., van der Velde, T., Kienzle, M., Hutton, T., Plagányi, E., Miller, M., Donovan, A., Ye, Y. (2010). Developing techniques to estimate total allowable catches for the NPF major prawn species. FRDC Project No. 2007/018.</p> <p>Kenyon, R.A., Deng, R., Donovan, A., van der Velde, T. and Fry, G. (2016). An integrated monitoring program for the Northern Prawn Fishery 2015/18. Report to the Australian Fisheries Management Authority, Project 2015/0810. CSIRO. Brisbane.</p>
OVERALL PERFORMANCE INDICATOR SCORE:		100

Grooved tiger prawn (*P. semisulcatus*)

Evaluation Table for PI 1.2.4

PI 1.2.4		There is an adequate assessment of the stock status		
Scoring Issue		SG 60	SG 80	SG 100
a	Guide post		The assessment is appropriate for the stock and for the harvest control rule.	The assessment is appropriate for the stock and for the harvest control rule and takes into account the major features relevant to the biology of the species and the nature of the fishery.
	Met?		Y	Y
	Justification	Brown and grooved tiger prawns are assessed using a size- structured population dynamics model which operates on a weekly time-step (Dichmont <i>et al.</i> , 2010). The parameters of this multi-species model are estimated using data on catches, catch-rates, length-frequency data from surveys and the fishery, survey indices and tag release-recapture data. The estimates include annual recruitment, fishery and survey selection patterns, parameters which define the size-transition matrix, and recruitment patterns. The results from the multi-species stock assessment form part of the basis for evaluating the time-series of catches (by species) and levels of fishing effort (by fishing strategy) which maximize net present value. The bio-economic model (including blue endeavour prawns as well as the two Tiger prawns) takes into account costs which are proportional to catches, and those which are proportional to fishing effort, as well as fixed costs. The fit of the model to the data inputs is good, and the sensitivity of the results has been examined by changing the assumptions regarding the values for the economic parameters of the bio-economic model as well as those on which the assessment is based (Punt <i>et. al.</i> , 2010). Assessments are updated with the most recently		

PI 1.2.4		There is an adequate assessment of the stock status		
		available data every two years. The assessments are appropriate to the prawn stocks and account for the biology of the species and the fishery. SG80 and SG100 requirements are met.		
b	Guide post	The assessment estimates stock status relative to reference points.		
	Met?	Y		
	Justification	The assessment estimates stock status relative to the target and limit reference points as well as several other indicators relevant to management. SG60 is met.		
c	Guide post	The assessment identifies major sources of uncertainty.	The assessment takes uncertainty into account.	The assessment takes into account uncertainty and is evaluating stock status relative to reference points in a probabilistic way.
	Met?	Y	Y	Y?
	Justification	Sensitivity tests in the stock assessment have been carried out that indicate relative robustness to assumptions and different types of assessment techniques. These are taken into account in assessing stock status. Scenarios examined to estimate the changes in MSY and MEY-related outputs include: model estimates fishing patterns; an alternative fishing power series; alternative fishing patterns; different assessment models; setting different natural mortalities in the biological model. Outputs of the sensitivity tests are detailed in Buckworth <i>et al.</i> (2016). Punt <i>et al.</i> (2010) provides detail on the size-structures model used for tiger prawns. A key output of the stock assessment model is the time-trajectory of spawning stock size with 90% confidence intervals (Figure 8 of Punt <i>et al.</i> , 2010). SG60, SG80 and SG100 requirements are met.		
d	Guide post			The assessment has been tested and shown to be robust. Alternative hypotheses and assessment approaches have been rigorously explored.
	Met?			Y
	Justification	The assessment has been tested and shown to be robust. The assessment model used has evolved over time and a range of approaches have been undertaken. An evaluation of stock assessment methods and management strategies for the NPF was carried out by Dichmont <i>et al.</i> (2006a); Dichmont <i>et al.</i> (2006b); Dichmont <i>et al.</i> (2006c); and Dichmont <i>et al.</i> (2008) using the MSE. These assessment procedures investigated captured a range from very simple (a linear regression of log-catch-rate on time) to fairly complicated (an age- and stock-based assessment model), and two forms of decision rule. Buckworth <i>et al.</i> (2016) provides an overview of recent developments with the tiger prawn subfishery assessment. Various model improvements have been made based on a retrospective study of model performance (Deng <i>et al.</i> , 2015). SG100 is met.		
e	Guide post		The assessment of stock status is subject to peer review.	The assessment has been internally and externally peer reviewed.
	Met?		Y	Y

PI 1.2.4		There is an adequate assessment of the stock status
	Justification	<p>The stock assessment is carried out by the Commonwealth Scientific Industrial Research Organization (CSIRO) under contract from the Australian Fisheries Management Authority (AFMA). It is conducted by a team of data, information and stock assessment specialists including part-time input from a world-renowned expert from the University of Washington. Modelling results are then reviewed by the NPRAG, which is comprised of scientists, economists, fishery managers, fishing representatives, and environmentalists. Peer-group review of the actual assessments is provided by two independent stock assessment experts within the RAG. The methods and results of the assessments are also published in peer-reviewed scientific journals. The assessment was externally peer-reviewed in 2002 by an independent stock assessment expert who concluded that the assessment was world-class but also recommended the inclusion of fishery dependent data; a recommendation that has been followed. SG80 and SG100 are met.</p>
	References	<p>Buckworth, R.C., Deng, R.A., Plagányi, E.E., Punt, A., Upston, J., Pascoe, S., Miller, M., T. Hutton, T., Lawrence, E., and W. Venables (2015). Northern Prawn Fishery RAG Assessments 2013-15. Final Report to the Australian Fisheries Management Authority, Research Project 2013/0005, June 2015. CSIRO. Brisbane. 177 p.</p> <p>Buckworth, R.C., Deng, R.A., Hutton, T., Upston, J., Miller, M. and Pascoe, S. (2016). Status of the Northern Prawn Fishery Tiger Prawn Fishery at the end of 2015, with an estimated TAE for 2016. Report to the Australian Fisheries Management Authority, September 2016. CSIRO. Brisbane.</p> <p>Dichmont, C.M., Deng, A.R., Punt, A.E., Venables, W.N., Pascoe, S., Zhou, S., Kompas, T., Kenyon, R., Bishop, J., van der Velde, T., Kienzle, M., Hutton, T., Plagányi, E., Miller, M., Donovan, A., Ye, Y. (2010). Developing techniques to estimate total allowable catches for the NPF major prawn species. FRDC Project No. 2007/018.</p> <p>Dichmont, C.M., Deng, A., Punt, A.E., Ellis, N., Venables, W.N., Kompas, T., Ye, Y., Zhou, S., Bishop, J. (2008). Beyond biological performance measures in Management Strategy Evaluation: Bringing in economics and the effects of trawling on the benthos. Fisheries Research 94: 238-250.</p> <p>Dichmont, C. M., Deng, A., Punt, A. E., Venables, W., & Haddon, M. (2006a). Management strategies for short- lived species: The case of the Northern Prawn Fishery 1. Accounting for multiples species, spatial structure and implementation uncertainty when evaluating risk. Fisheries Research 82, 204-230.</p> <p>Dichmont, C. M., Deng, A., Punt, A. E., Venables, W., & Haddon, M. (2006b). Management strategies for short- lived species: The case of Australia's Northern Prawn Fishery 2. Choosing appropriate management strategies using input controls. Fisheries Research 82, 221-234.</p> <p>Dichmont, C. M., Deng, A., Punt, A. E., Venables, W., & Haddon, M. (2006c). Management strategies for short- lived species: The case of Australia's Northern Prawn Fishery 3. Factors affecting management and estimation performance. Fisheries Research 82, 235-245.</p> <p>Punt, A. E., Deng, R. A., Dichmont, C. M., Kompas, T., Venables, W. N., Zhou, S., <i>et al.</i> (2010). Integrating size-structured assessment and bio-economic management advice in Australia's Northern Prawn Fishery. ICES Journal of marine Sciences 76, 1985-1801.</p>
OVERALL PERFORMANCE INDICATOR SCORE:		100
CONDITION NUMBER (if relevant):		

Blue endeavour prawn (*Metapenaeus endeavouri*)

Evaluation Table for PI 1.1.1

PI 1.1.1		The stock is at a level which maintains high productivity and has a low probability of recruitment overfishing		
Scoring Issue		SG 60	SG 80	SG 100
a	Guide post	It is likely that the stock is above the point where recruitment would be impaired.	It is highly likely that the stock is above the point where recruitment would be impaired.	There is a high degree of certainty that the stock is above the point where recruitment would be impaired.
	Met?	Y	Y	Y
	Justification	<p>The limit reference point is the moving average of S_Y/S_{MSY} over the most recent 5 years. The most recent assessment of the status of the blue endeavour prawn (Buckworth <i>et al.</i>, 2016) shows that stock status is above the LRP ($S_{2011-2015}/S_{MSY}=76\%$) but below the TRP ($S_{2015}/S_{MEY}=80\%$). The stock is also above the LRP over the range of sensitivities examined (75-94%). The stock was depleted for several years in the early 2000s but has been rebuilding since (Figure 7). The stock was close to the LRP in 2002. The stock has shown that it can recover from these levels and the current assessment indicates that the HS is working to allow rebuilding to target levels.</p> <p>There is a high degree of certainty that the stock is above the point where recruitment would be impaired. SG60, SG80 and SG100 requirements are met.</p>		
b	Guide post		The stock is at or fluctuating around its target reference point.	There is a high degree of certainty that the stock has been fluctuating around its target reference point, or has been above its target reference point, over recent years.
	Met?		Y	N
	Justification	<p>Information on blue endeavour prawns should be considered in the context of it being a component of the tiger prawn fishery for which there is an operational objective to attain long-term MEY overall of the two tiger prawn and blue endeavour prawn stocks, calculated over a 7-year projection period. The approach adopted is that controlling the season length and TAE of tiger prawns will equally maintain the stock size of blue endeavour prawns in a highly productive state. This has been tested in MSEs (Dichmont <i>et al.</i>, 2014). As a result, the blue endeavour stock is not managed to an MSY target reference point, but does have explicit MSY limit reference point with requirements for management action. The stock assessment does calculate S_{MSY} and the ratio $S_{CURRENT}/S_{MSY}$ so that management action can be taken as necessary if the stock approaches the LRP and enables monitoring of the stock status against S_{MSY}. As a species with a life span of ~18 months and a generation time of about 1 year, it is appropriate to set a management target that prevents overfishing and keeps the stock in a highly productive range (note MSC interpretation on target reference points for short lived species, MSC 2015).</p> <p>The most recent assessment of the status of blue endeavour (Buckworth <i>et al.</i>, 2016) calculates that $S_{2015}/S_{MEY} = 80\%$ (77-84% over the range of sensitivities) (Table 5) and $S_{2015}/S_{MSY} = 77\%$ (77-97% over the range of sensitivities); in addition, $S_{2015}/S_0 = 45\%$ (i.e. the current stock is at 45% of unfished levels). The annual recruitment-index surveys also indicate the improved health of the blue endeavour stock. In 2015, the index was the second highest on record (Kenyon <i>et al.</i>, 2016). The MSE testing of the harvest strategy, healthy recruitment levels, low catch in relation to MSY, and the improving trajectory of the stock</p>		

PI 1.1.1		The stock is at a level which maintains high productivity and has a low probability of recruitment overfishing	
		such that stock size is close to S_{MSY} , indicate that the stock is in a healthy and productive state. This meets the requirements for the SG80. As the stock has not increased to the level of S_{MSY} , there is not a high degree of certainty that the stock is at a highly productive level.	
References		<p>Buckworth, R.C., Deng, R.A., Hutton, T., Upston, J., Miller, M. and Pascoe, S. (2016). Status of the Northern Prawn Fishery Tiger Prawn Fishery at the end of 2015, with an estimated TAE for 2016. Report to the Australian Fisheries Management Authority, September 2016. CSIRO. Brisbane.</p> <p>Dichmont, C.M., Jarrett, A., Hill, F., and Brown, M. (2014). Harvest Strategy for the Northern Prawn Fishery under Input Controls 2014. Report to the Australian Fisheries Management Authority, Project 2006/828. CSIRO. Brisbane. 32 p.</p> <p>Kenyon, R.A., Deng, R., Donovan, A., van der Velde, T. and Fry, G. (2016). An integrated monitoring program for the Northern Prawn Fishery 2015/18. Report to the Australian Fisheries Management Authority, Project 2015/0810. CSIRO. Brisbane.</p>	
Stock Status relative to Reference Points			
	Type of reference point	Value of reference point	Current stock status relative to reference point
Target reference point	S_{MEY} (used as an indicator)	$S_{2015}/S_{MEY} > 100\%$	$S_{2015}/S_{MEY} = 80\%$
Limit reference point	$0.5S_{MSY}$	$S_{2011-2015}/S_{MSY} > 50\%$	$S_{2011-2015}/S_{MSY} = 76\%$
OVERALL PERFORMANCE INDICATOR SCORE:			90
CONDITION NUMBER (if relevant):			

Blue endeavour prawn (*Metapenaeus endeavouri*)

Evaluation Table for PI 1.1.2

PI 1.1.2		Limit and target reference points are appropriate for the stock	
Scoring Issue		SG 60	SG 80
a	Guide post	Generic limit and target reference points are based on justifiable and reasonable practice appropriate for the species category.	Reference points are appropriate for the stock and can be estimated.

PI 1.1.2		Limit and target reference points are appropriate for the stock		
	Met?	Y	Y	
	Justification	<p>Blue endeavour prawns are managed as part of the tiger prawn subfishery with a Maximum Economic Yield (MEY) strategy designed to optimise the economic return from the fishery. This is typically achieved at a spawning biomass level (S_{MEY}) that is higher than the biomass that produces the Maximum Sustainable Yield (S_{MSY}), and in this respect, is a more precautionary approach than is normally applied in many prawn/shrimp fisheries.</p> <p>Biomass reference points for the harvest control rules are consistent with Australia's Harvest Strategy Policy (DAFF, 2007). The target reference point is S_{MEY} (spawning biomass at MEY). The limit reference point is the average of S_Y/S_{MSY} over 5 most recent years = 0.5.</p> <p>There is a state-of-the-art stock assessment to evaluate these reference values. The stock assessment also considers the status of the stock with respect to S_{MSY}, the default MSC TRP.</p> <p>The reference points are appropriate for the stock and can be estimated. SG60 and SG80 are met.</p>		
b	Guide post		The limit reference point is set above the level at which there is an appreciable risk of impairing reproductive capacity.	The limit reference point is set above the level at which there is an appreciable risk of impairing reproductive capacity following consideration of precautionary issues.
	Met?		Y	Y
	Justification	<p>The limit reference point is the average of S_Y/S_{MSY} over 5 most recent years = 0.5. A moving average used to account for year-to-year variability in abundance that could cause rapid changes in management responses. This LRP accords with the default MSC LRP. Blue endeavour prawns were previously assessed as depleted but have since recovered and are well above the LRP. The LRP is above the level at which there is an appreciable risk of impairing reproductive capacity and is precautionary. SG80 and SG100 are met.</p>		
c	Guide post		The target reference point is such that the stock is maintained at a level consistent with B_{MSY} or some measure or surrogate with similar intent or outcome.	The target reference point is such that the stock is maintained at a level consistent with B_{MSY} or some measure or surrogate with similar intent or outcome, and takes into account relevant precautionary issues such as the ecological role of the stock with a high degree of certainty.
	Met?		Y	Y
	Justification	<p>The target reference point is S_{MEY} (spawning biomass at MEY). The target reference point is well estimated and designed to maintain the stock at a level consistent with B_{MSY}. AFMA has a commitment to ongoing risk management strategies for its fisheries. There is also high level of ongoing research for the NPF, including annual spawning and recruitment surveys. Blue endeavour prawns are broadly distributed across the fishery. The annual surveys have indicated improved indices of spawning and recruitment for blue endeavour prawns in recent years (Kenyon <i>et al.</i>, 2016). At the site visit for this assessment, CSIRO scientists indicated that in addition to the stock assessment process and examination of outputs in relation to reference points, the surveys provide immediate indicators to flag stock problems if they arise which would result in a review of the available information and potential additional management action. The level of information available, the level of ongoing research, the</p>		

PI 1.1.2		Limit and target reference points are appropriate for the stock		
		improvements in stock status and the maintenance of the stock well above the PRI over a long period of time is sufficiently precautionary to account for the ecological role of the stock with a high degree of certainty. SG80 and SG100 are met.		
d	Guide post		For key low trophic level stocks, the target reference point takes into account the ecological role of the stock.	
	Met?		Not relevant	
	Justification	Blue endeavour prawns are not considered a key LTL species.		
References		<p>DAFF (2007). Commonwealth Fishery Harvest Strategy, Policy and Guidelines. http://www.agriculture.gov.au/fisheries/domestic/harvest_strategy_policy.</p> <p>Dichmont, C.M., Jarrett, A., Hill, F., and Brown, M. (2014). Harvest Strategy for the Northern Prawn Fishery under Input Controls 2014. Report to the Australian Fisheries Management Authority, Project 2006/828. CSIRO. Brisbane. 32 p.</p>		
OVERALL PERFORMANCE INDICATOR SCORE:				100
CONDITION NUMBER (if relevant):				

Blue endeavour prawn (*Metapenaeus endeavouri*)

Evaluation Table for PI 1.1.3

PI 1.1.3		Where the stock is depleted, there is evidence of stock rebuilding within a specified timeframe		
Scoring Issue		SG 60	SG 80	SG 100
a	Guide post	Where stocks are depleted rebuilding strategies, which have a reasonable expectation of success, are in place.		Where stocks are depleted, strategies are demonstrated to be rebuilding stocks continuously and there is strong evidence that rebuilding will be complete within the specified timeframe.
	Met?	(Y/N)		(Y/N)
	Justification	[Note: Insert as much text as required to justify the SG level achieved for this scoring issue]		
b	Guide post	A rebuilding timeframe is specified for the depleted stock that is the shorter of	A rebuilding timeframe is specified for the depleted stock that is the shorter of	The shortest practicable rebuilding timeframe is specified which does

PI 1.1.3		Where the stock is depleted, there is evidence of stock rebuilding within a specified timeframe		
		30 years or 3 times its generation time. For cases where 3 generations is less than 5 years, the rebuilding timeframe is up to 5 years.	20 years or 2 times its generation time. For cases where 2 generations is less than 5 years, the rebuilding timeframe is up to 5 years.	not exceed one generation time for the depleted stock.
	Met?	(Y/N)	(Y/N)	(Y/N)
	Justification	[Note: Insert as much text as required to justify the SG level achieved for this scoring issue]		
c	Guide post	Monitoring is in place to determine whether the rebuilding strategies are effective in rebuilding the stock within a specified timeframe.	There is evidence that they are rebuilding stocks, or it is highly likely based on simulation modelling or previous performance that they will be able to rebuild the stock within a specified timeframe.	
	Met?	(Y/N)	(Y/N)	
	Justification			
References				
OVERALL PERFORMANCE INDICATOR SCORE:				NA
CONDITION NUMBER (if relevant):				

Blue endeavour prawn (*Metapenaeus endeavouri*)

Evaluation Table for PI 1.2.1

PI 1.2.1		There is a robust and precautionary harvest strategy in place		
Scoring Issue		SG 60	SG 80	SG 100
a	Guide post	The harvest strategy is expected to achieve stock management objectives reflected in the target and limit reference points.	The harvest strategy is responsive to the state of the stock and the elements of the harvest strategy work together towards achieving management objectives reflected in the	The harvest strategy is responsive to the state of the stock and is designed to achieve stock management objectives reflected in the target and limit reference points.

PI 1.2.1		There is a robust and precautionary harvest strategy in place		
			target and limit reference points.	
	Met?	Y	Y	Y
	Justification	<p>The harvest strategy (HS) is based on input controls (Dichmont <i>et al.</i>, 2014). The HS is compliant with the Commonwealth of Australia's Legislative requirements and is aimed at realizing the objectives of the NPF Management Plan 1995 that includes "Ensure the utilization of the fishery resources is consistent with the principles of ecologically sustainable development and the exercise of the precautionary principle." The operational objective of the HS is to attain long-term maximum economic yield (MEY) from the Tiger and Endeavour prawn species. MEY is calculated as the effort level in each year over a 7-year projection period that creates the biggest difference between the total revenue generated from tiger and endeavour prawns and the total costs of fishing for the tiger prawn fishery as a whole.</p> <p>The harvest strategy for the blue endeavour prawns includes:</p> <ol style="list-style-type: none"> 1. Indicators (data from the fishery) 2. Monitoring (agreed protocols to get data) 3. Reference points (target and limit) 4. Decision rules (agreed rules for setting input controls) <p>The HS is designed to be responsive to the state of the stock and achieve objectives reflected in the target and limit reference points. SG60, SG80 and SG100 requirements are met..</p>		
b	Guide post	The harvest strategy is likely to work based on prior experience or plausible argument.	The harvest strategy may not have been fully tested but evidence exists that it is achieving its objectives.	The performance of the harvest strategy has been fully evaluated and evidence exists to show that it is achieving its objectives including being clearly able to maintain stocks at target levels.
	Met?	Y	Y	Y
	Justification	The HS has been tested using the NPF Management Strategy Evaluation (Dichmont <i>et al.</i> , 2006a, Dichmont <i>et al.</i> , 2006b, Dichmont <i>et al.</i> , 2006c, Dichmont <i>et al.</i> , 2008, and Dichmont <i>et al.</i> , 2012a). Regular assessments provide evidence that the HS is achieving its objectives and maintaining the stock at target levels. SG60, SG80 and SG100 requirements are met.		
c	Guide post	Monitoring is in place that is expected to determine whether the harvest strategy is working.		
	Met?	Y		
	Justification	There is a high level of monitoring and data collection for the NPF. There is an ongoing assessment program to evaluate how the harvest strategy is working. SG60 is met.		
d	Guide post			The harvest strategy is periodically reviewed and improved as necessary.
	Met?			Y

PI 1.2.1		There is a robust and precautionary harvest strategy in place		
	Justification	The harvest strategy is periodically reviewed and improved as necessary. There have been several adjustments to the HS since its adoption, including specific changes for blue endeavour prawn, most recently in 2014. Detailed information on review processes is given at PI 3.2.5. SG100 is met.		
e	Guide post	It is likely that shark finning is not taking place.	It is highly likely that shark finning is not taking place.	There is a high degree of certainty that shark finning is not taking place.
	Met?	Not relevant	Not relevant	Not relevant
	Justification	Sharks are not a target species.		
References		<p>Dichmont, C.M., Deng, A., Punt, A.E., Ellis, N., Venables, W.N., Kompas, T., Ye, Y., Zhou, S., Bishop, J. (2008). Beyond biological performance measures in Management Strategy Evaluation: Bringing in economics and the effects of trawling on the benthos. Fisheries Research 94: 238-250.</p> <p>Dichmont, C.M., Deng, R.A., Punt, A.E., Venables, W., Hutton, T. (2012). From input to output controls in a short-lived species: the case of the Northern Prawn Fishery. Marine and Freshwater Research, 2012, 63, 727–739.</p> <p>Dichmont, C.M., Jarrett, A., Hill, F., and Brown, M. (2014). Harvest Strategy for the Northern Prawn Fishery under Input Controls 2014. Report to the Australian Fisheries Management Authority, Project 2006/828. CSIRO. Brisbane. 32 p.</p> <p>Australia Government, Northern Prawn Fishery Management Plan, 1995. Available at https://www.legislation.gov.au/Details/F2012C00160.</p>		
OVERALL PERFORMANCE INDICATOR SCORE:				100
CONDITION NUMBER (if relevant):				

Blue endeavour prawn (*Metapenaeus endeavouri*)

Evaluation Table for PI 1.2.2

PI 1.2.2		There are well defined and effective harvest control rules in place		
Scoring Issue		SG 60	SG 80	SG 100
a	Guide post	Generally understood harvest rules are in place that are consistent with the harvest strategy and which act to reduce the exploitation rate as limit reference points are approached.	Well defined harvest control rules are in place that are consistent with the harvest strategy and ensure that the exploitation rate is reduced as limit reference points are approached.	

PI 1.2.2		There are well defined and effective harvest control rules in place		
	Met?	Y	Y	
	Justification	<p>The harvest strategy contains a comprehensive set of control rules that feed into HS actions, including no target fishing if the LRP is triggered as well as changes to fishing effort to achieve MEY through the use of spatial and temporal closures and gear modifications. The flow chart for the use of the LRP is seen in Figure 13 and the control rules are in Box 1.</p> <p>There is also a 350kg/day trigger in place, which if met, results in closure of the fishery. This trigger applies to all target species of the tiger prawn subfishery. The trigger is set at the break-even point, where costs equal revenue.</p> <p>SG60 and SG80 are met.</p>		
b	Guide post		The selection of the harvest control rules takes into account the main uncertainties.	The design of the harvest control rules takes into account a wide range of uncertainties.
	Met?		Y	Y
	Justification	The control rules were part of the MSE reported in 1.2.1 that includes testing of the design of the rules. Assessments examine the sensitivity of management performance to a wide range of uncertainties. SG80 and SG100 requirements are met.		
c	Guide post	There is some evidence that tools used to implement harvest control rules are appropriate and effective in controlling exploitation.	Available evidence indicates that the tools in use are appropriate and effective in achieving the exploitation levels required under the harvest control rules.	Evidence clearly shows that the tools in use are effective in achieving the exploitation levels required under the harvest control rules.
	Met?	Y	Y	Y
	Justification	Following a period of overfishing in the early 2000s, a rebuilding strategy based on the control rules was implemented and the stock has been successfully rebuilt to around the TRP. Recent assessments provide evidence that ongoing exploitation levels are appropriate. SG60, SG80 and SG100 requirements are met.		
References		Dichmont, C.M., Jarrett, A., Hill, F., and Brown, M. (2014). Harvest Strategy for the Northern Prawn Fishery under Input Controls 2014. Report to the Australian Fisheries Management Authority, Project 2006/828. CSIRO. Brisbane. 32 p.		
OVERALL PERFORMANCE INDICATOR SCORE:				100
CONDITION NUMBER (if relevant):				

Blue endeavour prawn (*Metapenaeus endeavouri*)

Evaluation Table for PI 1.2.3

PI 1.2.3		Relevant information is collected to support the harvest strategy		
Scoring Issue		SG 60	SG 80	SG 100
a	Guide post	Some relevant information related to stock structure, stock productivity and fleet composition is available to support the harvest strategy.	Sufficient relevant information related to stock structure, stock productivity, fleet composition and other data is available to support the harvest strategy.	A comprehensive range of information (on stock structure, stock productivity, fleet composition, stock abundance, fishery removals and other information such as environmental information), including some that may not be directly related to the current harvest strategy, is available.
	Met?	Y	Y	Y
	Justification	There is a comprehensive data collection program for the NPF to ensure reliable information is available on which to base management decisions. This includes fishery independent surveys (both at the time of prawn recruitment (“recruitment” surveys) and at the time of peak spawning (“spawning” surveys), daily catch and effort logbooks, seasonal landing returns, VMS data and economic surveys (see Figure 16). Vessel gear details are also collected which tracks changes in gear and technology in the fishery. The NPF also has a crew member observer programme and a scientific observer programme. Environmental information includes general climatic observations through the Australian meteorological network, oceanographic observations during past research cruises and the annual “recruitment” and “spawning” survey cruises. Dichmont <i>et al.</i> (2010) provides a review of the data used in the stock assessment. SG60, SG80 and SG100 requirements are met.		
b	Guide post	Stock abundance and fishery removals are monitored and at least one indicator is available and monitored with sufficient frequency to support the harvest control rule.	Stock abundance and fishery removals are regularly monitored at a level of accuracy and coverage consistent with the harvest control rule, and one or more indicators are available and monitored with sufficient frequency to support the harvest control rule.	All information required by the harvest control rule is monitored with high frequency and a high degree of certainty, and there is a good understanding of inherent uncertainties in the information [data] and the robustness of assessment and management to this uncertainty.
	Met?	Y	Y	Y
	Justification	The information collected is used in the regular stock assessments, and fed in real time into the HS decision making process that determines the length of closures and the appropriate fishing effort level to achieve the TRP. A well-established research program has examined uncertainties in the data. There is a good understanding of uncertainties in the information that has been tested through sensitivity analyses in the stock assessment. All information required by the harvest control rules is monitored with high frequency and a high degree of certainty. SG60, SG80 and SG100 requirements are met.		
c	Guide post		There is good information on all other fishery removals from the stock.	
	Met?		Y	

PI 1.2.3		Relevant information is collected to support the harvest strategy
	Justification	The client vessels are the only prawn trawlers operating across the region and catches from the fishery are representative of total removals. SG80 is met.
	References	<p>Dichmont, C.M., Jarrett, A., Hill, F., and Brown, M. (2014). Harvest Strategy for the Northern Prawn Fishery under Input Controls 2014. Report to the Australian Fisheries Management Authority, Project 2006/828. CSIRO. Brisbane. 32 p.</p> <p>Dichmont, C.M., Deng, A.R., Punt, A.E., Venables, W.N., Pascoe, S., Zhou, S., Kompas, T., Kenyon, R., Bishop, J., van der Velde, T., Kienzle, M., Hutton, T., Plagányi, E., Miller, M., Donovan, A., Ye, Y. (2010). Developing techniques to estimate total allowable catches for the NPF major prawn species. FRDC Project No. 2007/018.</p> <p>Kenyon, R.A., Deng, R., Donovan, A., van der Velde, T. and Fry, G. (2016). An integrated monitoring program for the Northern Prawn Fishery 2015/18. Report to the Australian Fisheries Management Authority, Project 2015/0810. CSIRO. Brisbane.</p>
OVERALL PERFORMANCE INDICATOR SCORE:		100
CONDITION NUMBER (if relevant):		

Blue endeavour prawn (*Metapenaeus endeavouri*)

Evaluation Table for PI 1.2.4

PI 1.2.4		There is an adequate assessment of the stock status		
Scoring Issue		SG 60	SG 80	SG 100
a	Guide post		The assessment is appropriate for the stock and for the harvest control rule.	The assessment is appropriate for the stock and for the harvest control rule and takes into account the major features relevant to the biology of the species and the nature of the fishery.
	Met?		Y	Y
	Justification	<p>Blue endeavour prawns are assessed using a biomass dynamics model (using a hierarchical Bayesian state-space framework) (Zhou <i>et al.</i>, 2009, Zhou, 2010). This is a simpler approach than for the tiger prawn species and has been adopted because fewer input parameters are required in this approach. Outputs are combined with those for the two tiger prawns in the bio-economic model. The results from the multi-species stock assessment form part of the basis for evaluating the time-series of catches (by species) and levels of fishing effort (by fishing strategy) which maximize net present value. The bio-economic model takes into account costs which are proportional to catches, and those which are proportional to fishing effort, as well as fixed costs. The fit of the model to the data inputs is good, and the sensitivity of the results has been examined by changing the assumptions regarding the values for the economic parameters of the bio-economic model as well as those on which the assessment is based (Punt <i>et al.</i>, 2010). Assessments are updated with the most recently available data every two years. The assessments are appropriate to the prawn stocks and account for the biology of the species and the fishery. SG80 and SG100 requirements are met.</p>		

PI 1.2.4		There is an adequate assessment of the stock status		
b	Guide post	The assessment estimates stock status relative to reference points.		
	Met?	Y		
	Justification	The assessment estimates stock status relative to the target and limit reference points as well as several other indicators relevant to management. SG60 is met.		
c	Guide post	The assessment identifies major sources of uncertainty.	The assessment takes uncertainty into account.	The assessment takes into account uncertainty and is evaluating stock status relative to reference points in a probabilistic way.
	Met?	Y	Y	Y
	Justification	As with the tiger prawn assessment, a range of probable scenarios is used to examine uncertainty. The sensitivity tests in the stock assessment have been carried out that indicate relative robustness to assumptions and different types of assessment techniques. These are taken into account in assessing stock status. Outputs of the latest sensitivity tests are detailed in Buckworth <i>et al.</i> (2016). SG60, SG80 and SG100 requirements are met.		
d	Guide post			The assessment has been tested and shown to be robust. Alternative hypotheses and assessment approaches have been rigorously explored.
	Met?			Y
	Justification	The assessment has been tested and shown to be robust. The assessment model used has evolved over time and a range of approaches have been undertaken. An evaluation of stock assessment methods and management strategies for the NPF was carried out by Dichmont <i>et al.</i> (2006a); Dichmont <i>et al.</i> (2006b); Dichmont <i>et al.</i> (2006c); and Dichmont <i>et al.</i> (2008) using the MSE. These assessment procedures investigated captured a range from very simple (a linear regression of log-catch-rate on time) to fairly complicated (an age- and stock-based assessment model), and two forms of decision rule. Buckworth <i>et al.</i> (2016) provides an overview of recent developments with the tiger prawn subfishery assessment.. The blue endeavour prawn assessment uses a Bayesian hierarchical biomass production model which provides maximum likelihood estimates for stock assessment outputs (Zhou <i>et al.</i> , 2009). SG100 is met.		
e	Guide post		The assessment of stock status is subject to peer review.	The assessment has been internally and externally peer reviewed.
	Met?		Y	Y
	Justification	The stock assessment is carried out by the CSIRO under contract from AFMA. It is conducted by a team of data, information and stock assessment specialists including part-time input from a world-renowned expert from the University of Washington. Modelling results are then reviewed by the NPRAG, which is comprised of scientists, economists, fishery managers, fishing representatives, and environmentalists. Peer-group review of the actual assessments is provided by two independent stock assessment experts within the RAG. The methods and results of the assessments are also published in peer-reviewed scientific journals. The		

PI 1.2.4	There is an adequate assessment of the stock status	
		assessment model used for blue endeavour prawns (Zhou <i>et al.</i> , 2009) was published in a peer-reviewed journal. SG80 and SG100 are met.
References	Buckworth, R.C., Deng, R.A., Plagányi, E.E., Punt, A., Upston, J., Pascoe, S., Miller, M., T. Hutton, T., Lawrence, E., and W. Venables (2015). Northern Prawn Fishery RAG Assessments 2013-15. Final Report to the Australian Fisheries Management Authority, Research Project 2013/0005, June 2015. CSIRO. Brisbane. 177 p.	
	Buckworth, R.C., Deng, R.A., Hutton, T., Upston, J., Miller, M. and Pascoe, S. (2016). Status of the Northern Prawn Fishery Tiger Prawn Fishery at the end of 2015, with an estimated TAE for 2016. Report to the Australian Fisheries Management Authority, September 2016. CSIRO. Brisbane.	
	Dichmont, C.M., Deng, A.R., Punt, A.E., Venables, W.N., Pascoe, S., Zhou, S., Kompas, T., Kenyon, R., Bishop, J., van der Velde, T., Kienzie, M., Hutton, T., Plagányi, E., Miller, M., Donovan, A., Ye, Y. (2010). Developing techniques to estimate total allowable catches for the NPF major prawn species. FRDC Project No. 2007/018.	
	Dichmont, C.M., Deng, A., Punt, A.E., Ellis, N., Venables, W.N., Kompas, T., Ye, Y., Zhou, S., Bishop, J. (2008). Beyond biological performance measures in Management Strategy Evaluation: Bringing in economics and the effects of trawling on the benthos. Fisheries Research 94: 238-250.	
	Dichmont, C. M., Deng, A., Punt, A. E., Venables, W., & Haddon, M. (2006a). Management strategies for short- lived species: The case of the Northern Prawn Fishery 1. Accounting for multiples species, spatial structure and implementation uncertainty when evaluating risk. Fisheries Research 82, 204-230.	
	Dichmont, C. M., Deng, A., Punt, A. E., Venables, W., & Haddon, M. (2006b). Management strategies for short- lived species: The case of Australia's Northern Prawn Fishery 2. Choosing appropriate management strategies using input controls. Fisheries Research 82, 221-234.	
	Dichmont, C. M., Deng, A., Punt, A. E., Venables, W., & Haddon, M. (2006c). Management strategies for short- lived species: The case of Australia's Northern Prawn Fishery 3. Factors affecting management and estimation performance. Fisheries Research 82, 235-245.	
	Punt, A. E., Deng, R. A., Dichmont, C. M., Kompas, T., Venables, W. N., Zhou, S., <i>et al.</i> (2010). Integrating size-structured assessment and bio-economic management advice in Australia's Northern Prawn Fishery. ICES Journal of marine Sciences 76, 1985-1801.	
OVERALL PERFORMANCE INDICATOR SCORE:		100
CONDITION NUMBER (if relevant):		

Red endeavour prawn (*M. ensis*)

Evaluation Table for PI 1.1.1

PI 1.1.1		The stock is at a level which maintains high productivity and has a low probability of recruitment overfishing		
Scoring Issue		SG 60	SG 80	SG 100
a	Guide post	It is likely that the stock is above the point where recruitment would be impaired.	It is highly likely that the stock is above the point where recruitment would be impaired.	There is a high degree of certainty that the stock is above the point where recruitment would be impaired.
	Met?	NA (RBF)	NA (RBF)	NA (RBF)
	Justification	<p>No stock assessment is available for red endeavour prawns. The original MSC assessment of the NPF (MRAG, 2012) reports that the status of this stock is assessed based on logic that applies for stocks that are well managed but do not have a formal stock assessment or biomass based reference points. At the time of the 2012 assessment, both species of endeavour prawns (red and blue endeavour prawns) were included as economic bycatch in the in the bio-economic model used for the tiger prawn subfishery (MRAG, 2012) and the two species were considered together as part of the harvest strategy at that time (AFMA, 2010). In an updated bio-economic model red endeavour prawns are not considered due to a lack of a stock assessment for the species. See discussion of the current harvest strategy below (Dichmont et al., 2014).</p> <p>As described in the Principle 2 section of this report, an ecological risk assessment of the NPF was undertaken in 2007 (Griffiths <i>et al.</i>, 2007). The methodology used was similar to that for the MSC RBF and included a SICA and PSA. The SICA focused on brown tiger prawn as it had been overfished and was considered as the most vulnerable P1 component. The PSA assessed red endeavour prawns as being at low risk.</p> <p>During the 2017 site visit it became apparent that available information was inadequate to apply the standard assessment methodology, as prescribed in the FAM V2, for PI 1.1.1. A Scale Intensity Consequence Analysis (SICA) and a Productivity Susceptibility Analysis (PSA) were undertaken (as described at Appendix 2), updating the 2007 results.</p> <p>The updated SICA is based on the results of a questionnaire distributed via a “Notice of Remote Risk-Based Framework Process” published on the MSC website on 2 May 2017. The Northern Prawn Fishery Assessment Group met in Brisbane on 11 May 2017 for one of its regular meetings. During that meeting a workshop was conducted to discuss the SICA questionnaire. A consolidated response to the questionnaire was provided by the participants (attached at Appendix 2, Section 10.2.3). The consolidated response from NPRAG was used to inform the SICA scoring at Table 40. The SICA indicates an overall consequence score of 2, corresponding to an MSC score of 80.</p> <p>The PSA information was completed by using the “MSC PSA worksheet for RBF”. The PSA derived score for PI 1.1.1 was 1.93, corresponding to an MSC score of 96 (Appendix 2, Section 10.2.2).</p> <p>The overall score for red endeavour prawn is assigned according to Table CC19 of MSC CR v1.3. The final MSC score for this element is 96.</p>		
b	Guide post		The stock is at or fluctuating around its target reference point.	There is a high degree of certainty that the stock has been fluctuating around its target reference point, or has been above its target reference point, over recent years.

PI 1.1.1		The stock is at a level which maintains high productivity and has a low probability of recruitment overfishing		
	Met?		NA (RBF)	NA (RBF)
	Justification	See Scoring Guidepost (a).		
References		<p>AFMA (2010). Northern Prawn Fishery (NPF) Harvest Strategy under Inputs Controls. Canberra, Australia: Australian Fisheries Management Authority. www.afma.gov.au/wp-content/uploads/2010/07/harvest_strategy.pdf.</p> <p>Griffiths, S., Kenyon, R., Bulman, C., Dowdney, J., Williams, A., Sporic, M. and Fuller, M. (2007). Ecological risk assessment for the effects of fishing: Report for the Northern Prawn Fishery. Australian Fisheries Management Authority, Canberra.</p> <p>MRAG (2012), MSC Assessment Report for Public Certification Report for Australian Northern Prawn Fishery, Brown tiger prawn (<i>Penaeus esculentus</i>) Grooved tiger prawn (<i>P. semisulcatus</i>) Blue endeavour prawn (<i>Metapenaeus endeavouri</i>) Red endeavour prawn (<i>M. ensis</i>) White banana prawn (<i>Fenneropenaeus merguiensis</i>); Red-legged banana prawn (<i>F. indicus</i>) Twin, triple and quad otter trawl, Public Certification Report. MRAG Americas, November 2012, 399pp.</p>		
Stock Status relative to Reference Points				
	Type of reference point	Value of reference point	Current stock status relative to reference point	
Target reference point	NA	NA	NA	
Limit reference point	NA	NA	NA	
OVERALL PERFORMANCE INDICATOR SCORE:				96
CONDITION NUMBER (if relevant):				

Red endeavour prawn (*M. ensis*)

Evaluation Table for PI 1.1.2

PI 1.1.2	Limit and target reference points are appropriate for the stock		
Scoring Issue	SG 60	SG 80	SG 100

PI 1.1.2		Limit and target reference points are appropriate for the stock		
a	Guide post	Generic limit and target reference points are based on justifiable and reasonable practice appropriate for the species category.	Reference points are appropriate for the stock and can be estimated.	
	Met?	NA (RBF)	NA (RBF)	
	Justification	The default score for this PI is 80 when RBF is used to score PI 1.1.1., in accordance with MSC CR v1.3.		
b	Guide post		The limit reference point is set above the level at which there is an appreciable risk of impairing reproductive capacity.	The limit reference point is set above the level at which there is an appreciable risk of impairing reproductive capacity following consideration of precautionary issues.
	Met?		NA (RBF)	NA (RBF)
	Justification	The default score for this PI is 80 when RBF is used to score PI 1.1.1., in accordance with MSC CR v1.3.		
c	Guide post		The target reference point is such that the stock is maintained at a level consistent with B_{MSY} or some measure or surrogate with similar intent or outcome.	The target reference point is such that the stock is maintained at a level consistent with B_{MSY} or some measure or surrogate with similar intent or outcome, or a higher level, and takes into account relevant precautionary issues such as the ecological role of the stock with a high degree of certainty.
	Met?		NA (RBF)	NA (RBF)
	Justification	The default score for this PI is 80 when RBF is used to score PI 1.1.1., in accordance with MSC CR v1.3.		
d	Guide post		For key low trophic level stocks, the target reference point takes into account the ecological role of the stock.	
	Met?		NA (RBF)	
	Justification	The default score for this PI is 80 when RBF is used to score PI 1.1.1., in accordance with MSC CR v1.3.		
References				
OVERALL PERFORMANCE INDICATOR SCORE:				80

PI 1.1.2	Limit and target reference points are appropriate for the stock
CONDITION NUMBER (if relevant):	

Red endeavour prawn (*M. ensis*)

Evaluation Table for PI 1.1.3

PI 1.1.3		Where the stock is depleted, there is evidence of stock rebuilding within a specified timeframe		
Scoring Issue		SG 60	SG 80	SG 100
a	Guide post	Where stocks are depleted rebuilding strategies, which have a reasonable expectation of success, are in place.		Where stocks are depleted, strategies are demonstrated to be rebuilding stocks continuously and there is strong evidence that rebuilding will be complete within the specified timeframe.
	Met?	NA (RBF)		NA (RBF)
	Justification	This PI is not scored if the RBF is used.		
b	Guide post	A rebuilding timeframe is specified for the depleted stock that is the shorter of 30 years or 3 times its generation time. For cases where 3 generations is less than 5 years, the rebuilding timeframe is up to 5 years.	A rebuilding timeframe is specified for the depleted stock that is the shorter of 20 years or 2 times its generation time. For cases where 2 generations is less than 5 years, the rebuilding timeframe is up to 5 years.	The shortest practicable rebuilding timeframe is specified which does not exceed one generation time for the depleted stock.
	Met?	NA (RBF)	NA (RBF)	NA (RBF)
	Justification	This PI is not scored if the RBF is used.		
c	Guide post	Monitoring is in place to determine whether the rebuilding strategies are effective in rebuilding the stock within a specified timeframe.	There is evidence that they are rebuilding stocks, or it is highly likely based on simulation modelling or previous performance that they will be able to rebuild the stock within a specified timeframe.	
	Met?	NA (RBF)	NA (RBF)	

PI 1.1.3		Where the stock is depleted, there is evidence of stock rebuilding within a specified timeframe
	Justification	This PI is not scored if the RBF is used.
References		
OVERALL PERFORMANCE INDICATOR SCORE:		NA
CONDITION NUMBER (if relevant):		

Red endeavour prawn (*M. ensis*)

Evaluation Table for PI 1.2.1

PI 1.2.1		There is a robust and precautionary harvest strategy in place		
Scoring Issue		SG 60	SG 80	SG 100
a	Guide post	The harvest strategy is expected to achieve stock management objectives reflected in the target and limit reference points.	The harvest strategy is responsive to the state of the stock and the elements of the harvest strategy work together towards achieving management objectives reflected in the target and limit reference points.	The harvest strategy is responsive to the state of the stock and is designed to achieve stock management objectives reflected in the target and limit reference points.
	Met?	Y	N	N
	Justification	<p>There is a formal harvest strategy in place for the Northern Prawn Fishery (Dichmont <i>et al.</i>, 2014). The HS is compliant with the Commonwealth of Australia's Legislative requirements and is aimed at realizing the objectives of the NPF Management Plan 1995, including to "ensure the utilization of the fishery resources is consistent with the principles of ecologically sustainable development and the exercise of the precautionary principle" and to "maximise economic efficiency in the utilisation of the fisheries resources within the Northern Prawn Fishery". There are separate components of the HS applying to the tiger prawn, white banana prawn and red-legged banana prawn sub-fisheries.</p> <p>Red endeavour prawns are taken within the tiger prawn subfishery. The operational objective of the HS is to attain long-term maximum economic yield (MEY) from the tiger prawn subfishery. MEY, as applied to this fishery, is not constant but depends on the expectations of future prices and costs. Further, MEY is not independent of the dynamic path chosen to achieve MEY. For the NPF, MEY is assumed to be achieved over a seven-year period. The dynamic path to MEY is calculated as the effort level and associated catch in each year over a seven-year projection period that leads to a long run sustainable yield that maximises profits over time. The bio-economic model used in the HS is based on the stock assessments of the two species of tiger prawns and blue endeavour prawns. Red endeavour prawns are not considered in the bio-economic model as no stock assessment is available for this species. Hence the reference points and control rules described above (for brown tiger prawn, grooved tiger prawn and blue endeavour prawns) adopted under the HS</p>		

PI 1.2.1		There is a robust and precautionary harvest strategy in place		
		<p>do not strictly apply to red endeavour prawns, though the red endeavour catches are an economic bycatch of the tiger prawn subfishery. There is, however, an overriding TRP in the NPF HS of S_{MEY} (Dichmont <i>et al.</i>, 2014) and an overriding LRP in the Commonwealth Harvest Strategy of $0.5S_{MSY}$.</p> <p>There is limited spatial separation between tiger and endeavour prawns (with the exception of the 'spikes' in catches of red endeavour prawns which occur very occasionally) and the correlation between tiger and endeavour prawn catches is quite high. As endeavour prawns are generally taken as an incidental part of the tiger prawn catch, many controls which apply to tiger prawns also apply to endeavour prawns. These include spatial and temporal closures, as well as vessel limits and net length limits. The low overlap of the fishery footprint on the range of the stock (<10%) provides protection to the stock. Recent catch data and ongoing fishery independent surveys provide evidence that the objective to maintain the red endeavour population is being met.</p> <p>Whilst the HS is expected to achieve stock management objectives for red endeavour prawns (SG60), the elements of the HS are not as well developed as for the two tiger prawns and blue endeavour prawns. It is not evident that the elements of the HS are working together towards achieving management objectives reflected in target and limit reference points.</p>		
b	Guide post	The harvest strategy is likely to work based on prior experience or plausible argument.	The harvest strategy may not have been fully tested but evidence exists that it is achieving its objectives.	The performance of the harvest strategy has been fully evaluated and evidence exists to show that it is achieving its objectives including being clearly able to maintain stocks at target levels.
	Met?	Y	Y	N
	Justification	The HS for the tiger prawn subfishery has been tested using MSE for the two tiger prawns and blue endeavour prawns (Dichmont <i>et al.</i> 2014). Red endeavour prawns were not included in the more recent MSE, however, this species was part of the MSE conducted previously for the fishery (Dichmont <i>et al.</i> 2008). There is evidence that the HS is achieving its objectives for the tiger prawn subfishery as a whole. Whilst the current HS is lacking in its approach to red endeavour prawns, there is evidence from recent catch data and from ongoing fishery independent surveys that the objective to maintain the red endeavour population is being met. The use of the RBF in this assessment indicates that the fishery presents a low risk to the stock. SG60 and SG80 requirements are met.		
c	Guide post	Monitoring is in place that is expected to determine whether the harvest strategy is working.		
	Met?	Y		
	Justification	There is extensive monitoring of data from the commercial fishery and there are annual fishery independent surveys. There is an ongoing assessment program to evaluate how the harvest strategy is working. SG60 is met.		
d	Guide post			The harvest strategy is periodically reviewed and improved as necessary.
	Met?			N

PI 1.2.1		There is a robust and precautionary harvest strategy in place		
	Justification	Not scored as PI 1.2.1a SG80 is not met. There is ongoing review of the HS and there have been several iterations since a formal HS was first adopted. However, SG100 not met given the reduced focus on the species in the most recent HS.		
e	Guide post	It is likely that shark finning is not taking place.	It is highly likely that shark finning is not taking place.	There is a high degree of certainty that shark finning is not taking place.
	Met?	Not relevant	Not relevant	Not relevant
	Justification	Sharks are not a target species.		
References		<p>AFMA (2010). Northern Prawn Fishery (NPF) Harvest Strategy under Inputs Controls. Canberra, Australia: Australian Fisheries Management Authority. www.afma.gov.au/wp-content/uploads/2010/07/harvest_strategy.pdf.</p> <p>Dichmont, C.M., Jarrett, A., Hill, F., and Brown, M. (2014). Harvest Strategy for the Northern Prawn Fishery under Input Controls 2014. Report to the Australian Fisheries Management Authority, Project 2006/828. CSIRO. Brisbane. 32 p.</p>		
OVERALL PERFORMANCE INDICATOR SCORE:				70
CONDITION NUMBER (if relevant):				1

Red endeavour prawn (*M. ensis*)

Evaluation Table for PI 1.2.2

PI 1.2.2		There are well defined and effective harvest control rules in place		
Scoring Issue		SG 60	SG 80	SG 100
a	Guide post	Generally understood harvest rules are in place that are consistent with the harvest strategy and which act to reduce the exploitation rate as limit reference points are approached.	Well defined harvest control rules are in place that are consistent with the harvest strategy and ensure that the exploitation rate is reduced as limit reference points are approached.	
	Met?	Y	N	
	Justification	The NPF HS contains a comprehensive set of control rules that feed into management actions, including no target fishing if the LRP is triggered as well as changes to fishing effort to achieve MEY through the use of spatial and temporal closures and gear restrictions. The flow chart for the use of the LRP for the tiger prawn subfishery is seen in Figure 13 and the control rules are in Box 1. As currently written, the control rules in the HS for the tiger prawn subfishery apply to brown tiger prawn, grooved tiger prawn and blue endeavour prawn. Well-		

PI 1.2.2		There are well defined and effective harvest control rules in place		
		defined control rules are not in place for red endeavour prawns. There are, however, generally understood rules in place that have reduced exploitation rates on red endeavour prawns. There has been a major reduction in the number of vessels in the fishery and a reduction in the amount of gear that can be used. There are seasonal and temporal closures which also afford protection to red endeavour prawns. SG60 requirements are met.		
b	Guide post		The selection of the harvest control rules takes into account the main uncertainties.	The design of the harvest control rules takes into account a wide range of uncertainties.
	Met?		Y	N
	Justification	Whilst the current HS does not specify control rules for red endeavour prawns, the overall rules in place for the fishery (vessel and gear restrictions, spatial and temporal closures) take into account the main uncertainties in management of red endeavour prawns. Previous iterations of the HS have undertaken MSE considering red endeavour prawns and control rules adopted since then have strengthened overall measures in place for the fishery. The low overlap of the fishery footprint on the range of the stock (<10%) provides a buffer from uncertainties not otherwise covered. SG80 requirements are met.		
c	Guide post	There is some evidence that tools used to implement harvest control rules are appropriate and effective in controlling exploitation.	Available evidence indicates that the tools in use are appropriate and effective in achieving the exploitation levels required under the harvest control rules.	Evidence clearly shows that the tools in use are effective in achieving the exploitation levels required under the harvest control rules.
	Met?	Y	Y	N
	Justification	Following a period of overfishing in the tiger prawn subfishery in the late 1990s, a rebuilding strategy based on the control rules was implemented in 2003. Although this strategy was directed at tiger prawns it has had benefits for endeavour prawn species. Recent catch information, fishery independent survey data and the results of the risk-based analysis provide evidence that ongoing exploitation levels are appropriate under the current HS. SG60 and SG80 requirements are met.		
References		<p>AFMA (2010). Northern Prawn Fishery (NPF) Harvest Strategy under Inputs Controls. Canberra, Australia: Australian Fisheries Management Authority. www.afma.gov.au/wp-content/uploads/2010/07/harvest_strategy.pdf.</p> <p>Dichmont, C.M., Jarrett, A., Hill, F., and Brown, M. (2014). Harvest Strategy for the Northern Prawn Fishery under Input Controls 2014. Report to the Australian Fisheries Management Authority, Project 2006/828. CSIRO. Brisbane. 32 p.</p>		
OVERALL PERFORMANCE INDICATOR SCORE:				75
CONDITION NUMBER (if relevant):				2

Red endeavour prawn (*M. ensis*)

Evaluation Table for PI 1.2.3

PI 1.2.3		Relevant information is collected to support the harvest strategy		
Scoring Issue		SG 60	SG 80	SG 100
a	Guide post	Some relevant information related to stock structure, stock productivity and fleet composition is available to support the harvest strategy.	Sufficient relevant information related to stock structure, stock productivity, fleet composition and other data is available to support the harvest strategy.	A comprehensive range of information (on stock structure, stock productivity, fleet composition, stock abundance, fishery removals and other information such as environmental information), including some that may not be directly related to the current harvest strategy, is available.
	Met?	Y	Y	N
	Justification	<p>An extensive data collection program (Figure 16) has been established for the NPF to ensure reliable information is available on which to base management decisions. Information is collected through fishery dependent and independent programs on all retained species taken in the NPF.</p> <p>The NPF-wide Daily Catch & Effort logbook program requires operators to record, besides catch data, the location of fishing operations (latitude/longitude) for every day they fish and/or search, regardless of whether any catch is taken; the total number of shots for each fishing day; the species/product retained and size grade information. Retained catch information is verified by landing returns records. VMS data verifies the catch locations recorded in logbooks. Each year a recruitment survey is undertaken on the key fishing grounds of the Gulf of Carpentaria. In addition, a spawner survey is undertaken during the mid-season break in winter on the western grounds of the Gulf. The distribution of red endeavour prawns taken in the 2016 monitoring survey is shown in Figure 8. Vessel gear data are collected to track changes in gear and technology in the fishery. The NPF also has a crew member observer programme and a scientific observer programme.</p> <p>Because red endeavour prawn catches are low and variable, there is inadequate information for a stock assessment based on the otherwise existing comprehensive data collection systems. To collect additional information for a complete stock assessment would require a dedicated research project inconsistent with the scale and intensity of the catch of a species that is caught as an incidental to the main species and is otherwise well managed.</p> <p>Although not currently utilized, sufficient relevant information related to stock structure, stock productivity, fleet composition and other data is available to support the harvest strategy. SG60 and SG80 are met.</p>		
b	Guide post	Stock abundance and fishery removals are monitored and at least one indicator is available and monitored with sufficient frequency to support the harvest control rule.	Stock abundance and fishery removals are regularly monitored at a level of accuracy and coverage consistent with the harvest control rule, and one or more indicators are available and monitored with sufficient frequency to support the harvest control rule.	All information required by the harvest control rule is monitored with high frequency and a high degree of certainty, and there is a good understanding of inherent uncertainties in the information [data] and the robustness of assessment and management to this uncertainty.
	Met?	Y	Y	N

PI 1.2.3		Relevant information is collected to support the harvest strategy		
	Justification	Information collected from the fishery is used in real time in the HS decision making process that determines the length of closures and the appropriate fishing effort level for the tiger prawn subfishery. There is a good understanding of uncertainties in the information available. Removals from the fishery are well monitored. NP RAG meetings take place several times per year and review available information from the fishery and the surveys. There is a condition for SI 1.2.2a requiring the development of a harvest control rule. The annual surveys provide information on the abundance of red endeavour prawns that could be incorporated into a harvest control rule. As it stands, if the surveys highlighted a problem with red endeavour prawns this would trigger further consideration of the data and potential management action (Pers. comm. Dr Trevor Hutton, site visit 13 February 2017). Catches of this byproduct species have been maintained over the history of the fishery. The fishery operates in only a small percentage of the overall management area and closed areas are monitored via VMs. The SICA analysis suggest a low impact on the stock. SG60 and SG80 requirements are met. The level of certainty required for SG100 is not met.		
c	Guide post		There is good information on all other fishery removals from the stock.	
	Met?		Y	
	Justification	The client vessels are the only prawn trawlers operating across the region and catches from the fishery are representative of total removals. SG80 is met.		
References		Dichmont, C.M., Jarrett, A., Hill, F., and Brown, M. (2014). Harvest Strategy for the Northern Prawn Fishery under Input Controls 2014. Report to the Australian Fisheries Management Authority, Project 2006/828. CSIRO. Brisbane. 32 p.		
OVERALL PERFORMANCE INDICATOR SCORE:				80

Red endeavour prawn (*M. ensis*)

Evaluation Table for PI 1.2.4

PI 1.2.4		There is an adequate assessment of the stock status		
Scoring Issue		SG 60	SG 80	SG 100
a	Guide post		The assessment is appropriate for the stock and for the harvest control rule.	The assessment is appropriate for the stock and for the harvest control rule and takes into account the major features relevant to the biology of the species and the nature of the fishery.
	Met?		NA (RBF)	NA (RBF)

PI 1.2.4		There is an adequate assessment of the stock status		
	Justification	The default score for this PI is 80 when RBF is used to score PI 1.1.1., in accordance with MSC CR v1.3.		
b	Guide post	The assessment estimates stock status relative to reference points.		
	Met?	NA (RBF)		
	Justification	The default score for this PI is 80 when RBF is used to score PI 1.1.1., in accordance with MSC CR v1.3.		
c	Guide post	The assessment identifies major sources of uncertainty.	The assessment takes uncertainty into account.	The assessment takes into account uncertainty and is evaluating stock status relative to reference points in a probabilistic way.
	Met?	NA (RBF)	NA (RBF)	NA (RBF)
	Justification	The default score for this PI is 80 when RBF is used to score PI 1.1.1., in accordance with MSC CR v1.3.		
d	Guide post			The assessment has been tested and shown to be robust. Alternative hypotheses and assessment approaches have been rigorously explored.
	Met?			NA (RBF)
	Justification	The default score for this PI is 80 when RBF is used to score PI 1.1.1., in accordance with MSC CR v1.3.		
e	Guide post		The assessment of stock status is subject to peer review.	The assessment has been internally and externally peer reviewed.
	Met?		NA (RBF)	NA (RBF)
	Justification	The default score for this PI is 80 when RBF is used to score PI 1.1.1., in accordance with MSC CR v1.3.		
References				
OVERALL PERFORMANCE INDICATOR SCORE:				80
CONDITION NUMBER (if relevant):				

White banana prawns (*Fenneropenaeus merguensis*);

Evaluation Table for PI 1.1.1

PI 1.1.1		The stock is at a level which maintains high productivity and has a low probability of recruitment overfishing		
Scoring Issue		SG 60	SG 80	SG 100
a	Guide post	It is likely that the stock is above the point where recruitment would be impaired.	It is highly likely that the stock is above the point where recruitment would be impaired.	There is a high degree of certainty that the stock is above the point where recruitment would be impaired.
	Met?	Y	Y	N
	Justification	<p>The recruitment of white banana prawns is strongly driven by environmental conditions (rainfall and catchment basin runoff) (Vance <i>et al.</i>, 1998). Consequently, it has not been possible to develop a stock assessment model for white banana prawn.</p> <p>Harvest rates for white banana prawn in the fishery are understood to have been high (>90 per cent of available biomass) in some years (Buckworth <i>et al.</i>, 2013), but the species is believed to be resilient to fishing pressure, and recruitment appears to be more closely associated with seasonal rainfall than fishing mortality. The harvest strategy for the stock has, inter alia, an objective to allow sufficient escapement to ensure an adequate spawning biomass and to allow subsequent recruitment. This is achieved by closing the season when catch rates fall below a trigger level.</p> <p>Since 1970, catches, especially in the southeastern GoC have responded as expected to changes in rainfall, indicating that the white banana prawn stock has remained at levels above those at which recruitment has been impaired. Catches have also recovered in areas of the Gulf where there were some concerns that overfishing may have occurred. There is evidence that the escapement (biomass and number of prawns remaining at the end of the banana prawn fishing season (in May/June)) has increased in recent years (MRAG, 2012). It is highly likely that the stock is above the point where recruitment would be impaired. SG60 and SG80 requirements are met.</p>		
b	Guide post		The stock is at or fluctuating around its target reference point.	There is a high degree of certainty that the stock has been fluctuating around its target reference point, or has been above its target reference point, over recent years.
	Met?		Y	N
	Justification	<p>Catches, have fluctuated around a long-term average with no conclusive evidence of long-term positive or negative trends in overall trends in the catch residual (catch with the effects of rainfall and changing effort removed). The harvest strategy for the stock has, inter alia, an objective to allow sufficient escapement to ensure an adequate spawning biomass and to allow subsequent recruitment. This is achieved by closing the season when catch rates fall below a trigger level associated with permitting sufficient prawns to escape to ensure an adequate spawning biomass for subsequent recruitment. In addition, the trigger is designed to achieve an economic outcome by closing fishing when catch rates fall below uneconomic levels. The MEY point for the banana prawn fishery is the point such that weekly marginal revenue equals weekly marginal cost i.e. when catch rates fall to the point where revenue generated by the catch is equal to the daily costs of fishing, so that marginal profit falls to zero: the “break even” catch rate.</p>		

PI 1.1.1		The stock is at a level which maintains high productivity and has a low probability of recruitment overfishing	
		<p>Based on a consideration of the dynamics of white banana prawns (Figure 10) it can be inferred that it is highly likely that over the history of the fishery, the stock has fluctuated around a highly productive level consistent with B_{MSY} or better, but without formal biomass-related reference points there is an element of uncertainty.</p> <p>The harvest strategy results in management of the fishery to maintain the stock at MEY target levels. SG80 is met.</p>	
References		<p>Dichmont, C.M., Jarrett, A., Hill, F., and Brown, M. (2014). Harvest Strategy for the Northern Prawn Fishery under Input Controls 2014. Report to the Australian Fisheries Management Authority, Project 2006/828. CSIRO. Brisbane. 32 p.</p> <p>Buckworth, R.C., Ellis, N., Zhou, S., Pascoe, S., Deng, R.A., Hill, F.G. and O’Brien, M. (2013). Comparison of TAC and current management for the White Banana Prawn fishery of the Northern Prawn Fishery. Final Report for Project RR2012/0812 to the Australian Fisheries Management Authority, June 2013.</p> <p>MRAG (2012), MSC Assessment Report for Public Certification Report for Australian Northern Prawn Fishery, Brown tiger prawn (<i>Penaeus esculentus</i>) Grooved tiger prawn (<i>P. semisulcatus</i>) Blue endeavour prawn (<i>Metapenaeus endeavouri</i>) Red endeavour prawn (<i>M. ensis</i>) White banana prawn (<i>Fenneropenaeus merguensis</i>); Red-legged banana prawn (<i>F. indicus</i>) Twin, triple and quad otter trawl, Public Certification Report. MRAG Americas, November 2012, 399pp.</p> <p>Vance, D. J., Haywood, M. D., Heales, D. S., Kenyon, R. A., & Loneragon, N. R. (1998). Seasonal and annual variation i abundance of postlarval and juvenile banana prawns, <i>Penaeus merguensis</i>, and environmental variation in two estuaries in tropical Northeastern Australia: a six-year study. Marine ecology Progress Series 163, 21-36.</p> <p>Venables, W.N., Hutton, T., Lawrence, E., Rothlisberg, P., Buckworth, R., Hartcher, M., Kenyon, R. (2011). Prediction of common banana prawn potential catch in Australia’s Northern Prawn Fishery. AFMA Project.</p>	
Stock Status relative to Reference Points			
	Type of reference point	Value of reference point	Current stock status relative to reference point
Target reference point	MEY catch rate trigger	Minimum trigger value: 425kg/boat/day Maximum trigger value: 575kg/boat/day	<p>At the final reporting period for 2015 the average catch per boat was 789 kg, well above the trigger level, hence the season continued until 15 June.</p> <p>At the final reporting period for 2016 the average catch per boat was 420 kg, below the trigger level, hence the season closed on 9 June.</p>
Limit reference point	MEY catch rate trigger	Above catch rate triggers are expected to maintain stock above the point where recruitment would be impaired.	<p>At the final reporting period for 2015 the average catch per boat was 789 kg, well above the trigger level.</p> <p>At the final reporting period for 2016 the average catch per boat was 420 kg, below the trigger level and the season closed on 9 June.</p>

PI 1.1.1	The stock is at a level which maintains high productivity and has a low probability of recruitment overfishing
OVERALL PERFORMANCE INDICATOR SCORE:	80
CONDITION NUMBER (if relevant):	

White banana prawns (*Fenneropenaeus merguensis*);

Evaluation Table for PI 1.1.2

PI 1.1.2		Limit and target reference points are appropriate for the stock		
Scoring Issue		SG 60	SG 80	SG 100
a	Guide post	Generic limit and target reference points are based on justifiable and reasonable practice appropriate for the species category.	Reference points are appropriate for the stock and can be estimated.	
	Met?	Y	Y	
	Justification	<p>The high variability and environmental dependency of this species results in significant variations in catch from year to year. Consistent with the fact that a stock assessment based on simple stock: recruitment based models is not possible, there are no formal biomass reference points. The surrogate LRP and TRP measures are (i) that there will be a sufficient escapement from the subfishery to not jeopardize subsequent recruitment and (ii) that the economic yield is maximized each year within this constraint, thus achieving the maximum average return. Until 2013 there was a surrogate limit reference point catch rate of 500kg/day that was used to shorten the season length. In October 2013, the AFMA Commission adopted the MEY-based catch trigger as the new management target. This is discussed further at PI 1.2.</p> <p>The MEY trigger is variable and calculated in-season, based on information on prawn prices and costs. The reference points are appropriate for the stock and can be estimated. SG60 and SG80 are met.</p>		
b	Guide post		The limit reference point is set above the level at which there is an appreciable risk of impairing reproductive capacity.	The limit reference point is set above the level at which there is an appreciable risk of impairing reproductive capacity following consideration of precautionary issues.
	Met?		Y	N
	Justification	Historical catches and analyses of catch residuals have shown that adopted management approach maintains the stock above the level at which there is an appreciable risk of impairing reproductive capacity. SG80 is met.		

PI 1.1.2		Limit and target reference points are appropriate for the stock		
c	Guide post		The target reference point is such that the stock is maintained at a level consistent with B_{MSY} or some measure or surrogate with similar intent or outcome.	The target reference point is such that the stock is maintained at a level consistent with B_{MSY} or some measure or surrogate with similar intent or outcome, or a higher level, and takes into account relevant precautionary issues such as the ecological role of the stock with a high degree of certainty.
	Met?		Y	N
	Justification	<p>There is currently no formal stock assessment for banana prawns nor evaluation of stock status in relation to MSY levels. The harvest strategy for the stock has, inter alia, an objective to allow sufficient escapement to ensure an adequate spawning biomass and to allow subsequent recruitment. Historical records indicate that the banana prawn fishery is sustainable with the current short fishing season. The season closes when catch rates fall below a trigger level associated with permitting sufficient prawns to escape to ensure an adequate spawning biomass for subsequent recruitment. In addition, the trigger is designed to achieve an economic outcome by closing fishing when catch rates fall below uneconomic levels. The MEY point for the banana prawn fishery is the point such that weekly marginal revenue equals weekly marginal cost i.e. when catch rates fall to the point where revenue generated by the catch is equal to the daily costs of fishing, so that marginal profit falls to zero: the “break even” catch rate.</p> <p>The MEY-based harvest strategy is appropriate to maintain the stock at a level consistent with maximizing the average yield (within the constraint of ensuring adequate recruitment). SG80 is met.</p>		
d	Guide post		For key low trophic level stocks, the target reference point takes into account the ecological role of the stock.	
	Met?		Not relevant	
	Justification	Banana prawns are not considered to be a low trophic species.		
References		<p>AFMA (2010). Northern Prawn Fishery (NPF) Harvest Strategy under Inputs Controls. Canberra, Australia: Australian Fisheries Management Authority. www.afma.gov.au/wp-content/uploads/2010/07/harvest_strategy.pdf.</p> <p>Dichmont, C.M., Jarrett, A., Hill, F., and Brown, M. (2012). Harvest Strategy for the Northern Prawn Fishery under Input Controls 2012. Report to the Australian Fisheries Management Authority, Project 2006/828. CSIRO. Brisbane. 32 p.</p> <p>Dichmont, C.M., Jarrett, A., Hill, F., and Brown, M. (2014). Harvest Strategy for the Northern Prawn Fishery under Input Controls 2014. Report to the Australian Fisheries Management Authority, Project 2006/828. CSIRO. Brisbane. 32 p.</p>		
OVERALL PERFORMANCE INDICATOR SCORE:				80
CONDITION NUMBER (if relevant):				

White banana prawns (*Fenneropenaeus merguensis*);

Evaluation Table for PI 1.1.3

PI 1.1.3		Where the stock is depleted, there is evidence of stock rebuilding within a specified timeframe		
Scoring Issue		SG 60	SG 80	SG 100
a	Guide post	Where stocks are depleted rebuilding strategies, which have a reasonable expectation of success, are in place.		Where stocks are depleted, strategies are demonstrated to be rebuilding stocks continuously and there is strong evidence that rebuilding will be complete within the specified timeframe.
	Met?	(Y/N)		(Y/N)
	Justification	[Note: Insert as much text as required to justify the SG level achieved for this scoring issue]		
b	Guide post	A rebuilding timeframe is specified for the depleted stock that is the shorter of 30 years or 3 times its generation time. For cases where 3 generations is less than 5 years, the rebuilding timeframe is up to 5 years.	A rebuilding timeframe is specified for the depleted stock that is the shorter of 20 years or 2 times its generation time. For cases where 2 generations is less than 5 years, the rebuilding timeframe is up to 5 years.	The shortest practicable rebuilding timeframe is specified which does not exceed one generation time for the depleted stock.
	Met?	(Y/N)	(Y/N)	(Y/N)
	Justification	[Note: Insert as much text as required to justify the SG level achieved for this scoring issue]		
c	Guide post	Monitoring is in place to determine whether the rebuilding strategies are effective in rebuilding the stock within a specified timeframe.	There is evidence that they are rebuilding stocks, or it is highly likely based on simulation modelling or previous performance that they will be able to rebuild the stock within a specified timeframe.	
	Met?	(Y/N)	(Y/N)	
	Justification			
References				

PI 1.1.3	Where the stock is depleted, there is evidence of stock rebuilding within a specified timeframe	
OVERALL PERFORMANCE INDICATOR SCORE:		NA
CONDITION NUMBER (if relevant):		

White banana prawns (*Fenneropenaeus merguensis*);

Evaluation Table for PI 1.2.1

PI 1.2.1		There is a robust and precautionary harvest strategy in place		
Scoring Issue		SG 60	SG 80	SG 100
a	Guide post	The harvest strategy is expected to achieve stock management objectives reflected in the target and limit reference points.	The harvest strategy is responsive to the state of the stock and the elements of the harvest strategy work together towards achieving management objectives reflected in the target and limit reference points.	The harvest strategy is responsive to the state of the stock and is designed to achieve stock management objectives reflected in the target and limit reference points.
	Met?	Y	Y	Y
	Justification	<p>The operational objective is to allow sufficient escapement from the fishery to ensure an adequate spawning biomass of banana prawns (based on historical data) and, within this parameter, maximize the economic return from the fishery and also to minimize the catch of tiger prawns in the first four weeks of the banana prawn season.</p> <p>The HS is based on:</p> <ol style="list-style-type: none"> 1. Banana prawn catch and catch per unit effort 2. Reported industry data on catches for weeks 4 & 5; 6 & 7; 8 & 9 of the season 3. Tiger prawn incidental catch trigger of 6.6 tonnes/week <p>These measures are responsive to the state of the stock and the elements of the harvest strategy work together towards achieving management objectives reflected in the surrogate target and limit reference points. SG60, SG80 and SG100 requirements are met.</p>		
b	Guide post	The harvest strategy is likely to work based on prior experience or plausible argument.	The harvest strategy may not have been fully tested but evidence exists that it is achieving its objectives.	The performance of the harvest strategy has been fully evaluated and evidence exists to show that it is achieving its objectives including being clearly able to maintain stocks at target levels.
	Met?	Y	Y	N

PI 1.2.1		There is a robust and precautionary harvest strategy in place		
	Justification	Venables <i>et al.</i> (2011) has evaluated stock recruitment patterns relative to rainfall and this has been reviewed in the context of the Banana prawn harvest strategy. Both the past history of catches and analyses of residuals have shown that the control rules used have been effective. Even in the years where there have been very poor catches in some areas, the rebound in the catch would indicate that the banana prawn fishery is resilient. Recent analyses have also shown that the catch rate at the end of the season is now higher than in earlier years, providing evidence that the escapement (biomass and number of prawns remaining at the end of the banana prawn fishing season (in April/May)) has increased in recent years (MRAG, 2012). Buckworth <i>et al.</i> (2013) evaluates the performance of the harvest strategy in comparison with a total allowable catch approach. SG60 and SG80 requirements are met.		
c	Guide post	Monitoring is in place that is expected to determine whether the harvest strategy is working.		
	Met?	Y		
	Justification	There is a high level of monitoring and data collection for the NPF. There is an ongoing assessment program to evaluate how the harvest strategy is working.		
d	Guide post			The harvest strategy is periodically reviewed and improved as necessary.
	Met?			Y
	Justification	The harvest strategy is reviewed regularly by NPRAG. Venables <i>et al.</i> (2011) has evaluated stock recruitment patterns relative to rainfall and this has been reviewed in the context of the Banana prawn harvest strategy. Dichmont <i>et al.</i> (2014) provides a review of the harvest strategy for the fishery. SG100 is met.		
e	Guide post	It is likely that shark finning is not taking place.	It is highly likely that shark finning is not taking place.	There is a high degree of certainty that shark finning is not taking place.
	Met?	Not relevant	Not relevant	Not relevant
	Justification	Sharks are not a target species.		
References		<p>Buckworth, R.C., Ellis, N., Zhou, S., Pascoe, S., Deng, R.A., Hill, F.G. and O'Brien, M. (2013). Comparison of TAC and current management for the White Banana Prawn fishery of the Northern Prawn Fishery. Final Report for Project RR2012/0812 to the Australian Fisheries Management Authority, June 2013.</p> <p>Dichmont, C.M., Jarrett, A., Hill, F., and Brown, M. (2014). Harvest Strategy for the Northern Prawn Fishery under Input Controls 2014. Report to the Australian Fisheries Management Authority, Project 2006/828. CSIRO. Brisbane. 32 p.</p> <p>MRAG (2012), MSC Assessment Report for Public Certification Report for Australian Northern Prawn Fishery, Brown tiger prawn (<i>Penaeus esculentus</i>) Grooved tiger prawn (<i>P. semisulcatus</i>) Blue endeavour prawn (<i>Metapenaeus endeavouri</i>) Red endeavour prawn (<i>M. ensis</i>) White banana prawn (<i>Fenneropenaeus merguensis</i>); Red-legged banana prawn (<i>F.</i></p>		

PI 1.2.1	There is a robust and precautionary harvest strategy in place			
	<i>indicus</i>) Twin, triple and quad otter trawl, Public Certification Report. MRAG Americas, November 2012, 399pp. Venables, W.N., Hutton, T., Lawrence, E., Rothlisberg, P., Buckworth, R., Hartcher, M., Kenyon, R. (2011). Prediction of common banana prawn potential catch in Australia's Northern Prawn Fishery. AFMA Project.			
OVERALL PERFORMANCE INDICATOR SCORE:				85
CONDITION NUMBER (if relevant):				

White banana prawns (*Fenneropenaeus merguensis*);

Evaluation Table for PI 1.2.2

PI 1.2.2		There are well defined and effective harvest control rules in place		
Scoring Issue		SG 60	SG 80	SG 100
a	Guide post	Generally understood harvest rules are in place that are consistent with the harvest strategy and which act to reduce the exploitation rate as limit reference points are approached.	Well defined harvest control rules are in place that are consistent with the harvest strategy and ensure that the exploitation rate is reduced as limit reference points are approached.	
	Met?	Y	Y	
	Justification	A detailed set of harvest control rules is in place that are consistent with the MEY-based harvest strategy (Dichmont <i>et al.</i> , 2014) (see Section 3.3.9 of the report). The banana prawn fishery is managed by a fixed length season, with some in-season management aimed primarily at allowing a maximum season length in highly productive years, and reducing the season length in years of low production. The season is closed when catch rates fall below a trigger level associated with permitting sufficient prawns to escape to ensure an adequate spawning biomass for subsequent recruitment (based on an analysis of historical data, Dichmont et al., 2012b). In addition, the trigger is designed to achieve an economic outcome by closing fishing when catch rates fall below uneconomic levels.		
b	Guide post		The selection of the harvest control rules takes into account the main uncertainties.	The design of the harvest control rules takes into account a wide range of uncertainties.
	Met?		Y	N
	Justification	The annual recruitment of the white banana prawns is driven by environmental conditions (rainfall and catchment basin runoff). The harvest strategy and harvest control rules takes into account the highly variable nature of the stock. To the extent possible under input controls, the selection of the harvest control rules takes into account the main uncertainties. This is		

PI 1.2.2		There are well defined and effective harvest control rules in place		
		implemented through close monitoring of catch rates from the fishery and closure of the fishery when trigger levels are met. The trigger limits ensure sufficient escapement to protect the spawning stock biomass. SG80 is met.		
c	Guide post	There is some evidence that tools used to implement harvest control rules are appropriate and effective in controlling exploitation.	Available evidence indicates that the tools in use are appropriate and effective in achieving the exploitation levels required under the harvest control rules.	Evidence clearly shows that the tools in use are effective in achieving the exploitation levels required under the harvest control rules.
	Met?	Y	Y	N
	Justification	The history of the fishery shows that the tools in place have been effective. Even in the years where there have been very poor catches in some areas, the rebound in the catch would indicate that the banana prawn fishery is resilient. The MEY-based rules adopted since 2013 further strengthen the management of the fishery and are likely to improve the effectiveness of management measures. SG60 and SG80 are met.		
References		<p>Dichmont, C.M., Jarrett, A., Hill, F., and Brown, M. (2014). Harvest Strategy for the Northern Prawn Fishery under Input Controls 2014. Report to the Australian Fisheries Management Authority, Project 2006/828. CSIRO. Brisbane. 32 p.</p> <p>Dichmont, C.M., Jarrett, A., Hill, F., and Brown, M. (2012b). Harvest Strategy for the Northern Prawn Fishery under Input Controls 2012. Report to the Australian Fisheries Management Authority, Project 2006/828. CSIRO. Brisbane. 32 p.</p>		
OVERALL PERFORMANCE INDICATOR SCORE:				80
CONDITION NUMBER (if relevant):				

White banana prawns (*Fenneropenaeus merguensis*);

Evaluation Table for PI 1.2.3

PI 1.2.3		Relevant information is collected to support the harvest strategy		
Scoring Issue		SG 60	SG 80	SG 100
a	Guide post	Some relevant information related to stock structure, stock productivity and fleet composition is available to support the harvest strategy.	Sufficient relevant information related to stock structure, stock productivity, fleet composition and other data is available to support the harvest strategy.	A comprehensive range of information (on stock structure, stock productivity, fleet composition, stock abundance, fishery removals and other information such as environmental information), including some that may not be directly related to the current harvest strategy, is available.

PI 1.2.3		Relevant information is collected to support the harvest strategy		
	Met?	Y	Y	Y
	Justification	<p>A comprehensive data collection program has been established for the NPF to ensure reliable information is available on which to base management decisions. This includes fishery independent surveys, daily catch and effort logbooks, seasonal landing returns, VMS data and economic surveys. The NPF also has a crew member observer programme and a scientific observer programme.</p> <p>Real time monitoring is used during the fishing season to feed the observed catch rate data into the closure options under the HS. SG60, SG80 and SG100 requirements are met.</p>		
b	Guide post	Stock abundance and fishery removals are monitored and at least one indicator is available and monitored with sufficient frequency to support the harvest control rule.	Stock abundance and fishery removals are regularly monitored at a level of accuracy and coverage consistent with the harvest control rule, and one or more indicators are available and monitored with sufficient frequency to support the harvest control rule.	All information required by the harvest control rule is monitored with high frequency and a high degree of certainty, and there is a good understanding of inherent uncertainties in the information [data] and the robustness of assessment and management to this uncertainty.
	Met?	Y	Y	N
	Justification	<p>The information collected is used in the real-time HS decision making process that determines the appropriate length of the season to achieve MEY. A well-established research program has examined uncertainties in the data. There is a good understanding of uncertainties in the information and the harvest strategy has been tested using management strategy evaluation. There is no formal assessment of stock status. SG60 and SG80 requirements are met.</p>		
c	Guide post		There is good information on all other fishery removals from the stock.	
	Met?		Y	
	Justification	There is good information on all fishery removals from the stock. SG80 is met.		
References		Dichmont, C.M., Jarrett, A., Hill, F., and Brown, M. (2014). Harvest Strategy for the Northern Prawn Fishery under Input Controls 2014. Report to the Australian Fisheries Management Authority, Project 2006/828. CSIRO. Brisbane. 32 p.		
OVERALL PERFORMANCE INDICATOR SCORE:				90

White banana prawns (*Fenneropenaeus merguensis*);

Evaluation Table for PI 1.2.4

PI 1.2.4		There is an adequate assessment of the stock status		
Scoring Issue		SG 60	SG 80	SG 100
a	Guide post		The assessment is appropriate for the stock and for the harvest control rule.	The assessment is appropriate for the stock and for the harvest control rule and takes into account the major features relevant to the biology of the species and the nature of the fishery.
	Met?		Y	N
	Justification	There is no formal assessment of the stock status but the harvest strategy (HS) is informed by real-time recording of catch rates at intervals throughout the banana prawn season. The harvest strategy control rules are appropriate to the stock and the level of monitoring supports this approach. SG80 requirements are met.		
b	Guide post	The assessment estimates stock status relative to reference points.		
	Met?	Y		
	Justification	Because of the environmentally driven inter-annual variability there are no formal biomass reference points. The harvest strategy is based on trigger level reference points based on catch rates from the fishery. There is comprehensive monitoring of the fishery to support the MEY harvest strategy based largely on up-to-date catch rate information. SG60 is met.		
c	Guide post	The assessment identifies major sources of uncertainty.	The assessment takes uncertainty into account.	The assessment takes into account uncertainty and is evaluating stock status relative to reference points in a probabilistic way.
	Met?	Y	Y	N
	Justification	The degree of historical knowledge of the fishery and the high level of monitoring accounts for uncertainty. Stock status is not evaluated relative to formal reference points. SG60 and SG80 are met.		
d	Guide post			The assessment has been tested and shown to be robust. Alternative hypotheses and assessment approaches have been rigorously explored.
	Met?			N
	Justification	The harvest strategy for management of the fishery has been subject to management strategy evaluation. However, there is no formal stock assessment and SG100 is not met.		
e	Guide post		The assessment of stock status is subject to peer review.	The assessment has been internally and externally peer reviewed.

PI 1.2.4		There is an adequate assessment of the stock status		
	Met?		Y	N
	Justification	The fishery performance is regularly reviewed by NPRAG and by internal CSIRO processes. Annual status reports also review the assessment and report on current status of the stock (Patterson <i>et al.</i> , 2016) This review process meets the SG80 but is considered by the assessment team to be predominantly an internal process.		
References		<p>Dichmont, C.M., Jarrett, A., Hill, F., and Brown, M. (2014). Harvest Strategy for the Northern Prawn Fishery under Input Controls 2014. Report to the Australian Fisheries Management Authority, Project 2006/828. CSIRO. Brisbane. 32 p.</p> <p>Vance, D. J., Haywood, M. D., Heales, D. S., Kenyon, R. A., & Loneragon, N. R. (1998). Seasonal and annual variation in abundance of postlarval and juvenile banana prawns, <i>Penaeus merguensis</i>, and environmental variation in two estuaries in tropical North-eastern Australia: a six-year study. Marine ecology Progress Series 163, 21-36.</p> <p>Venables, W., Hutton, T., Lawrence, E., Rothlisberg, P., Buckworth, R., Hartcher, M. and Kenyon, R. (2011). Predictions of common banana prawn potential catch in Australia's Northern Prawn Fishery. Canberra, Australia: Australian Fisheries Management Authority.</p>		
OVERALL PERFORMANCE INDICATOR SCORE:				80
CONDITION NUMBER (if relevant):				

Red-legged banana prawns (*Fenneropenaeus indicus*)

Evaluation Table for PI 1.1.1

PI 1.1.1		The stock is at a level which maintains high productivity and has a low probability of recruitment overfishing		
Scoring Issue		SG 60	SG 80	SG 100
a	Guide post	It is likely that the stock is above the point where recruitment would be impaired.	It is highly likely that the stock is above the point where recruitment would be impaired.	There is a high degree of certainty that the stock is above the point where recruitment would be impaired.
	Met?	Y	Y	N
	Justification	The most recent accepted assessment for the stock was undertaken in 2015 (Buckworth <i>et al.</i> , 2015b), and includes data up to and including 2014. Although there are wide confidence intervals on the estimate of spawning biomass, the 2015 assessment indicates that the stock is well above the point of recruitment impairment. The estimate of spawning stock biomass in 2014 was approximately 3.2 times the S_{MSY} , i.e. well above the LRP of $0.5 S_{MSY}$. The LRP is that there be no fishing if spawning biomass falls below $0.5 S_{MSY}$ two years in a row. Low catches and effort in 2015 resulted in the 2016 update of the assessment not being able to provide reliable estimates of stock status (Plagányi <i>et al.</i> , 2016). Despite this, the previous assessment suggests that it is highly likely that the stock is above the point where recruitment would be impaired. SG60 and SG80 are met.		
b	Guide post		The stock is at or fluctuating around its target reference point.	There is a high degree of certainty that the stock has been fluctuating around its target reference point, or has been above its target reference point, over recent years.
	Met?		Y	N
	Justification	The most recent accepted assessment for the stock was undertaken in 2015 (Buckworth <i>et al.</i> , 2015b), and includes data up to and including 2014. Since the mid-2000s, spawning biomass has been near the B_{MEY} level (Figure 12). The spawning biomass level at the end of 2014 is estimated to have been well above B_{MSY} and B_{MEY} . The estimate of spawning stock biomass in 2014 was approximately 2.7 times the S_{MEY} , i.e. well above the TRP of S_{MEY} . Low catches and effort in 2015 resulted in the assessment model not being able to provide reliable estimates of stock status. The wide 90% confidence intervals highlight the large uncertainty associated with model estimates of spawning biomass and its position relative to the TRP of S_{MEY} . SG80 requirements are met.		
References		<p>Buckworth, R.C., Plagányi, E.É., Upston, J., Deng, R.A., Miller, M. & Hutton, T. (2015b). Assessment of the Joseph Bonaparte Gulf red-legged banana prawn (<i>Penaeus indicus</i>) fishery to 2014, with TAE recommendations for 2015, report to the Northern Prawn Resource Assessment Group, AFMA research project 2013/0005, CSIRO, Brisbane.</p> <p>Plagányi, É., Miller, M., Upston, J., Moeseneder, C., Weeks, S., Kenyon, R., Hutton, T. Deng, R., Dennis, D. and Buckworth, R. (2016). Summary of the 2015 Joseph Bonaparte Gulf Red-legged Banana Prawn (<i>Penaeus indicus</i>) Fishery performance. Report to the Australian Fisheries Management Authority, September 2016. CSIRO. Brisbane.</p>		

PI 1.1.1	The stock is at a level which maintains high productivity and has a low probability of recruitment overfishing		
Stock Status relative to Reference Points			
	Type of reference point	Value of reference point	Current stock status relative to reference point
Target reference point	S _{MEY}	S ₂₀₁₄ /S _{MEY} > 100%	S ₂₀₁₅ /S _{MEY} = 269%
Limit reference point	0.5S _{MSY} (over 2 most recent years)	S ₂₀₁₄ /S _{MSY} > 50%	S ₂₀₁₄ = 323%
OVERALL PERFORMANCE INDICATOR SCORE:			80
CONDITION NUMBER (if relevant):			

Red-legged banana prawns (*Fenneropenaeus indicus*)

Evaluation Table for PI 1.1.2

PI 1.1.2	Limit and target reference points are appropriate for the stock		
Scoring Issue	SG 60	SG 80	SG 100
a	Guide post	Generic limit and target reference points are based on justifiable and reasonable practice appropriate for the species category.	Reference points are appropriate for the stock and can be estimated.
	Met?	Y	Y
	Justification	The red-legged banana prawn subfishery is managed in conjunction with the white banana prawn and the tiger prawn sub-fisheries. Reference points adopted are consistent with the Commonwealth Harvest Strategy Policy and are similar to those accepted for the two species of tiger prawns and the blue endeavour prawn (the LRP is $0.5 \times S_{MSY}$ over the two most recent years and the TRP is the proxy for $S_{MEY} = 1.2 \times S_{MSY}$). The assessment model computed that the LRP of $0.5B_{MSY}$ was equal to 390 kg/day. The reference points are appropriate for the stock and can be estimated. SG60 and SG80 are met.	
b	Guide post	The limit reference point is set above the level at which there is an appreciable risk of	The limit reference point is set above the level at which there is an appreciable risk of impairing reproductive capacity following

PI 1.1.2		Limit and target reference points are appropriate for the stock		
			impairing reproductive capacity.	consideration of precautionary issues.
	Met?		Y	N
	Justification	There is a limit reference point that S_Y/S_{MSY} over 2 most recent years = 0.5. Previous assessment indicates that the stock has only dropped below the LRP once, during the years 1997-1999 (Dichmont <i>et al.</i> , 2014), but the spawning biomass has increased consistently since then SG80 is met.		
c	Guide post		The target reference point is such that the stock is maintained at a level consistent with B_{MSY} or some measure or surrogate with similar intent or outcome.	The target reference point is such that the stock is maintained at a level consistent with B_{MSY} or some measure or surrogate with similar intent or outcome, or a higher level, and takes into account relevant precautionary issues such as the ecological role of the stock with a high degree of certainty.
	Met?		Y	N
	Justification	The target reference point is to maintain spawning biomass at MEY. This is consistent with maintaining the stock at B_{MSY} . SG80 is met but SG100 is not.		
d	Guide post		For key low trophic level stocks, the target reference point takes into account the ecological role of the stock.	
	Met?		Not relevant	
	Justification	Red-legged banana prawn is not considered a low trophic level species.		
References		<p>Buckworth, R.C., Plagányi, E.É., Upston, J., Deng, R.A., Miller, M. & Hutton, T. (2015). Assessment of the Joseph Bonaparte Gulf red-legged banana prawn (<i>Penaeus indicus</i>) fishery to 2014, with TAE recommendations for 2015, report to the Northern Prawn Resource Assessment Group, AFMA research project 2013/0005, CSIRO, Brisbane.</p> <p>Dichmont, C.M., Jarrett, A., Hill, F., and Brown, M. (2014). Harvest Strategy for the Northern Prawn Fishery under Input Controls 2014. Report to the Australian Fisheries Management Authority, Project 2006/828. CSIRO. Brisbane. 32 p.</p>		
OVERALL PERFORMANCE INDICATOR SCORE:				80
CONDITION NUMBER (if relevant):				

Red-legged banana prawns (*Fenneropenaeus indicus*)

Evaluation Table for PI 1.1.3

PI 1.1.3		Where the stock is depleted, there is evidence of stock rebuilding within a specified timeframe		
Scoring Issue		SG 60	SG 80	SG 100
a	Guide post	Where stocks are depleted rebuilding strategies, which have a reasonable expectation of success, are in place.		Where stocks are depleted, strategies are demonstrated to be rebuilding stocks continuously and there is strong evidence that rebuilding will be complete within the specified timeframe.
	Met?	(Y/N)		(Y/N)
	Justification	[Note: Insert as much text as required to justify the SG level achieved for this scoring issue]		
b	Guide post	A rebuilding timeframe is specified for the depleted stock that is the shorter of 30 years or 3 times its generation time. For cases where 3 generations is less than 5 years, the rebuilding timeframe is up to 5 years.	A rebuilding timeframe is specified for the depleted stock that is the shorter of 20 years or 2 times its generation time. For cases where 2 generations is less than 5 years, the rebuilding timeframe is up to 5 years.	The shortest practicable rebuilding timeframe is specified which does not exceed one generation time for the depleted stock.
	Met?	(Y/N)	(Y/N)	(Y/N)
	Justification	[Note: Insert as much text as required to justify the SG level achieved for this scoring issue]		
c	Guide post	Monitoring is in place to determine whether the rebuilding strategies are effective in rebuilding the stock within a specified timeframe.	There is evidence that they are rebuilding stocks, or it is highly likely based on simulation modelling or previous performance that they will be able to rebuild the stock within a specified timeframe.	
	Met?	(Y/N)	(Y/N)	
	Justification			
References				
OVERALL PERFORMANCE INDICATOR SCORE:				NA
CONDITION NUMBER (if relevant):				

Red-legged banana prawns (*Fenneropenaeus indicus*)

Evaluation Table for PI 1.2.1

PI 1.2.1		There is a robust and precautionary harvest strategy in place		
Scoring Issue		SG 60	SG 80	SG 100
a	Guide post	The harvest strategy is expected to achieve stock management objectives reflected in the target and limit reference points.	The harvest strategy is responsive to the state of the stock and the elements of the harvest strategy work together towards achieving management objectives reflected in the target and limit reference points.	The harvest strategy is responsive to the state of the stock and is designed to achieve stock management objectives reflected in the target and limit reference points.
	Met?	Y	Y	Y
	Justification	<p>Since the initial MSC assessment of the NPF a formal HS has been adopted for red-legged banana prawns. The HS is based on input controls and compliant with the Commonwealth of Australia's Legislative requirements. It is aimed at realizing the objectives of the NPF Management Plan 1995 that includes "Ensure the utilization of the fishery resources is consistent with the principles of ecologically sustainable development and the exercise of the precautionary principle." The operational objective of the HS is to attain long-term maximum economic yield (MEY). The HS includes:</p> <ol style="list-style-type: none"> 1. Indicators (data from the fishery) 2. Monitoring (agreed protocols to get data) 3. Reference points (target and limit) 4. Decision rules (agreed rules for setting input controls) <p>The HS is designed to be responsive to the state of the stock and achieve objectives reflected in the target and limit reference points. SG60, SG80 and SG100 requirements are met.</p>		
b	Guide post	The harvest strategy is likely to work based on prior experience or plausible argument.	The harvest strategy may not have been fully tested but evidence exists that it is achieving its objectives.	The performance of the harvest strategy has been fully evaluated and evidence exists to show that it is achieving its objectives including being clearly able to maintain stocks at target levels.
	Met?	Y	Y	N
	Justification	The HS has been tested using the NPF Management Strategy Evaluation (Dichmont <i>et al.</i> , 2014). The 2015 assessment indicated increasing spawning biomass levels in recent years (Buckworth <i>et al.</i> , 2015b), meeting SG60 and SG80 requirements. However, the level of uncertainty in the assessment prevents SG100 being met.		
c	Guide post	Monitoring is in place that is expected to determine whether the harvest strategy is working.		

PI 1.2.1		There is a robust and precautionary harvest strategy in place		
	Met?	Y		
	Justification	The information gathered is described in Section 3.3.10 of the report. A comprehensive data collection program (fishery dependent and fishery independent) has been established for the NPF to ensure reliable information is available on which to base management decisions. Information is maintained on all target prawn species taken in the NPF. There is an ongoing assessment program to evaluate how the harvest strategy is working. SG60 is met.		
d	Guide post			The harvest strategy is periodically reviewed and improved as necessary.
	Met?			Y
	Justification	There is ongoing examination of the HS and improvements are made as required. There have been several adjustments to the HS since its adoption, most recently in 2014. Detailed information on review processes is given at PI 3.2.5. SG100 is met.		
e	Guide post	It is likely that shark finning is not taking place.	It is highly likely that shark finning is not taking place.	There is a high degree of certainty that shark finning is not taking place.
	Met?	Not relevant	Not relevant	Not relevant
	Justification	Sharks are not a target species.		
References		<p>Buckworth, R.C., Plagányi, E.É., Upston, J., Deng, R.A., Miller, M. & Hutton, T. (2015b). Assessment of the Joseph Bonaparte Gulf red-legged banana prawn (<i>Penaeus indicus</i>) fishery to 2014, with TAE recommendations for 2015, report to the Northern Prawn Resource Assessment Group, AFMA research project 2013/0005, CSIRO, Brisbane.</p> <p>Dichmont, C.M., Jarrett, A., Hill, F., and Brown, M. (2014). Harvest Strategy for the Northern Prawn Fishery under Input Controls 2014. Report to the Australian Fisheries Management Authority, Project 2006/828. CSIRO. Brisbane. 32 p.</p>		
OVERALL PERFORMANCE INDICATOR SCORE:				90
CONDITION NUMBER (if relevant):				

Red-legged banana prawns (*Fenneropenaeus indicus*)

Evaluation Table for PI 1.2.2

PI 1.2.2		There are well defined and effective harvest control rules in place		
Scoring Issue	SG 60	SG 80	SG 100	

PI 1.2.2		There are well defined and effective harvest control rules in place			
a	Guide post	Generally understood harvest rules are in place that are consistent with the harvest strategy and which act to reduce the exploitation rate as limit reference points are approached.	Well defined harvest control rules are in place that are consistent with the harvest strategy and ensure that the exploitation rate is reduced as limit reference points are approached.		
	Met?	Y	Y		
	Justification	The harvest strategy contains a comprehensive set of control rules that feed into HS actions, including no target fishing if the LRP is triggered as well as changes to fishing effort to achieve MEY through the use of spatial and temporal closures and gear modifications. The control rules are described in Box 3. The LRP is implemented as a 390kg/day trigger, which if met, results in closure of the fishery. SG60 and SG80 are met.			
b	Guide post		The selection of the harvest control rules takes into account the main uncertainties.	The design of the harvest control rules takes into account a wide range of uncertainties.	
	Met?		N	N	
	Justification	The control rules were part of the MSE reported in 1.2.1 that includes testing of the design of the rules. However, there is a higher level of uncertainty in the red-legged banana prawn assessment than for tiger prawns. NPRAG (2016a) has indicated that further consideration of the appropriateness of the HS in years of low fishing effort is needed. The implication of the low catches and catch rates of red-legged prawns in JBG in 2015 and 2016 for the harvest control rules requires further investigation.			
c	Guide post	There is some evidence that tools used to implement harvest control rules are appropriate and effective in controlling exploitation.	Available evidence indicates that the tools in use are appropriate and effective in achieving the exploitation levels required under the harvest control rules.	Evidence clearly shows that the tools in use are effective in achieving the exploitation levels required under the harvest control rules.	
	Met?	Y	N	N	
	Justification	Recent assessment has indicated improving levels of spawning biomass. However, the low catches and catch rates in 2015 and 2016 require further investigation to determine whether the tools in place are effective in achieving appropriate exploitation levels. SG60 requirements are met.			
References		Dichmont, C.M., Jarrett, A., Hill, F., and Brown, M. (2014). Harvest Strategy for the Northern Prawn Fishery under Input Controls 2014. Report to the Australian Fisheries Management Authority, Project 2006/828. CSIRO. Brisbane. 32 p.			
OVERALL PERFORMANCE INDICATOR SCORE:					65
CONDITION NUMBER (if relevant):					3

Red-legged banana prawns (*Fenneropenaeus indicus*)

Evaluation Table for PI 1.2.3

PI 1.2.3		Relevant information is collected to support the harvest strategy		
Scoring Issue		SG 60	SG 80	SG 100
a	Guide post	Some relevant information related to stock structure, stock productivity and fleet composition is available to support the harvest strategy.	Sufficient relevant information related to stock structure, stock productivity, fleet composition and other data is available to support the harvest strategy.	A comprehensive range of information (on stock structure, stock productivity, fleet composition, stock abundance, fishery removals and other information such as environmental information), including some that may not be directly related to the current harvest strategy, is available.
	Met?	Y	Y	N
	Justification	A comprehensive data collection program has been established for the NPF to ensure reliable information is available on which to base management decisions. For red-legged banana prawns, this includes daily catch and effort logbooks, seasonal landing returns, VMS data and economic surveys. The NPF also has a crew member observer programme and a scientific observer programme. There are no fishery-independent surveys undertaken in Joseph Bonaparte Gulf. SG60 and SG80 requirements are met.		
b	Guide post	Stock abundance and fishery removals are monitored and at least one indicator is available and monitored with sufficient frequency to support the harvest control rule.	Stock abundance and fishery removals are regularly monitored at a level of accuracy and coverage consistent with the harvest control rule, and one or more indicators are available and monitored with sufficient frequency to support the harvest control rule.	All information required by the harvest control rule is monitored with high frequency and a high degree of certainty, and there is a good understanding of inherent uncertainties in the information [data] and the robustness of assessment and management to this uncertainty.
	Met?	Y	Y	N
	Justification	The information collected is used in the regular stock assessments, and fed in real time into the HS decision making process that determines the length of closures and the appropriate fishing effort level to achieve the TRP. A well-established research program has examined uncertainties in the data. There is a good understanding of uncertainties in the information. The assessment is not as robust as the assessment of the tiger prawn subfishery. SG60 and SG80 requirements are met.		
c	Guide post		There is good information on all other fishery removals from the stock.	

PI 1.2.3		Relevant information is collected to support the harvest strategy		
	Met?		Y	
	Justification	The client vessels are the only prawn trawlers operating across the region and catches from the fishery are representative of total removals. SG80 is met.		
References		Dichmont, C.M., Jarrett, A., Hill, F., and Brown, M. (2014). Harvest Strategy for the Northern Prawn Fishery under Input Controls 2014. Report to the Australian Fisheries Management Authority, Project 2006/828. CSIRO. Brisbane. 32 p.		
OVERALL PERFORMANCE INDICATOR SCORE:				80

Red-legged banana prawns (*Fenneropenaeus indicus*)

Evaluation Table for PI 1.2.4

PI 1.2.4		There is an adequate assessment of the stock status		
Scoring Issue		SG 60	SG 80	SG 100
a	Guide post		The assessment is appropriate for the stock and for the harvest control rule.	The assessment is appropriate for the stock and for the harvest control rule and takes into account the major features relevant to the biology of the species and the nature of the fishery.
	Met?		Y	N
	Justification	<p>Red-legged banana prawns are assessed using a quarterly “age-based” biological model based on weekly catch and effort data starting in 1980. The assessment takes into account main uncertainties. However, because there is no pre-season survey, the assessment relies on CPUE data only and the standardisation of these data may be less reliable than that applied to the other species which have been subject to longer and more in-depth analyses, especially in the interpretation of catch rates. The assessment is appropriate for the stock and for the harvest control rule. SG80 is met.</p> <p>The modelling is carried out by CSIRO under contract from the Australian Fisheries Management Authority. It is conducted by a team of data, information and stock assessment specialists including part-time input from a world- renowned expert from the University of Washington. Modelling results are then reviewed by the Northern Prawn Research Advisory Group (NPFRAG) comprised of scientists, economist, fishery managers, fishing representatives, and environmentalists. Peer-group review of the actual assessments is provided by two independent stock assessment experts in the RAG. Sensitivity tests have been carried out that indicate relative robustness to assumptions and different types of assessment techniques. These are taken into account in assessing stock status.</p>		

PI 1.2.4		There is an adequate assessment of the stock status		
b	Guide post	The assessment estimates stock status relative to reference points.		
	Met?	Y		
	Justification	As indicated in Section 3.3.7 of the report, the assessment estimates stock status relative to the spawning biomass reference points required for the HS. SG60 is met.		
c	Guide post	The assessment identifies major sources of uncertainty.	The assessment takes uncertainty into account.	The assessment takes into account uncertainty and is evaluating stock status relative to reference points in a probabilistic way.
	Met?	Y	Y	Y
	Justification	Details of the uncertainties examined in the assessment are provided in Buckworth <i>et al.</i> (2015b). The assessment estimates confidence intervals on the population estimates it derives. Confidence intervals on the spawning biomass estimates are provided in Figure 12. SG100 is met.		
d	Guide post			The assessment has been tested and shown to be robust. Alternative hypotheses and assessment approaches have been rigorously explored.
	Met?			N
	Justification	There has been a management strategy evaluation of the harvest strategy. However, there is uncertainty in the underlying data leading to a lack of robustness in the assessment. Because there is no pre-season survey, the assessment relies on CPUE data only and the standardisation of these data may be less reliable than that applied to the other species which have been subject to longer and more in-depth analyses. SG100 is not met.		
e	Guide post		The assessment of stock status is subject to peer review.	The assessment has been internally and externally peer reviewed.
	Met?		Y	N
	Justification	The assessment is regularly reviewed by NPRAG and by internal CSIRO processes. Annual status reports also review the assessment and report on current status of the stock (Patterson <i>et al.</i> , 2016) This review process meets the SG80 but is considered by the assessment team to be predominantly an internal process.		
References		<p>Buckworth, R.C., Plagányi, E.É., Upston, J., Deng, R.A., Miller, M. & Hutton, T. (2015b). Assessment of the Joseph Bonaparte Gulf red-legged banana prawn (<i>Penaeus indicus</i>) fishery to 2014, with TAE recommendations for 2015, report to the Northern Prawn Resource Assessment Group, AFMA research project 2013/0005, CSIRO, Brisbane.</p> <p>Plagányi, É., Miller, M., Upston, J., Moeseneder, C., Weeks, S., Kenyon, R., Hutton, T. Deng, R., Dennis, D. and Buckworth, R. (2016). Summary of the 2015 Joseph Bonaparte Gulf Red-legged Banana Prawn (<i>Penaeus indicus</i>) Fishery performance. Report to the Australian Fisheries Management Authority, September 2016. CSIRO. Brisbane.</p>		

PI 1.2.4	There is an adequate assessment of the stock status	
OVERALL PERFORMANCE INDICATOR SCORE:		85
CONDITION NUMBER (if relevant):		

7.1.2 Principle Two: Ecosystem Impact (P2)

Evaluation Table for PI 2.1.1

PI 2.1.1		The fishery does not pose a risk of serious or irreversible harm to the retained species and does not hinder recovery of depleted retained species							
Scoring Issue		SG 60		SG 80		SG 100			
a	Guide post	Main retained species are likely to be within biologically based limits (if not, go to scoring issue c below).		Main retained species are highly likely to be within biologically based limits (if not, go to scoring issue c below).		There is a high degree of certainty that retained species are within biologically based limits and fluctuating around their target reference points.			
	Met?	Y		Y		Partially			
	Justification	Scoring Elements UoAs	Brown Tiger	Grooved Tiger	Blue Endeavour	Red Endeavour	Red-legged Banana	White Banana	By product
		Brown Tiger		X	X	X	X	X	X
		Grooved Tiger	X		X	X	X	X	X
		Blue Endeavour	X	X		X	X	X	X
		Red Endeavour	X	X	X		X	X	X
		Red-legged Banana	X	X	X	X		X	X
		White Banana	X	X	X	X			X
	<p>Table: Retained species (scoring elements) in each unit of assessment; greyed where species or groups of species percentage contributions $\leq 0.5\%$ to total catch weight. Note: Greyed elements are not scored for Outcome PIs because some cannot have target reference points defined due to very low overlap with the fishery and extremely low catches.</p> <p>The exemption from scoring species with catches under 0.5% was based on CB3.5.4 and CB3.5.3 because of evidence of very low or negligible risk over the period of proposed certification (MSC, 2012, p. C167, please see the response to the peer reviewer A for more information)</p> <p>Most retained species have been identified to species level from logbook data (NPFI, 2016, unpublished) and a byproduct study (Milton <i>et al.</i>, 2010). Some groups (e.g. mixed non-target</p>								

PI 2.1.1	<p>The fishery does not pose a risk of serious or irreversible harm to the retained species and does not hinder recovery of depleted retained species</p>
	<p>prawns <0.01%), with extremely low percentage contribution as a group, could not be identified to species level. Species with 2012-2015 percentage contributions to total catch biomass > 5% were classified as "main". No vulnerable species with percentage contributions between 5% and 2% have been identified in any of the three NPF subfisheries. Where the retained species had very low percentage contributions, <0.5%, the impact of any unit of assessment was considered <i>de minimis</i>. This was based on the species wide distributions outside the fishing areas and on low risk scores identified at Ecological Risk Assessments (ERAs) (Griffiths <i>et al.</i>, 2007, AFMA 2008a, Zhou & Griffiths 2009a, Zhou, 2011). All potentially retained species in the NPF are subject to risk assessments which are periodically updated (next ERA in 2017). Species potentially at risk are listed on a priority list and closely monitored (fishery dependent and independent). None of the species recorded as retained in the last 10 years is currently on the NPF priority list (NPF, 2016, unpublished; Fry <i>et al.</i>, 2015).</p> <p><u>Main Retained Species</u></p> <p>Tiger Prawn Subfishery (4UoAs: brown tiger prawn, grooved tiger prawn, blue endeavour prawn, red endeavour prawn)</p> <p>Grooved tiger prawn (<i>Penaeus semisulcatus</i>) (2011-2015 average = 18%) is a main retained species in the tiger prawn subfishery and assessed as such, within brown tiger prawn (<i>P. esculentus</i>), blue endeavour prawn (<i>Metapenaeus endeavouri</i>) and red endeavour prawn (<i>M. ensis</i>) UoAs. Grooved tiger prawn is a target species in the NPF and managed under the NPF harvest strategy. The outcome for the grooved tiger prawn stock in tiger prawn subfishery is detailed under P1 section of this report. The most recent assessment of the status of grooved tiger prawn (Buckworth <i>et al.</i>, 2016) showed that stock status was above the limit reference point or LRP ($S_{2011-2015}/S_{MSY}=114\%$, $LRP = 0.5S_{MSY}$) and also, above the target reference point or TRP ($S_{2015}/S_{MEY}=171\%$, $TRP = S_{MEY}$). Effort in 2015 was close to the effort at maximum economic yield, E_{MEY} (99%) and to the effort at maximum sustainable yield E_{MSY} (82%) indicating that overfishing is not occurring (Table 4). There is a high degree of certainty that the grooved tiger prawn stock is within its biologically based limits (BBLs) and above its TRP, and the tiger prawn subfishery does not cause serious or irreversible harm. The requirement for this scoring issue is met at SG60, SG80 and SG100 by all three UoAs: brown tiger prawn, blue endeavour prawn and red endeavour prawn.</p> <p>Brown tiger prawn (<i>P. esculentus</i>) (2012-2015 average = 7.2 %) is a main retained species in grooved tiger prawn, blue endeavour prawn and red endeavour prawn UoAs and it is also a target species in the tiger prawn subfishery. The most recent assessment of the status of brown tiger prawn (Buckworth <i>et al.</i>, 2016) showed that stock status was above the LRP ($S_{2011-2015}/S_{MSY}=122\%$, $LRP = 0.5S_{MSY}$) and also above the TRP ($S_{2015}/S_{MEY}=162\%$, $TRP = S_{MEY}$). The fishing effort in 2015 was well below that at E_{MSY} indicating that overfishing is not occurring (Table 3). There is a high degree of certainty that the brown tiger prawn stock is within BBLs and fluctuating around its TRP and the tiger prawn subfishery does not cause serious or irreversible harm. The requirement is met at SG60, SG80 and SG100 by all three UoAs: grooved tiger prawn, blue endeavour prawn and red endeavour prawn.</p> <p>White Banana Prawn Subfishery (one UoA: white banana prawn)</p> <p>There were no main retained species in white banana prawn unit of assessment.</p> <p>Red-Legged Banana Prawn Subfishery (one UoA: red-legged banana prawn)</p> <p>White banana prawn (<i>F. merguiensis</i>) (2012-2015 average = 11.6%) is a main retained species in the red-legged banana prawn subfishery. White banana prawn catch in the red-legged banana subfishery is very low compared to the catch when the species is targeted the overlap between the two banana prawn species distributions being limited (Loneragan <i>et al.</i>, 2002). White banana prawn is managed as target species in the NPF and its outcome is known and understood. The recruitment of white banana prawns is strongly driven by environmental</p>

PI 2.1.1	The fishery does not pose a risk of serious or irreversible harm to the retained species and does not hinder recovery of depleted retained species
	<p>conditions (rainfall and catchment basin runoff) (Vance <i>et al.</i>, 1998). Consequently, it has not been possible to develop a stock assessment model for white banana prawn.</p> <p>Since 1970, catches, have responded as expected to the changes in rainfall, indicating that the stocks of banana prawns have remained at levels above those at which recruitment has been impaired. There is evidence that the escapement (biomass and number of prawns remaining at the end of the banana prawn fishing season (in May/June) has increased in recent years (MRAG, 2012). Based on a consideration of the dynamics of white banana prawns (Figure 10) the stock has fluctuated over the history of the fishery around a highly productive level consistent with B_{MSY} or better.</p> <p>There is a high degree of certainty that white banana prawn is within its biologically based limits and above target reference points and the red-legged banana prawn UoA does not pose a risk of serious or irreversible harm. The requirement is met at SG60, SG80 and SG 100.</p> <p><u>Minor Retained Species</u></p> <p>Minor retained species belong to two categories: (i) species that are managed as target in the NPF HS and (ii) species that are managed as byproduct in the NPF HS.</p> <p>Tiger Prawn Subfishery (four UoAs: brown tiger prawn, grooved tiger prawn, blue endeavour prawn, red endeavour prawn)</p> <p>Blue endeavour prawn (<i>M. endeavouri</i>) (2011-2015 average = 4%) is a minor retained species in brown tiger prawn, groove tiger prawn and red endeavour prawn units of assessment. The most recent stock assessment (Buckworth <i>et al.</i>, 2016) shows that blue endeavour prawn was above the limit reference point ($S_{2011-2015}/S_{MSY}=76\%$, $LRP = 0.5S_{MSY}$) but below the target reference point ($S_{2015}/S_{MEY}=80\%$, $TRP = S_{MEY}$). The stock was depleted for several years in the early 2000s but has been rebuilding since (Figure 7). The species dynamics have shown that it can recover from these levels and the current assessment indicates that the HS is working to allow rebuilding to target levels. There is a high degree of certainty that blue endeavour prawn is within its biologically based limits and around its target reference points. The requirement at is met at SG60, SG80 and SG100.</p> <p>Red endeavour prawn (<i>M. ensis</i>) (2011-2015 average = 2.6%) is a minor retained species in brown tiger prawn, grooved tiger prawn and blue endeavour prawn. No recent stock assessment is available for this species and no target reference point was defined. At the 2007 ERA for target species, red endeavour prawn scored low risk ($PSA=1.94$) from tiger prawn subfishery. The species has a wide Indo-Pacific distribution and prefers deeper habitats (over 35m, in Crocos <i>et al.</i>, 2001), suggesting a limited overlap with the tiger prawn subfishery. The species is protected through harvest controls applied to the other targets in the tiger prawn subfishery and it is monitored within annual NPF prawn monitoring surveys undertaken by CSIRO.</p> <p>It is highly likely that the red endeavour prawn stock is within its BBLs. No target points have been defined, thus it cannot be stated that the species fluctuates around TRPs. The requirement at SG60 and SG80 is met but at not SG100.</p> <p>Red-legged banana prawn (<i>Fenneropenaeus indicus</i>) is a minor species in the tiger prawn subfishery (2011-2015 average contribution= 1.6%). The most recent stock assessment was undertaken in 2015 (Buckworth <i>et al.</i>, 2015b), and includes data up to and including 2014. The estimate of spawning stock biomass in 2014 was approximately 2.7 times the S_{MEY}, i.e. well above the TRP at S_{MEY}. It was also approximately 3.2 times the S_{MSY}, i.e. well above the LRP of $0.5 S_{MSY}$. Low catches and effort in 2015 resulted in the 2016 update of the assessment not being able to provide reliable estimates of stock status (Plagányi <i>et al.</i>, 2016). Despite this, the previous assessment suggests that it is highly likely that the stock is above the point where recruitment would be impaired. Most red-legged banana prawn is caught in Joseph Bonaparte Gulf, where this species is targeted while fishing effort in the tiger prawn subfishery occurs in the Gulf of Carpentaria and north of Arnhem Land, thus the overlap with red-legged banana prawn species distribution is low. There is a high degree of certainty that</p>

PI 2.1.1		The fishery does not pose a risk of serious or irreversible harm to the retained species and does not hinder recovery of depleted retained species		
		<p>tiger prawn subfishery does not pose a risk of serious or irreversible harm to red-legged banana prawn stock and the stock is within BBLs and above its TRP. The requirement is met at SG60, SG80 and SG100.</p> <p>Bugs (<i>Thenus parindicus</i> and <i>T. australiensis</i>) (2011-2015 average = 0.9%) are minor species in the tiger prawn subfishery. Milton <i>et al.</i> (2010) estimated a maximum sustainable catch as the allowable biological catch (ABC), consistent with an exploitation rate at MSY. For bugs, this was 1887t (95%CI lower bound 1716t, upper bound 2057t). In these calculations, the discarded portion of the catch was taken into consideration. For bugs, the discarded catch was estimated as all bugs smaller than 75 mm CW and all berried females (which are legally protected). Discarded bugs usually survive, thus the discarded catch does not substantially contribute to the fishing mortality. The actual retained catch in the NPF tiger prawn subfishery is much lower than the ABC. The ABC refers to the species of bugs combined. This is sufficient to sustainably manage the two bug species because the species composition was predicted to be stable in the catch over the years (Milton <i>et al.</i>, 2010). Data about bug species abundance and distribution continue to be collected during the NPF prawn monitoring surveys and an eventual increase in risk can be identified early enough to inform and adjust the management strategy. At ERA <i>T. parindicus</i> and <i>T. australiensis</i> were assessed as low risk from the NPF tiger prawn subfishery (Griffiths <i>et al.</i>, 2007).</p> <p>There is a high degree of certainty that bugs species stocks are within their BBLs but no target points have been defined, thus it cannot be stated that the species fluctuates around their TRPs. The requirement is met at SG60 and SG80 but not at SG100.</p> <p>White Banana Prawn Subfishery (one UoA: white banana prawn)</p> <p>Due to highly targeted fishing method in this subfishery white banana prawn makes up most of the catch, while the retained species component is very low: 0.6% other NPF target species and 0.07% byproduct species. Each minor retained species in white banana prawn subfishery had percentage contributions <0.5% and the impact from the subfishery was considered <i>de minimis</i>. The requirement is met at SG60, SG80 and SG100 by default.</p> <p>Red-Legged Banana Prawn Subfishery (one UoA: red-legged banana prawn)</p> <p>All minor retained species in red-legged banana prawn UoA contributed in 2012-2015 about 1.2% annual average, with most catch consisting of other NPF targets. Only blue endeavour prawn had a percentage contribution of 0.6%. Blue endeavour prawn is managed sustainably as a target species in the tiger prawn subfishery and the outcome is known and understood. A very small part of the catch is being taken from the JBG in the red-legged banana prawn subfishery. All the other minor retained species had percentage contributions under 0.5% and the impact from the red-legged banana was considered <i>de minimis</i>. There is a high degree of certainty that blue endeavour prawn is within its BBLs and fluctuating around its target reference points. The requirement is met at SG60, SG80 and SG100.</p>		
b	Guide post			Target reference points are defined for retained species.
	Met?			Partially
	Justification	<p>Target reference points consistent with Australia's Harvest Strategy Policy (DAFF, 2007) are defined for brown tiger prawn, grooved tiger prawn, blue endeavour prawn, white banana prawn and red-legged banana prawn as follows:</p> <p>Brown tiger prawn, groove tiger prawn, blue endeavour prawn: the target reference point is S_{MEY} (spawning biomass at MEY). There is also an effort reference point relating to the biomass reference points, E_{MEY} (effort at maximum economic yield). The limit reference point is the average of spawning stock size divided by the spawning stock at MSY over 5 most recent years (S_Y / S_{MSY}) = 0.5. The stock assessment also considers the status of the</p>		

PI 2.1.1		The fishery does not pose a risk of serious or irreversible harm to the retained species and does not hinder recovery of depleted retained species		
		<p>stocks with respect to S_{MSY}, the default MSC TRP. The requirement is met at SG100 by all six UoAs.</p> <p>White banana prawn: Formal target reference points are not possible to be defined for white banana prawn due to species' life history. The surrogate LRP and TRP measures are (i) that there will be sufficient escapement from the subfishery to not jeopardize subsequent recruitment and (ii) that the economic yield is maximized each year within this constraint, thus achieving the maximum average return. Until 2013 there was a surrogate limit reference point catch rate of 500kg/day that was used to shorten the season length. In October 2013, the AFMA Commission adopted the MEY-based catch trigger, calculated in-season, as the new management target. The requirement is met at SG100 in all five UoAs where white banana prawn is retained and not target.</p> <p>Red-legged banana prawn: Reference points adopted are consistent with the Commonwealth Harvest Strategy Policy and are similar to those adopted for the two species of tiger prawns and the blue endeavour prawn (the LRP is $0.5 \times S_{MSY}$ over the two most recent years and the TRP is the proxy for $S_{MEY} = 1.2 \times S_{MSY}$). The requirement is met at SG100 by all five UoAs where red-legged banana prawn is retained and not target.</p> <p>For red endeavour prawn there are no target reference points defined. The requirement is not met at SG100 by any of the UoAs where this species is retained and not target.</p> <p>For bugs, ABC limits were defined but not target reference points. The objective of the NPF management strategy is not to reach a target reference point, and catches of byproduct are not representative of the status of byproduct species stocks. Catches of retained bugs and other byproduct species are very low and managed limit reference points. TRPs are not applicable.</p>		
c	Guide post	If main retained species are outside the limits there are measures in place that are expected to ensure that the fishery does not hinder recovery and rebuilding of the depleted species.	If main retained species are outside the limits there is a partial strategy of demonstrably effective management measures in place such that the fishery does not hinder recovery and rebuilding.	
	Met?	N/A	N/A	
	Justification	Not scored		
d	Guide post	If the status is poorly known there are measures or practices in place that are expected to result in the fishery not causing the retained species to be outside biologically based limits or hindering recovery.		
	Met?	N/A		
	Justification	Not scored		

PI 2.1.1	The fishery does not pose a risk of serious or irreversible harm to the retained species and does not hinder recovery of depleted retained species
References	<p>AFMA 2008a. Residual Risk Assessment of the Level 2 Ecological Risk Assessment Species Results. Report for the Northern Prawn Fishery</p> <p>Buckworth, R.C., Deng, R.A., Hutton, T., Upston, J., Miller, M. and Pascoe, S. (2016). Status of the Northern Prawn Fishery Tiger Prawn Fishery at the end of 2015, with an estimated TAE for 2016. Report to the Australian Fisheries Management Authority, September 2016. CSIRO. Brisbane.</p> <p>Buckworth, R.C., Plagányi, E.É., Upston, J., Deng, R.A., Miller, M. & Hutton, T. (2015b). Assessment of the Joseph Bonaparte Gulf red-legged banana prawn (<i>Penaeus indicus</i>) fishery to 2014, with TAE recommendations for 2015, report to the Northern Prawn Resource Assessment Group, AFMA research project 2013/0005, CSIRO, Brisbane.</p> <p>Crococ, P. J., Park, Y. C., Die, D. J., Warburton, K., & Manson, F. (2001). Reproductive dynamics of endeavour prawns, <i>Metapenaeus endeavouri</i> and <i>M. ensis</i>, in Albatross Bay, Gulf of Carpentaria, Australia. <i>Marine Biology</i>, 138(1), 63-75. doi:10.1007/s002270000388</p> <p>DAFF (2007). Commonwealth Fishery Harvest Strategy, Policy and Guidelines. http://www.agriculture.gov.au/fisheries/domestic/harvest_strategy_policy.</p> <p>Fry, G., Brewer, D., Dell, Q., Tonks, M., Lawrence, E., Venables, W., Darnell, R. 2009. Assessing the sustainability of the Northern Prawn Fishery bycatch from annual monitoring data. AFMA Project 2008/826, CSIRO Marine and Atmospheric Research.</p> <p>Griffiths, S., Kenyon, R., Bulman, C., Dowdney, J., Williams, A., Sporcic, M. and Fuller, M. 2007. Ecological Risk Assessment for Effects of Fishing: Report for the Northern Prawn Fishery. Report for the Australian Fisheries Management Authority, Canberra, 319pp.</p> <p>Larcombe, J., Bath, A., Green, R. 2016. Northern Prawn Fishery in ABARES, 2016, Fishery status reports, Chapter 5, pp: 64-85.</p> <p>Loneragan, N., Die, D., Kenyon, R., Taylor, B., Vance, D., Manson, F., Pendrey, B., Venables, B., 2002. The growth, mortality, movements and nursery habitats of red legged banana prawns (<i>Penaeus indicus</i>) in the Joseph Bonaparte Gulf. Final report on FRDC Project 97/105. CSIRO Marine Research, Cleveland, Australia. ISBN 1 876 996 09 9.</p> <p>Milton, D.A., Fry, G. C., Tonks, M., Zhou, S., Kuhnert, P., and Zhu, M. 2010. Assessing data poor resources: developing a management strategy for byproduct species in the Northern Prawn. FRDC Project 2006/008 Final Report</p> <p>Plagányi, É., Miller, M., Upston, J., Moeseneder, C., Weeks, S., Kenyon, R., Hutton, T. Deng, R., Dennis, D. and Buckworth, R. (2016). Summary of the 2015 Joseph Bonaparte Gulf Red-legged Banana Prawn (<i>Penaeus indicus</i>) Fishery performance. Report to the Australian Fisheries Management Authority, September 2016. CSIRO. Brisbane.</p> <p>Zhou, S., Griffiths, S.P. and Miller, M. 2009a. Sustainability assessment for fishing effects (SAFE) on highly diverse and data-limited fish bycatch in a tropical prawn trawl fishery. <i>Marine and Freshwater Research</i> 60: 563-570.</p> <p>Zhou (2011). Sustainability assessment of fish species potentially impacted in the Northern Prawn Fishery: 2007-2009. Report to the Australia Fisheries Management Authority, Canberra, Australia. February 2011.</p>
OVERALL PERFORMANCE INDICATOR SCORE:	
UoA: Brown Tiger Prawn	90

PI 2.1.1		The fishery does not pose a risk of serious or irreversible harm to the retained species and does not hinder recovery of depleted retained species					
scoring element issue		Grooved Tiger	Blue Endeavour	Red Endeavour	Red-Legged Banana	Bugs	
PI 2.1.1a		100	100	80	100	80	
PI 2.1.1b		100	100	N/A	100	N/A	
PI 2.1.1c		N/A	N/A	N/A	N/A	N/A	
PI 2.1.1d		N/A	N/A	N/A	N/A	N/A	
Total		100	100	80	100	80	
PI 2.1.1 overall		90					
UoA: Grooved Tiger Prawn							90
scoring element issue		Brown Tiger	Blue Endeavour	Red Endeavour	Red-Legged Banana	Bugs	
PI 2.1.1a		100	100	80	100	80	
PI 2.1.1b		100	100	N/A	100	N/A	
PI 2.1.1c		N/A	N/A	N/A	N/A	N/A	
PI 2.1.1d		N/A	N/A	N/A	N/A	N/A	
Total		100	100	80	100	80	
PI 2.1.1 overall		90					
UoA: Blue Endeavour Prawn							90
scoring element issue		Grooved Tiger	Brown Tiger	Red Endeavour	Red-Legged Banana	Bugs	
PI 2.1.1a		100	100	80	100	80	
PI 2.1.1b		100	100	N/A	100	N/A	
PI 2.1.1c		N/A	N/A	N/A	N/A	N/A	
PI 2.1.1d		N/A	N/A	N/A	N/A	N/A	
Total		100	100	80	100	80	
PI 2.1.1 overall		90					
UoA: Red Endeavour Prawn							95
scoring element issue		Brown Tiger	Grooved Tiger	Blue Endeavour	Red-Legged Banana	Bugs	
PI 2.1.1a		100	100	100	100	80	
PI 2.1.1b		100	100	N/A	100	N/A	
PI 2.1.1c		N/A	N/A	N/A	N/A	N/A	
PI 2.1.1d		N/A	N/A	N/A	N/A	N/A	
Total		100	100	100	100	80	
PI 2.1.1 overall		95					
UoA: White Banana Prawn							100
Exceptionally low impact on retained species							
UoA: Red Legged Banana Prawn							100
scoring element issue		White Banana	Blue Endeavour				
PI 2.1.1a		100	100				
PI 2.1.1b		100	100				

PI 2.1.1		The fishery does not pose a risk of serious or irreversible harm to the retained species and does not hinder recovery of depleted retained species			
PI 2.1.1c		N/A	N/A		
PI 2.1.1d		N/A	N/A		
Total		100	100		
PI 2.1.1 overall		100			

Evaluation Table for PI 2.1.2

PI 2.1.2		There is a strategy in place for managing retained species that is designed to ensure the fishery does not pose a risk of serious or irreversible harm to retained species		
Scoring Issue		SG 60	SG 80	SG 100
a	Guide post	There are measures in place, if necessary, that are expected to maintain the main retained species at levels which are highly likely to be within biologically based limits, or to ensure the fishery does not hinder their recovery and rebuilding.	There is a partial strategy in place, if necessary, that is expected to maintain the main retained species at levels which are highly likely to be within biologically based limits, or to ensure the fishery does not hinder their recovery and rebuilding.	There is a strategy in place for managing retained species.
	Met?	Y	Y	Partially
	Justification	<p>The NPF Management Plan 1995 (last revision in 2012) includes long-term management objectives referring to the protection of retained species:</p> <ul style="list-style-type: none">- Objective 1. Ensure the utilisation of the fishery resources within the Northern Prawn Fishery is consistent with the principles of ecologically sustainable development and the exercise of the precautionary principle; and- Objective 5. Ensure that the incidental catch of non-target commercial and other species in the NPF is reduced to a minimum (Dichmont <i>et al.</i>, 2014). <p>NPF management achieves these objective through a combination of input controls: limited entry, seasonal closures, permanent area closures, gear restrictions and operational controls.</p> <p>Management of brown tiger prawn, grooved tiger prawn, blue endeavour prawn and red endeavour prawn as retained species:</p> <p>Tiger Prawn Subfishery</p> <p>Brown tiger prawn, grooved tiger prawn, blue endeavour prawn and red endeavour prawn are mainly targeted in the tiger prawn subfishery and covered by the tiger prawn harvest strategy. These species are also retained species in the UoAs when they are not assessed as targets. The operational objective of the tiger prawn HS is to attain long-term maximum economic yield (MEY) from the tiger prawn subfishery overall. MEY is calculated as the biomass at the effort level in each year over a 7-year projection period that creates the biggest difference between the total revenue generated from tiger and endeavour prawns and the total costs of fishing for the tiger prawn fishery as a whole. The harvest strategy contains a comprehensive set of control rules for brown tiger prawn, grooved tiger prawn and blue</p>		

PI 2.1.2	<p>There is a strategy in place for managing retained species that is designed to ensure the fishery does not pose a risk of serious or irreversible harm to retained species</p>
	<p>endeavour that feed into HS actions, including rules to cease fishing for the species where stock falls below limit reference point ($0.5S_{MSY}$). The HS is designed to be responsive to the state of each species' stock (except for red endeavour) and achieve objectives reflected in the target and limit reference points (Dichmont <i>et al.</i>, 2014). The requirement for brown and grooved tiger prawns and blue endeavour prawn management in brown tiger, grooved tiger respectively, blue endeavour and red endeavour UoAs is met at SG60, SG80 and SG100.</p> <p>There are no specific measures for red endeavour prawns although the harvest strategy that is in place for tiger prawn species and blue endeavour prawn is highly likely to benefit this species and to maintain it within its biologically based limits (Dichmont <i>et al.</i>, 2014). Red endeavour prawn is currently managed as a part of a multispecies stock, together with tiger prawn species and blue endeavour prawn. The rationale for this is that long term catches of tiger and endeavour prawns are highly correlated and maintaining tiger prawn and blue endeavour prawn stock at levels that fluctuate around their TRPs will maintain red endeavour prawns at sustainable levels (Dichmont <i>et al.</i>, 2014). Closures that are in place to protect spawning tiger prawns protect spawning red-endeavour prawns as well. Also, the NPF management is precautionary through effort and footprint control (which are significantly reduced compared to historical levels). Red endeavour prawn prefers depths over 35m (Crococ <i>et al.</i>, 2001) while in tiger prawn subfishery most fishing occurs in shallower waters (Fry, 2017, pers. comm.). There is a partial strategy in place, that is expected to maintain the red endeavour prawn (minor retained) at levels which are highly likely to be within biologically based limits but there is no specific strategy for this species in the tiger prawn subfishery. The requirement for red endeavour prawn management in brown tiger, grooved tiger and blue endeavour UoAs is met at SG60 and SG80 but not at SG 100.</p> <p>White Banana Prawn and Red-Legged Banana Prawn Subfisheries</p> <p>During the first fishing season of the year (banana season), brown tiger, groove tiger, blue endeavour and red endeavour prawns are likely to be retained in low quantities, in banana trawls (in white banana prawn UoA). A decision rule to protect spawning individuals from these species is closure of the fishery west of 138° (the white banana and red-legged banana subfisheries will be closed) and daylight ban for fishing east of 138° if the pro-rata total tiger prawn catch for the first 4 weeks is more than 24 t. The daylight ban is mainly to protect spawning tiger prawns but the other species are likely to be protected as well (AFMA, 2016). Early closure of the banana season to allow tiger prawn targeting only on a limited area in the GoC, ensures that the retained quantities of tiger and endeavour prawn in white banana and red-legged banana UoAs are minimal. As there is a long term correlation between catches of tiger prawns and catches of endeavour prawn, the strategy is adequate to manage all tiger and endeavour prawn species as retained species banana prawn subfisheries.</p> <p>The red-legged banana prawn subfishery operates during both fishing seasons. During the second season, tiger and endeavour prawns are managed as per the tiger prawn HS (Dichmont <i>et al.</i>, 2014), while catches of these species in the red-legged banana subfishery are very low (less than 1% of all tiger prawn catch and less than 2% of all endeavour prawn catch)</p> <p>There is a strategy in place to manage tiger prawn and endeavour prawn species and it applies to white banana and red-legged banana prawn subfisheries as well. The requirement for tiger and endeavour prawn management in white banana and red-legged banana prawns UoAs is met at SG60, SG80 and SG100.</p> <p>Management of white banana prawn and red-legged banana prawn as retained species</p> <p>Tiger Prawn Subfishery</p> <p>White banana prawn aggregations are not targeted in the tiger subfishery. There is also low spatial overlap of the white banana stock with tiger prawn fishing grounds (Larcombe <i>et al.</i>, 2016), and white banana catch is prevented through spatial management. The requirement for white banana prawn management in the tiger prawn subfishery (brown tiger prawn, grooved</p>

PI 2.1.2	There is a strategy in place for managing retained species that is designed to ensure the fishery does not pose a risk of serious or irreversible harm to retained species
	<p>tiger prawn, blue endeavour prawn and red endeavour prawn UoAs) is met at SG60, SG80 and SG100.</p> <p>Red-legged banana catch in tiger prawn subfishery is low because there is a low overlap of the red-legged banana prawn and tiger prawn stocks. There is a harvest strategy in place to manage red-legged banana prawn caught in during the tiger fishing season. If a minimum of 100 fishing days has been achieved in a year and the red-legged banana prawn stock size falls below the LRP (390kg/boat per fishing day in August, September and October) for the two most recent consecutive years, then the total allowable effort (TAE) is zero for a year (no fishing in the following year) (Dichmont <i>et al.</i>, 2014). Red-legged banana prawn caught in tiger prawn subfishery counts towards calculating the trigger limits for this species (Dichmont <i>et al.</i>, 2014). There is a strategy to manage red-legged banana prawn in the NPF, including measures that apply to tiger prawn subfishery. The requirement for red-legged banana prawn management in tiger prawn subfishery (brown tiger prawn, grooved tiger prawn, blue endeavour prawn and red endeavour prawn UoAs) is met at SG60, SG80 and SG100.</p> <p>White Banana Subfishery</p> <p>Red-legged banana prawn catch, in white banana prawn subfishery, is low because red-legged banana prawn has a low susceptibility to be caught when targeting white banana prawn aggregations (when fishing gear is deployed above the sea bottom for 30 minutes/rawl). Also, the overlap of the distribution of commercial size red-legged banana prawn with white banana prawn fishing grounds (shallow waters <20m, GoC and Arnhem Land) is low because the red-legged banana sub-adults migrate to deeper water habitats (50-80m) (Loneragan <i>et al.</i>, 2002). Red-legged banana catch is included in the daily trigger limits for banana prawns and given the low susceptibility to be caught, this is enough to manage the species sustainably. There is a strategy to manage red-legged banana prawn in the NPF, including measures that apply to white banana subfishery. The requirement for red-legged banana prawn management in white banana prawn subfishery (white banana prawn UoA) is met at SG60, SG80 and SG100.</p> <p>Red-Legged Banana Subfishery</p> <p>There is a harvest strategy to manage white banana prawn during the banana season and this covers the management of white banana prawn caught in red-legged banana subfishery during the first fishing season. The operational objective is to allow sufficient escapement from the fishery to ensure an adequate spawning biomass of banana prawns (based on historical data) and, within this parameter, maximise the economic return from the fishery, and also to minimise the catch of tiger prawns in the first four weeks of the banana prawn season. The HS is based on: (i) banana prawn catch and catch per unit effort, (ii) reported industry data on catches for weeks 4 & 5; 6 & 7; 8 & 9 of the first fishing season (iii) tiger prawn incidental catch trigger of 6 tonnes/week for the first four weeks of the season. An on-going rule was to close banana fishing west of 138° and to prevent daylight trawling east of this location, if average daily catches did not meet the 500kg/day during the two-week reporting period. The trigger refers to catches of both white banana and red-legged banana prawns. Since October 2013 the 500kg trigger was replaced with an MEY which is variable and calculated in season (AFMA, 2016). If the MEY is not met and the decision rule is triggered, red-legged banana subfishery as well as white banana subfishery close in order to protect spawning biomass of banana prawns. There is a strategy to manage white banana prawn in the NPF, including measures that apply to red-legged banana subfishery. The requirement for white banana prawn management in red-legged banana UoAs is met at SG60, SG80 and SG100.</p> <p>Management of byproduct species</p> <p>Byproduct Species are minor retained species for the four UoAs in tiger prawn subfishery. These species are managed through species specific measures, as well as general measures that reduce incidental catch and increase post-capture survival. Measures to minimise incidental catch in general are: fishing effort control, permanent and temporal closed areas and promoting activities that reduce gaps in knowledge and the impacts of fishing (e.g.</p>

PI 2.1.2		There is a strategy in place for managing retained species that is designed to ensure the fishery does not pose a risk of serious or irreversible harm to retained species		
		<p>compliance monitoring, training of Crew Member Observers and Scientific Observers, dissemination of information for species identification, species status, proper handling of the catch).</p> <p>The tiger prawn subfishery operates only for about four months of the year (usually 1 August-30 November) and only at night time (see Direction No. 171, AFMA, 2016). Footprint control and permanent and seasonal closures ensure the maintenance of byproduct populations. Gear restrictions and compulsory use of approved BRDs (Direction No. 50, AFMA, 2016) reduce the overall incidental catch and especially of big fish and mammals, and this might help prevent crushing and increase post capture survival for discarded portion of the retained byproduct such as bugs and scallops. NPF vessels also use hoppers (Fry <i>et al.</i>, 2015) (a wet "well" for sorting retained catch from discards) which also increase post capture survival.</p> <p>As specific measures for mud bugs, individuals smaller than the current minimum legal size (60 mm CW) and egg-bearing females are returned to the water alive. Also, the removal of eggs from females by any method is prohibited. A maximum catch limit of 100t was introduced as a trigger to review the available data and appropriate measures. This limit is very conservative compared to the Acceptable Biological Catch (ABC) of 1716t (Milton <i>et al.</i>, 2010). The retained quantity of bugs has been maintained under the 100t limit since this limit was introduced.</p> <p>A 500 t trigger limit for squid was set in 2006 and still applies. If the trigger is reached, appropriate management measures are to be developed and implemented. Since 2014, at the last revision of the NPF Harvest Strategy, a 300t limit was set to trigger a review of the management measures. The estimated ABC for squid was between 300t and 400t, but the authors admit that this limit may be underestimated. Based on the results of the byproduct study (Milton <i>et al.</i>, 2010), squid are less vulnerable to night prawn trawling because they migrate in the water column for feeding.</p> <p>The NPF Harvest Strategy lists western king prawn and red-spot king prawn as target species but they are caught incidentally during tiger prawn fishing activities. Levels of catch for these prawn species are very low compared to other target species. There are no specific management measures, however, these species are generally protected by the management measures adopted for the tiger prawn resource, as well as through spatial and temporal closures. Closures in the fishery include permanent closures (Direction No. 169, AFMA, 2016) of seagrass beds and other sensitive habitats and seasonal closures (Direction No. 171, AFMA, 2016) of juvenile prawn stock habitat, which are designed to coincide with recruitment phases, and also to protect pre-spawning prawns. The daylight trawl closure during the tiger prawn fishing season reduces the capture of spawning tiger and king prawns. Spawning index and recruitment index are assessed annually during prawn monitoring surveys to ensure the populations are maintained above their BBL (Dichmont <i>et al.</i>, 2014).</p> <p>There are specific measures (harvest controls) for other byproduct species as well, as set in the NPF Harvest Strategy in Table 8 (Dichmont <i>et al.</i>, 2014). These measures and trigger limits apply for the NPF overall. There is a strategy to manage byproduct species and it applies to all three subfisheries. The requirement for byproduct management is met at SG60, SG80 and SG100 by all six UoAs.</p>		
b	Guide post	The measures are considered likely to work, based on plausible argument (e.g., general experience, theory or comparison with similar fisheries/species).	There is some objective basis for confidence that the partial strategy will work, based on some information directly about the fishery and/or species involved.	Testing supports high confidence that the strategy will work, based on information directly about the fishery and/or species involved.
	Met?	Y	Y	Partially

PI 2.1.2	There is a strategy in place for managing retained species that is designed to ensure the fishery does not pose a risk of serious or irreversible harm to retained species
	<p>Justification</p> <p>The tiger prawn HS (including brown tiger prawn, grooved tiger prawn, blue endeavour prawn) has been tested using the NPF Management Strategy Evaluation (Dichmont <i>et al.</i>, 2006a, Dichmont <i>et al.</i>, 2006b, Dichmont <i>et al.</i>, 2006c, Dichmont <i>et al.</i>, 2008, and Dichmont <i>et al.</i>, 2012a). The HS is designed to be responsive to the state of each stock and achieve objectives reflected in the target and limit reference points cumulatively for targeted and non-targeted retained catch. Testing supports high confidence that the strategy for tiger and blue endeavour prawns will work and this is valid for all six UoAs. the requirement is met by all six UoAs at SG60, SG80 and SG100.</p> <p>There is some basis for confidence that the partial strategy for red endeavour prawn will work based on information directly about the fishery and the species involved: low overlap of the species with the NPF fishing grounds (Crococ <i>et al.</i>, 2001), the low risk score from both tiger and banana fisheries (Griffiths <i>et al.</i>, 2007), consistent low catches since 1998 (Larcombe <i>et al.</i>, 2016), and ongoing fishery independent surveys (Kenyon <i>et al.</i>, 2016). The requirement for this scoring issue in brown tiger prawn, grooved tiger prawn and blue endeavour prawn UoAs is met at SG60, SG80 but not at SG100.</p> <p>In white banana and red-legged banana subfisheries, red endeavour catch is less than 0.5% and measures for the management of tiger prawns in these subfishery are sufficient to manage red-endeavour prawns. testing of tiger prawn strategy combined to information about red endeavour catches in white banana and red-legged banana subfishery supports high confidence that the strategy will work. The requirement is met by default at SG100 by white banana prawn and red-legged banana prawn UoAs.</p> <p>The HS for red-legged banana prawns has been tested using the NPF Management Strategy Evaluation (Dichmont <i>et al.</i>, 2014). The 2015 assessment indicated increasing spawning biomass levels in recent years (Buckworth <i>et al.</i>, 2015b). There is some uncertainty concerning the low catches and catch rates in 2015 and 2016 which require further investigation to determine whether the tools in place are effective in achieving appropriate exploitation levels. This uncertainty relates more to the exploitation rates in the red-legged banana subfishery where most red-legged banana prawn is caught, while in tiger prawn subfishery this is a minor retained species. Testing supports high confidence that the strategy for red-legged banana prawn in brown tiger, grooved tiger, blue endeavour and red endeavour prawns UoAs will work, based on information directly about the species involved (increasing spawning biomass (Buckworth <i>et al.</i>, 2015b), and about the subfisheries involved: low risk scores from tiger prawn subfishery and banana prawn subfishery (Griffiths <i>et al.</i>, 2007), low spatial overlap between tiger prawn and white banana prawn fishing grounds (shallow waters) and red-legged banana stock (40-90m depths). The requirement is met at SG60, SG80 and SG 100 by all five UoAs where red-legged banana prawn is assessed as retained.</p> <p>The NPF HS for white banana prawn stock includes measures that are responsive to the state of the white banana stock. The elements of the harvest strategy during the first fishing season and the ones in the second fishing season work together towards achieving management objectives reflected in the surrogate target and limit reference points for retained white banana prawn both targeted and not targeted. Venables <i>et al.</i> (2011) has evaluated stock recruitment patterns relative to rainfall and this has been reviewed in the context of the banana prawn harvest strategy. Both the past history of catches and analyses of residuals have shown that the control rules used have been effective. Testing supports high confidence that the strategy to manage white banana prawns will work, and this applies also to the tiger prawn subfishery as well as the red-legged banana prawn subfishery based on information directly about the fishery and/or species involved. The requirement is met at SG60, SG80 and SG 100 by all five UoAs where white banana prawn is assessed as retained.</p> <p>For byproduct species, testing the management strategy and adjusting it, is an ongoing process. Based on the information directly about the fishery and the species involved, there is high degree of confidence that the strategy will work: for key byproduct species (bugs and squid) harvest controls that are in place were based on a byproduct study and long term</p>

PI 2.1.2		There is a strategy in place for managing retained species that is designed to ensure the fishery does not pose a risk of serious or irreversible harm to retained species		
		monitoring. No significant changes have been identified so far, however, ongoing monitoring ensures that any warning signs are recognised and investigated / addressed in their early stages. The requirement is met at SG60, SG80 and SG 100 for all six UoAs.		
c	Guide post		There is some evidence that the partial strategy is being implemented successfully.	There is clear evidence that the strategy is being implemented successfully.
	Met?		Y	Y
	Justification	A comprehensive data collection and validation, gear monitoring and VMS data to monitor the position of the vessels especially with respect to spatial and temporal closures, as well as compliance monitoring ensure management strategies for all retained species are implemented successfully in all six UoAs. Crew Observer training and coverage improved in recent years ensuring that best practices are employed in handling, measuring and recording the catch. Logbook recording is complied with, the logbook reports being compulsorily submitted to AFMA for validation (AFMA, 2016). The requirement is met at SG80 and SG100 by all six UoAs.		
d	Guide post			There is some evidence that the strategy is achieving its overall objective.
	Met?			Y
	Justification	<p>Tiger Prawn Subfishery (four UoAs: brown tiger prawn, grooved tiger prawn. blue endeavour prawn, red endeavour prawn)</p> <p>The harvest strategies of brown and grooved tiger prawn species and blue endeavour in tiger prawn subfishery, are regularly assessed and these assessments provide evidence that the NPF HS is achieving its objectives in maintaining these species within their biologically based limits (Dichmont <i>et al.</i>, 2008 and Dichmont <i>et al.</i>, 2012a, and Dichmont <i>et al.</i>, 2014). The requirement is met at SG100 by all UoAs in tiger prawn subfishery where brown tiger prawn and grooved tiger prawn species are assessed as retained.</p> <p>Red endeavour prawns were not included in the more recent MSE, however, this species was part of the MSE conducted previously for the fishery (Dichmont <i>et al.</i> 2008). Although the current tiger prawn HS is lacking in its approach to red endeavour prawns, there is some evidence from recent catch data (Larcombe <i>et al.</i>, 2016) and from ongoing fishery independent surveys (Kenyon <i>et al.</i>, 2016) that the objective to maintain the red endeavour population is being met. The requirement is met at SG100 by the brown tiger prawn, grooved tiger prawn and blue endeavour prawn UoAs.</p> <p>Red-legged banana stock assessments are similar to the ones for tiger prawn but less reliable, due to low effort in the red-legged banana subfishery and limited data available. The harvest strategy in tiger prawn subfishery does not include red-legged banana but this species is managed in the red-legged banana subfishery. Red-legged banana prawn in only a minor retained species in tiger prawn subfishery and there is some evidence that the strategy is achieving its overall objective as the 2015 assessment indicated increasing spawning biomass levels in recent years (Buckworth <i>et al.</i>, 2015b). The requirement is met at SG100 by all four UoAs of the tiger prawn subfishery.</p> <p>The abundance and distribution of the byproduct species are monitored annually (NPF prawn monitoring program) and reported periodically (e.g. Kenyon <i>et al.</i>, 2011, 2016). No significant changes identified over the years (since 2002) suggest that the strategy is working.</p>		

PI 2.1.2		There is a strategy in place for managing retained species that is designed to ensure the fishery does not pose a risk of serious or irreversible harm to retained species		
		<p>The requirement is met at SG100 the four UoAs of the tiger prawn subfishery.</p> <p>White Banana Prawn Subfishery (one UoA: white banana prawn)</p> <p>The impact of this fishery on retained species is <i>de minimis</i>, although all the management measures for other target and byproduct species apply. The requirement is met at SG100 by default for the white banana prawn UoA.</p> <p>Red-Legged Banana Prawn Subfishery (one UoA: red-legged banana prawn)</p> <p>White banana prawn is the only main retained species in the red-legged banana prawn subfishery. Recent analyses have shown that the catch rate of white banana prawn at the end of the banana season is now higher than in earlier years, providing evidence that the escapement (biomass and number of prawns remaining at the end of the banana prawn fishing season (in April/May)) has increased in recent years (MRAG, 2012). This means that the harvest strategy for white banana used across NPF (red-legged banana subfishery included) is achieving its objective. For all the other retained species, the catches are extremely low in the red-legged banana subfishery and the impact is <i>de minimis</i>. The requirement is met at SG100 by the red-legged banana prawn UoA.</p>		
e	Guide post	It is likely that shark finning is not taking place.	It is highly likely that shark finning is not taking place.	There is a high degree of certainty that shark finning is not taking place.
	Met?	Not scored	Not scored	Not scored
	Justification	Not applicable.		
References		<p>AFMA, 2016, <i>Northern Prawn Fishery Directions and Closures</i>, Australian Fisheries Management Authority. Canberra, Australia.</p> <p>Buckworth, R.C., Plagányi, E.É., Upston, J., Deng, R.A., Miller, M. & Hutton, T. (2015b). Assessment of the Joseph Bonaparte Gulf red-legged banana prawn (<i>Penaeus indicus</i>) fishery to 2014, with TAE recommendations for 2015, report to the Northern Prawn Resource Assessment Group, AFMA research project 2013/0005, CSIRO, Brisbane.</p> <p>Crocos, P. J., Park, Y. C., Die, D. J., Warburton, K., & Manson, F. (2001). Reproductive dynamics of endeavour prawns, <i>Metapenaeus endeavouri</i> and <i>M. ensis</i>, in albatross bay, gulf of Carpentaria, Australia. <i>Marine Biology</i>, 138(1), 63-75. doi:10.1007/s002270000388</p> <p>Dichmont, C. M., Deng, A., Punt, A. E., Venables, W., & Haddon, M. (2006a). Management strategies for short- lived species: The case of the Northern Prawn Fishery 1. Accounting for multiples species, spatial structure and implementation uncertainty when evaluating risk. <i>Fisheries Research</i> 82, 204-230.</p> <p>Dichmont, C. M., Deng, A., Punt, A. E., Venables, W., & Haddon, M. (2006b). Management strategies for short- lived species: The case of Australia's Northern Prawn Fishery 2. Choosing appropriate management strategies using input controls. <i>Fisheries Research</i> 82, 221-234.</p> <p>Dichmont, C. M., Deng, A., Punt, A. E., Venables, W., & Haddon, M. (2006c). Management strategies for short- lived species: The case of Australia's Northern Prawn Fishery 3. Factors affecting management and estimation performance. <i>Fisheries Research</i> 82, 235-245.</p> <p>Dichmont, C.M., Deng, A., Punt, A.E., Ellis, N., Venables, W.N., Kompas, T., Ye, Y., Zhou, S., Bishop, J. (2008). Beyond biological performance measures in Management</p>		

PI 2.1.2	<p>There is a strategy in place for managing retained species that is designed to ensure the fishery does not pose a risk of serious or irreversible harm to retained species</p>																												
	<p>Strategy Evaluation: Bringing in economics and the effects of trawling on the benthos. Fisheries Research 94: 238-250.</p> <p>Dichmont, C.M., Deng, R.A., Punt, A.E., Venables, W., Hutton, T. (2012). From input to output controls in a short-lived species: the case of the Northern Prawn Fishery. Marine and Freshwater Research, 2012, 63, 727–739.</p> <p>Dichmont, C.M, Jarrett, A., Hill, F., Brown, M. (2014) Harvest Strategy for the Northern Prawn Fishery under Input Controls. AFMA.</p> <p>Fry, G.C., Barwick, M, Lawrence, E. and Tonks, M. (2015) Monitoring interactions with bycatch species using crew-member observer data collected in the Northern Prawn Fishery: 2013 – 2014. Final Report to AFMA; R2013/0806. CSIRO, Australia. Pp. 218.</p> <p>Griffiths, S., Kenyon, R., Bulman, C., Dowdney, J., Williams, A., Sporicic, M. and Fuller, M. 2007. Ecological Risk Assessment for Effects of Fishing: Report for the Northern Prawn Fishery. Report for the Australian Fisheries Management Authority, Canberra, 319pp.</p> <p>Kenyon, R.A., Burrridge, C.Y., van der Velde, T.D., Donovan, A.G., Fry, G., Tonks, M., Cheers, S., 2011. An integrated monitoring program for the Northern Prawn Fishery 2011. AFMA 2009/0863 & 2010/0822 Final Report. CSIRO Marine and Atmospheric Research, Brisbane. 192 pp.</p> <p>Kenyon, R.A., Ellis, N., Donovan, A.G., van der Velde, T.D., Fry, G., Tonks, M., Cheers, S. and Dennis, D. 2016. An integrated monitoring program for the Northern Prawn Fishery 2012–2015. AFMA 2011/0811 Final Report. CSIRO Oceans and Atmosphere, Brisbane. 200 pp.</p> <p>Larcombe, J., Bath, A., Green, R. 2016. Norther Prawn Fishery in ABARES, 2016, Fishery status reports, Chapter 5, pp: 64-85.</p> <p>Loneragan, N., Die, D., Kenyon, R., Taylor, B., Vance, D., Manson, F., Pendrey, B., Venables, B., 2002. The growth, mortality, movements and nursery habitats of red legged banana prawns (<i>Penaeus indicus</i>) in the Joseph Bonaparte Gulf. Final report on FRDC Project 97/105. CSIRO Marine Research, Cleveland, Australia. ISBN 1 876 996 09 9.</p> <p>Milton, D.A., Fry, G. C., Tonks, M., Zhou, S., Kuhnert, P., and Zhu, M. 2010. Assessing data poor resources: developing a management strategy for byproduct species in the Northern Prawn. FRDC Project 2006/008 Final Report.</p> <p>MRAG (2012), MSC Assessment Report for Public Certification Report for Australian Northern Prawn Fishery, Brown tiger prawn (<i>Penaeus esculentus</i>) Grooved tiger prawn (<i>P. semisulcatus</i>) Blue endeavour prawn (<i>Metapenaeus endeavouri</i>) Red endeavour prawn (<i>M. ensis</i>) White banana prawn (<i>Fenneropenaeus merguensis</i>); Red-legged banana prawn (<i>F. indicus</i>) Twin, triple and quad otter trawl, Public Certification Report. MRAG Americas, November 2012, 399pp.</p> <p>Venables, W., Hutton, T., Lawrence, E., Rothlisberg, P., Buckworth, R., Hartcher, M. and Kenyon, R. (2011). Predictions of common banana prawn potential catch in Australia's Northern Prawn Fishery. Canberra, Australia: Australian Fisheries Management Authority.</p>																												
OVERALL PERFORMANCE INDICATOR SCORE:																													
UoA: Brown Tiger Prawn																													
<table><tr><td>scoring element issue</td><td>Grooved Tiger</td><td>Blue Endeavour</td><td>Red Endeavour</td><td>Red-legged Banana</td><td>White Banana</td><td>By product</td></tr><tr><td>PI 2.1.2a</td><td>100</td><td>100</td><td>80</td><td>100</td><td>100</td><td>100</td></tr><tr><td>PI 2.1.2b</td><td>100</td><td>100</td><td>80</td><td>100</td><td>100</td><td>100</td></tr><tr><td>PI 2.1.2c</td><td>100</td><td>100</td><td>100</td><td>100</td><td>100</td><td>100</td></tr></table>	scoring element issue	Grooved Tiger	Blue Endeavour	Red Endeavour	Red-legged Banana	White Banana	By product	PI 2.1.2a	100	100	80	100	100	100	PI 2.1.2b	100	100	80	100	100	100	PI 2.1.2c	100	100	100	100	100	100	95
scoring element issue	Grooved Tiger	Blue Endeavour	Red Endeavour	Red-legged Banana	White Banana	By product																							
PI 2.1.2a	100	100	80	100	100	100																							
PI 2.1.2b	100	100	80	100	100	100																							
PI 2.1.2c	100	100	100	100	100	100																							

PI 2.1.2		There is a strategy in place for managing retained species that is designed to ensure the fishery does not pose a risk of serious or irreversible harm to retained species							
PI 2.1.2d		100	100	100	100	100	100		
PI 2.1.2e		N/A	N/A	N/A	N/A	N/A	N/A		
Total		100	100	90	100	100	100		
PI 2.1.2 overall									
UoA: Grooved Tiger Prawn									
scoring element issue		Brown Tiger	Blue Endeavour	Red Endeavour	Red-legged Banana	White Banana	By product	95	
PI 2.1.2a		100	100	80	100	100	100		
PI 2.1.2b		100	100	80	100	100	100		
PI 2.1.2c		100	100	100	100	100	100		
PI 2.1.2d		100	100	100	100	100	100		
PI 2.1.2e		N/A	N/A	N/A	N/A	N/A	N/A		
Total		100	100	90	100	100	100		
PI 2.1.2 overall									
UoA: Blue Endeavour Prawn									
scoring element issue		Brown Tiger	Grooved Tiger	Red Endeavour	Red-legged Banana	White Banana	By product	95	
PI 2.1.2a		100	100	80	100	100	100		
PI 2.1.2b		100	100	80	100	100	100		
PI 2.1.2c		100	100	100	100	100	100		
PI 2.1.2d		100	100	100	100	100	100		
PI 2.1.2e		N/A	N/A	N/A	N/A	N/A	N/A		
Total		100	100	90	100	100	100		
PI 2.1.2 overall									
UoA: Red Endeavour Prawn									
scoring element issue		Brown Tiger	Grooved Tiger	Blue Endeavour	Red-legged Banana	White Banana	By product	100	
PI 2.1.2a		100	100	100	100	100	100		
PI 2.1.2b		100	100	100	100	100	100		
PI 2.1.2c		100	100	100	100	100	100		
PI 2.1.2d		100	100	100	100	100	100		
PI 2.1.2e		N/A	N/A	N/A	N/A	N/A	N/A		
Total		100	100	100	100	100	100		
PI 2.1.2 overall									
UoA: White Banana Prawn									
scoring element issue		Brown Tiger	Grooved Tiger	Blue Endeavour	Red Endeavour	Red-legged Banana	By product	100	
PI 2.1.2a		100	100	100	100	100	100		
PI 2.1.2b		100	100	100	100	100	100		
PI 2.1.2c		100	100	100	100	100	100		
PI 2.1.2d		100	100	100	100	100	100		
PI 2.1.2e		N/A	N/A	N/A	N/A	N/A	N/A		
Total		100	100	100	100	100	100		
PI 2.1.2 overall									

PI 2.1.2		There is a strategy in place for managing retained species that is designed to ensure the fishery does not pose a risk of serious or irreversible harm to retained species				
PI 2.1.2 overall						
UoA: Red Legged Banana Prawn						
<div>scoring element issue</div>	Brown Tiger	Grooved Tiger	Blue Endeavour	Red Endeavour	White Banana	By product
PI 2.1.2a	100	100	100	100	100	100
PI 2.1.2b	100	100	100	100	100	100
PI 2.1.2c	100	100	100	100	100	100
PI 2.1.2d	100	100	100	100	100	100
PI 2.1.2e	N/A	N/A	N/A	N/A	N/A	N/A
Total	100	100	100	100	100	100
PI 2.1.2 overall						
100						
CONDITION NUMBER (if relevant):						

Evaluation Table for PI 2.1.3

PI 2.1.3	Information on the nature and extent of retained species is adequate to determine the risk posed by the fishery and the effectiveness of the strategy to manage retained species		
Scoring Issue	SG 60	SG 80	SG 100
a	Guided post	Qualitative information is available on the amount of main retained species taken by the fishery.	Qualitative information and some quantitative information are available on the amount of main retained species taken by the fishery.
	Met?	Y	Y
	Justification	<p>A comprehensive data collection program (Figure 16) has been established for the NPF to ensure reliable information is available on which to base management decisions. Information is collected through fishery dependent and independent programs on all retained species (target and non-target) taken in the NPF.</p> <p>Information is available from the NPF-wide Daily Catch & Effort logbook program for all target and byproduct species. Under this program, operators are required to record, besides catch data, the location of fishing operations (latitude/longitude) for every day they fish and/or search, regardless of whether any catch is taken; the total number of shots for each fishing day; the species/product retained and size grade information. Retained catch information is verified by landing returns records. VMS data verifies the catch locations recorded in logbooks. This information assists in stock assessments and research being undertaken on effort creep and fishing power studies (Dichmont <i>et al.</i>, 2014). The Crew Member Observer program with coverage in all three subfisheries collects information on species that are on the NPF priority list. Two potentially retained byproduct species are on this list and monitored by CMOs, although these species have never been recorded in logbooks as retained (Fry <i>et al.</i>, 2015).</p> <p>Fishery independent research, including annual fishery independent surveys for target species (brown tiger prawn, grooved tiger prawn, blue endeavour prawn, red endeavour</p>	

PI 2.1.3		Information on the nature and extent of retained species is adequate to determine the risk posed by the fishery and the effectiveness of the strategy to manage retained species		
		<p>prawn, king prawn, white banana prawn) and byproduct (bugs, squid, cuttlefish, scallop), is undertaken in the NPF and used to verify fishery dependent information and narrow the gaps in knowledge. Every year, a recruitment survey is undertaken on the key fishing grounds of the Gulf of Carpentaria. A spawner survey is undertaken during the mid-season break in winter on the western grounds of the Gulf. (Dichmont <i>et al.</i>, 2014).</p> <p>In addition to target species, the NPF prawn monitoring program includes the most important byproduct species (bugs, squid, cuttlefish, scallop). The data has been used in the development of innovative new models to support the assessment byproduct (i.e. to estimate the ABCs) and also to produce distribution maps for byproduct catch rates (Milton <i>et al.</i>, 2010).</p> <p>Currently, fishery independent pre-season surveys are in place only in the Gulf of Carpentaria region (tiger prawn and white banana prawn subfisheries) but not in Joseph Bonaparte Gulf, thus fishery independent information on retained species in the red-legged banana subfishery is limited. However, the retained species in this subfishery are retained in the other two subfisheries and most of these species catch is from the GoC. Most information about the stock of the species that are retained in the three subfisheries is verifiable through fishery independent data.</p> <p>In addition to fishery independent surveys, AFMA Scientific Observer program collects data on species that are on the NPF priority list (Fry <i>et al.</i>, 2015)</p> <p>All retained species are subject of Ecological Risk Assessments (next ERA scheduled for 2017, (Fry, pers com 13 Feb 2017).</p> <p>Accurate and verifiable information is available on the catch of all retained species, and the consequences for the status of affected populations in all six UoAs. For brown tiger prawn, grooved tiger prawn, blue endeavour prawn, red endeavour prawn, white banana prawn and red-legged banana prawn UoAs the requirement is met at SG60, SG80 and SG100.</p>		
b	Guided post	Information is adequate to qualitatively assess outcome status with respect to biologically based limits.	Information is sufficient to estimate outcome status with respect to biologically based limits.	Information is sufficient to quantitatively estimate outcome status with a high degree of certainty.
	Met?	Y	Y	Y
	Justification	<p>Information is sufficient to quantitatively estimate outcome status with a high degree of certainty for all UoAs. (Note: high degree of certainty for P2 species, according to MSC FCR v1.3 definition means a probability that is greater or equal to 80% and not 100% (CB3.2.3.3, MSC, 2013, pC165). For the tiger prawn subfishery, quantitative data from logbooks is verified by seasonal landing returns (quantities landed for target and byproduct species) and by fishery independent surveys (estimates of catch rates, abundance and distribution maps in the GoC, where most fishing occurs). The requirement is met at SG60, SG80 and SG100 by the brown tiger prawn, grooved tiger prawn, blue endeavour prawn and red endeavour prawn UoAs.</p> <p>For the white banana prawn subfishery, similar data is available, however, the impact of this subfishery on retained species is <i>de minimis</i>: no retained species has a percentage contribution higher than 0.5% of the catch and all retained catch (other than white banana prawn) is less than 2%. The requirement is met at SG60, SG80 and SG100 by the white banana prawn UoA.</p> <p>For the red-legged banana subfishery quantitative data from logbooks (catch rate estimated from catch and effort data) is verified by seasonal landing returns (quantities landed for target and byproduct species). The only main retained species in this subfishery</p>		

PI 2.1.3		Information on the nature and extent of retained species is adequate to determine the risk posed by the fishery and the effectiveness of the strategy to manage retained species		
		is the white banana prawn which is managed sustainably as a target species in the NPF. Given the low quantities of all the other retained species in this subfishery compared to NPF overall this information is sufficient to quantitatively estimate outcome status for all retained species with a high degree of certainty. The requirement is met at SG60, SG80 and SG100 by the red-legged banana prawn UoA.		
c	Guidepost	Information is adequate to support measures to manage main retained species.	Information is adequate to support a partial strategy to manage main retained species.	Information is adequate to support a strategy to manage retained species, and evaluate with a high degree of certainty whether the strategy is achieving its objective.
	Met?	Y	Y	Y
	Justification	<p>The available information is adequate to support a strategy to manage retained species, and evaluate with a high degree of certainty whether the strategy is achieving its objective, for all UoAs.</p> <p>The main retained species in the tiger prawn subfishery and red-legged banana prawn subfishery (no main in white banana prawn subfishery) are also target species in the NPF, with harvest strategy and control rules which are regularly tested and adjusted (if necessary) based on adequate information (see also Principle 1).</p> <p>Although for red endeavour prawn a specific strategy does not exist, this species is managed as part of a stock complex, together with blue endeavour prawns and tiger prawns based on the long-term correlations between endeavour prawns catches and tiger prawn catches. Due to this correlation, if tiger prawns and blue endeavour prawns stock are maintained at sustainable levels, red-endeavour prawn stock will also be maintained (Dichmont et al., 2014). The species is also monitored in annual surveys (NPF prawn monitoring surveys) and the information from these surveys (no individuals per ha, recruitment index) is adequate to demonstrate the strategy is achieving its objective.</p> <p>Apart from bugs, all the other minor retained species, with percentage contribution > 0.5% of the catch in each of the three NPF subfisheries, are managed as target species in the NPF and for all except red endeavour prawn, there are harvest strategies regularly revised and based on adequate information (see also Principle 1). A byproduct study (Milton et al, 2010), was undertaken to provide adequate information to manage key byproduct species. All other byproduct species had percentage contributions <0.5% of the catch biomass and the impact from the three subfisheries was considered <i>de minimis</i> and do not need specific management measures.</p> <p>The requirement for this scoring issue is met at SG60, SG80 and SG100 by all six UoAs.</p>		
d	Guidepost		Sufficient data continue to be collected to detect any increase in risk level (e.g. due to changes in the outcome indicator score or the operation of the fishery or the effectiveness of the strategy)	Monitoring of retained species is conducted in sufficient detail to assess ongoing mortalities to all retained species.
	Met?		Y	Y

PI 2.1.3	Information on the nature and extent of retained species is adequate to determine the risk posed by the fishery and the effectiveness of the strategy to manage retained species
Justification	<p>A comprehensive integrated monitoring program is in place for retained species (target and non-target).</p> <p>Fishery-Dependent Monitoring:</p> <p>- Daily Catch & Effort (all three subfisheries)</p> <p>Fishery dependent monitoring consists in compulsory reporting catch data and effort in Daily Catch & Effort logbooks. Retained catch information is verified by landing returns records. The Vessel Monitoring System (VMS) verifies the catch locations.</p> <p>- Crew Member Observer Program (all three subfisheries)</p> <p>The number of NPF crew participating in the CMO program has significantly increased since 2010, covering 18% boat days of tiger prawn fleet and about 2% in banana prawn fleet (including white banana and red-legged banana). The CMOs collect data on species from the NPF priority list which includes two potentially retained mantis shrimp species, although these species have never been recorded in fishery logbooks as retained (Fry <i>et al.</i>, 2015).</p> <p>Fishery-Independent Monitoring:</p> <p>- NPF Prawn Monitoring Program (tiger prawn subfishery and white banana prawn subfishery)</p> <p>Fishery independent monitoring consists in annual fishery independent surveys for target species (brown tiger prawn, grooved tiger prawn, blue endeavour prawn, red endeavour prawn, king prawn, white banana prawn) and byproduct (bugs, squid, cuttlefish, scallop). Annually, a recruitment survey is undertaken on the key fishing grounds of the Gulf of Carpentaria. A spawner survey is undertaken during the mid-season break in winter on the western grounds of the Gulf. (Dichmont <i>et al.</i>, 2014). In addition to target species, the NPF prawn monitoring program includes the most important byproduct species (bugs, squid, cuttlefish, scallop). The data has been used in the development of innovative new models to support the assessment byproduct (i.e. to estimate the ABCs) and also to produce distribution maps for byproduct catch rates (Milton <i>et al.</i>, 2010).</p> <p>Currently, the independent pre-season surveys cover only in the Gulf of Carpentaria region where the majority of the NPF catch is taken (tiger prawn and white banana prawn subfisheries) but not in Joseph Bonaparte Gulf. Thus, there are no fishery independent pre-season surveys on retained species in the red-legged banana subfishery. Considering very low levels of retained species in this subfishery, fishery independent data collection at the same level as in the Gulf of Carpentaria, may not be cost-effective for the scope and the scale of the fishery. However, the AFMA Scientific Observer Program covers Joseph Bonaparte Gulf as well.</p> <p>- AFMA Scientific Observer Program</p> <p>AFMA Scientific Observers collect similar information to CMOs in order to compare and validate catch data and add taxonomic detail (better species identification). Monitoring of the two mantis shrimp species from the NPF priority list is part of in this program. AFMA SO program covers the three subfisheries and provides data mainly on NPF priority list.</p> <p>Retained catch information for species that are targeted in the NPF reflects total fishing mortality, although for byproduct a part of the catch is discarded, thus the retained catch is lower than fishing mortality. By comparing logbook records for byproduct catch and effort, landing return records and survey catch rates for byproduct species, total fishing mortality can be estimated (including the discarded part).</p> <p>The requirement for this scoring issue is met at SG80 and SG100 by all six UoAs (brown tiger prawn, grooved tiger prawn, blue endeavour prawn, red endeavour prawn, white banana prawn and red-legged banana prawn).</p>

PI 2.1.3	Information on the nature and extent of retained species is adequate to determine the risk posed by the fishery and the effectiveness of the strategy to manage retained species					
References	<p>Dichmont, C.M, Jarrett, A., Hill, F., Brown, M. (2014) Harvest Strategy for the Northern Prawn Fishery under Input Controls. AFMA</p> <p>Fry, G.C., Barwick, M, Lawrence, E. and Tonks, M. (2015) Monitoring interactions with bycatch species using crew-member observer data collected in the Northern Prawn Fishery: 2013 – 2014. Final Report to AFMA; R2013/0806. CSIRO, Australia. Pp. 218.</p> <p>Milton, D.A., Fry, G. C., Tonks, M., Zhou, S., Kuhnert, P., and Zhu, M. 2010. Assessing data poor resources: developing a management strategy for byproduct species in the Northern Prawn. FRDC Project 2006/008 Final Report</p>					
OVERALL PERFORMANCE INDICATOR SCORE:						
UoA: Brown Tiger Prawn						
<div>scoring element issue</div>	Grooved Tiger	Blue Endeavour	Red Endeavour	Red-legged Banana	White Banana	By product
PI 2.1.3a	100	100	100	100	100	100
PI 2.1.3b	100	100	100	100	100	100
PI 2.1.3c	100	100	100	100	100	100
PI 2.1.3d	100	100	100	100	100	100
Total	100	100	100	100	100	100
PI 2.1.3 overall	100					
100						
UoA: Grooved Tiger Prawn						
<div>scoring element issue</div>	Brown Tiger	Blue Endeavour	Red Endeavour	Red-legged Banana	White Banana	By product
PI 2.1.3a	100	100	100	100	100	100
PI 2.1.3b	100	100	100	100	100	100
PI 2.1.3c	100	100	100	100	100	100
PI 2.1.3d	100	100	100	100	100	100
Total	100	100	100	100	100	100
PI 2.1.3 overall	100					
100						
UoA: Blue Endeavour Prawn						
<div>scoring element issue</div>	Brown Tiger	Grooved Tiger	Red Endeavour	Red-legged Banana	White Banana	By product
PI 2.1.3a	100	100	100	100	100	100
PI 2.1.3b	100	100	100	100	100	100
PI 2.1.3c	100	100	100	100	100	100
PI 2.1.3d	100	100	100	100	100	100
Total	100	100	100	100	100	100
PI 2.1.3 overall	100					
100						
UoA: Red Endeavour Prawn						
<div>scoring element issue</div>	Brown Tiger	Grooved Tiger	Blue Endeavour	Red-legged Banana	White Banana	By product
PI 2.1.3a	100	100	100	100	100	100
PI 2.1.3b	100	100	100	100	100	100
100						

PI 2.1.3		Information on the nature and extent of retained species is adequate to determine the risk posed by the fishery and the effectiveness of the strategy to manage retained species							
PI 2.1.3c		100	100	100	100	100	100		
PI 2.1.3d		100	100	100	100	100	100		
Total		100	100	100	100	100	100		
PI 2.1.3 overall		100							
UoA: White Banana Prawn									
scoring element issue		Brown Tiger	Grooved Tiger	Blue Endeavour	Red Endeavour	Red-legged Banana	By product	100	
PI 2.1.3a		100	100	100	100	100	100		
PI 2.1.3b		100	100	100	100	100	100		
PI 2.1.3c		100	100	100	100	100	100		
PI 2.1.3d		100	100	100	100	100	100		
Total		100	100	100	100	100	100		
PI 2.1.3 overall		100							
UoA: Red Legged Banana Prawn									
scoring element issue		Brown Tiger	Grooved Tiger	Blue Endeavour	Red Endeavour	White Banana	By product	100	
PI 2.1.3a		100	100	100	100	100	100		
PI 2.1.3b		100	100	100	100	100	100		
PI 2.1.3c		100	100	100	100	100	100		
PI 2.1.3d		100	100	100	100	100	100		
Total		100	100	100	100	100	100		
PI 2.1.3 overall		100							
CONDITION NUMBER (if relevant):									

Evaluation Table for PI 2.2.1

PI 2.2.1		The fishery does not pose a risk of serious or irreversible harm to the bycatch species or species groups and does not hinder recovery of depleted bycatch species or species groups		
Scoring Issue		SG 60	SG 80	SG 100
a	Guide post	Main bycatch species are likely to be within biologically based limits (if not, go to scoring issue b below).	Main bycatch species are highly likely to be within biologically based limits (if not, go to scoring issue b below).	There is a high degree of certainty that bycatch species are within biologically based limits.
	Met?	Y	Y	Y
	Justification	Bycatch in prawn trawl fisheries usually constitutes a high percentage of the catch and comprises a high number of species. Table 10, in this report, gives a summary of total numbers of species or species groups recorded during the AFMA scientific observer and CSIRO scientific survey trawls in each subfishery. (Fry & Miller, 2016). Table 11 gives a summary of the mean percentage weight contribution of each species or species groups at 2% or above		

PI 2.2.1	<p>The fishery does not pose a risk of serious or irreversible harm to the bycatch species or species groups and does not hinder recovery of depleted bycatch species or species groups</p>
	<p>in each subfishery for the AFMA scientific observer dataset from 2013 to 2015. (Source: Fry & Miller, 2016).</p> <p>For the bycatch that is reported at species level, there are no species with percentage contributions higher than 5%. For some groups of species, records lack taxonomic detail and the contributions to the catch are reported at family level. Percentage contributions over 5% were reported for two families in the tiger prawn subfishery and one family in the red-legged banana prawn subfishery. For a conservative approach, we assumed that any species from those groups may have percentage contributions over 5% of the catch biomass and all were considered "main". The lists of species that occur on the NPF grounds for each of these groups were identified from CSIRO datasets (Fry & Miller, 2016) and from species lists used at ERAEF (Griffiths <i>et al.</i>, 2007). The outcome for "main" and "minor" bycatch species will be discussed per subfishery, in the following sections.</p> <p>Tiger Prawn Subfishery (brown tiger prawn, grooved tiger prawn, blue endeavour prawn and red endeavour prawn UoAs)</p> <p>Tiger prawn trawling generally occurs close to the substratum and as a result selectivity of prawns is low and bycatch is high. Dell <i>et al.</i> (2009) estimated the bycatch volume for the tiger prawn subfishery as 20,073 t yr⁻¹ ±568 SE, resulting in a bycatch to prawn ratio of 8:1. According to recent data from AFMA Scientific Observer Program, compiled by Fry & Miller (2016, Annex), bycatch in the tiger prawn subfishery accounted for about 66% and the bycatch to prawn ratio was 1.9:1.</p> <p>From AFMA SO datasets from 2007-2015, teleosts and elasmobranchs contributed an average of 47% total catch weight while invertebrates contributed about 15%. This is much lower than findings from Stobutzki <i>et al.</i>, 2001a. As survey trawls did not use BRDs or TEDs, the lower catch of teleosts and elasmobranchs is most likely due to the use of these devices.</p> <p>Fry & Miller (2016), compiled a list of 602 species potentially occurring in the NPF Tiger Prawn Subfishery bycatch. Two families, Leiognathidae (ponyfishes) and Mullidae (mulletts), contributed to total catch biomass with over 5%, average percentage contributions 2013-2015 (Fry & Miller, 2016). All the species from these families potentially occurring on the tiger prawn fishing grounds were considered as "main" bycatch. These species are presented in Table 12, section 5.2.1.</p> <p>All the main bycatch species have been subject to a quantitative ecological risk assessment, the Sustainability Assessment for Fishing Effects (SAFE), in 2007 and re-assessed in 2010 using updated fishery data (Zhou, 2011). All these species scored low risk from the Tiger Prawn Subfishery.</p> <p>No species with percentage contributions between 2% and 5% catch biomass were found to be vulnerable, mainly because they are species with small sized individuals and high productivity and are widely distributed outside the fishing grounds. Thus, they do not classify as main. All species in this category were also assessed at ERA Level 2.5 (SAFE) and scored low risk from the fishery. In addition, all species of teleosts and elasmobranchs identified as potential bycatch were SAFE assessed (Zhou & Griffiths, 2008; Zhou <i>et al.</i>, 2009a, Zhou, 2011)).</p> <p>The more recent SAFE for teleosts and elasmobranchs were done separately because of the differences in life history. No teleosts were found at medium risk (did not have estimated fishing mortality greater than their maximum sustainable fishing mortality (F_{msm})). There were also no species at high risk from the NPF fishery (with fishing mortalities in the period 2007-2009 higher than the unsustainable fishing mortality ($F_{2007-2009} > F_{crash}$) even when uncertainty was taken into consideration. A few species were scored as "precautionary medium risk", with fishing mortality greater than lower bound of 90%CI for F_{msm}. These species were then assessed by key biological researchers using the expert opinion method and only two of these species (<i>Lepidotrigla spinosa</i> and <i>Lepidotrigla</i> sp A) were regarded as</p>

PI 2.2.1	<p>The fishery does not pose a risk of serious or irreversible harm to the bycatch species or species groups and does not hinder recovery of depleted bycatch species or species groups</p>
	<p>potentially 'at risk' to trawling and subsequently included in the NPF priority list for future monitoring (Fry <i>et al.</i>, 2015).</p> <p>SAFE for elasmobranchs did not identified any species at medium risk ($F_{msm} \leq F_{2007-2009} < F_{crash}$). When uncertainty was taken into consideration, 9 species were at precautionary medium risk (Zhou, 2011). However, in the experts' opinion, due to the wide distribution of these species and the fact that most of them are large animals and excluded by TEDs, none of these species were deemed as being "at risk" of overfishing from the NPF tiger prawn fishery and do not need close monitoring (Zhou, 2011). From the previous assessments, two species of elasmobranchs, <i>Taeniura meyeri</i> and <i>Urogymnus asperrimus</i>, were considered at potential risk (Brewer <i>et al.</i> 2007; Zhou and Griffiths 2008). In the updated assessment with new data, <i>Taeniura meyeri</i> had a small fishing mortality, mainly due to its low occurrence in fished area. The estimated fishing mortality was smaller than its F_{msm}, even when uncertainty was taken into account. For <i>Urogymnus asperrimus</i>, although its mean fishing mortality was smaller than its F_{msm}, its $F_{2007-2009} + 90\%CI$ was slightly larger than its F_{msm} (Zhou, 2011).</p> <p>The current NPF priority list includes, besides the ETPs and two byproduct species (mantis shrimps) the following bycatch species: <i>Urogymnus asperrimus</i> (elasmobranch), <i>Lepidotrigla spinosa</i> and <i>Lepidotrigla</i> sp A, (teleosts). <i>Urogymnus asperrimus</i> has never been recorded in the tiger prawn subfishery bycatch in the last 10 years while <i>Lepidotrigla</i> species had percentage contributions less than 0.01% catch biomass (Fry & Miller, 2016, Annex).</p> <p>While risk assessments for bycatch focused on teleosts and elasmobranchs, many invertebrate species that are discarded were assessed at PSA under ERA for byproduct (Griffiths <i>et al.</i>, 2007). All species of invertebrates caught in prawn trawls were assessed for sustainability from trawl impact in studies of benthic biodiversity (Hill <i>et al.</i>, 2002, Haywood <i>et al.</i>, 2005, Bustamante <i>et al.</i>, 2010). Only one group, undifferentiated crabs (Infraorder Brachyura-undifferentiated), contributed over 0.5% (1.05%) of catch weight. It is likely that none of the species included in this group had individual percentage contributions over 0.5%. The most susceptible crab species are portunid crabs, thus this family is most likely to dominate "undifferentiated crabs", and are also the most sustainable from prawn trawling (Hill <i>et al.</i>, 2002).</p> <p>In conclusion, there is a high degree of certainty that all main bycatch species are within biologically based limits and the tiger prawn subfishery does not pose a risk of serious and irreversible harm (none of these species scored medium or high risk). The requirement at SG100 is met at SG60, SG80 and SG100 by the brown tiger prawn, grooved tiger prawn, blue endeavour prawn and red endeavour prawn UoAs.</p> <p>White Banana Prawn Subfishery (white banana prawn UoA)</p> <p>In the white banana prawn subfishery trawling is more selective than in the tiger prawn subfishery. The trawl gear is generally only deployed once a prawn aggregation or "mark" is located on the echo sounder. The gear operates within 5m from the seabed, towed at an average of 3.2 knots and the trawl duration is less than 1 hour (Griffiths <i>et al.</i>, 2007). Dell <i>et al.</i> (2009) estimated the bycatch volume for the white banana prawn subfishery as $1,502 \text{ t yr}^{-1} \pm 288 \text{ SE}$ and a bycatch to prawn ratio of 0.8:1. The same ratio was estimated from recent data (2007-2015) from Fry & Miller (2016).</p> <p>According to Fry & Miller (2016) 525 species (Table 10) have been identified in the NPF White Banana Prawn Subfishery bycatch. No individual species or group of species contributed a percentage average higher or equal to 5% of total catch biomass (Table 12). From the species/ groups with percentage contributions over 2% but less than 5% (Sciaenidae, <i>Carcarhinus</i>, <i>Loxodon</i> and <i>Rhizoprionodon</i> spp., <i>Polydactylus nigripinnis</i> and <i>Harpadon translucens</i>), no species was deemed as vulnerable and none of these species are on the NPF priority list (Zhou, 2011), thus they do not classify as "main".</p> <p>All teleost and elasmobranch species were SAFE assessed cumulatively with the tiger prawn fishery and all species that scored high and medium risk were reviewed by the NORMAC</p>

PI 2.2.1	<p>The fishery does not pose a risk of serious or irreversible harm to the bycatch species or species groups and does not hinder recovery of depleted bycatch species or species groups</p>
	<p>Bycatch Subcommittee after more information became available from research. None of the species with percentage contributions higher than 2% were deemed "at risk" of overfishing.</p> <p>Compared to tiger prawn subfishery, the bycatch in the white banana subfishery contained more teleost species and less invertebrates (Dell et al., 2009).</p> <p>There are no "main" bycatch species in white banana subfishery, thus the scoring guidepost SG80 is achieved by default. All teleost and elasmobranch species found at the bycatch survey have been included in the SAFE risk assessments (Zhou & Griffiths, 2008, Zhou <i>et al.</i>, 2009, Zhou, 2011). Bycatch species that remained on the NPF priority list (<i>Urogymnus asperrimus</i> (elasmobranch), <i>Lepidotrigla spinosa</i> and <i>Lepidotrigla</i> sp A, (teleosts)) have not been recorded as bycatch in the white banana subfishery in the last 10 years. No invertebrate species that have not been assessed at PSA as byproduct had percentage contribution > 0.5% in the white banana subfishery total catch, thus, the impact of the fishery is <i>de minimis</i>. There is a high degree of certainty that bycatch species are within biologically based limits and white banana prawn UoA does not pose a risk of serious or irreversible harm. The requirement is met at SG60, SG80 and SG100 by the white banana prawn UoA.</p> <p>Red-Legged Banana Prawn Subfishery (red-legged banana UoA)</p> <p>Red-Legged Banana Prawn Subfishery operates in Joseph Bonaparte Gulf. Fishing for the red-legged banana prawn is permitted day and night in both NPF fishing seasons: autumn (April to mid-June) and spring (August to November). Fishing takes place 14 days per month in waters 35–70m deep, with most fishing effort between 50 and 60 m. The trawling regime for this species is similar to the tiger prawn subfishery in other regions of the NPF, where the total duration of individual trawls is usually long (~ 3 h) (Tonks <i>et al.</i>, 2008). The estimated bycatch volume for the red-legged banana prawn subfishery was 4934 t yr⁻¹white a bycatch to prawn ratio 13:1 (Tonks <i>et al.</i>, 2008).</p> <p>According to Fry & Miller (2016), over 317 species (Table 12) have been identified in the NPF Red-Legged Banana Prawn Subfishery bycatch. This is the number of species recorded from the JBG since 1993 when CSIRO surveys started but the current number of bycatch species is lower because the fished area is much lower than the entire gulf (0.3-0.8%, Zhou <i>et al.</i>, 2015). Tonks <i>et al.</i> (2008) found, at 2000-2004 survey, 195 taxa from 85 families; 117 teleost taxa contributing 90.9% of the total biomass, 68 invertebrate taxa (7.7% of biomass), six species of elasmobranchs (1.3% of biomass).</p> <p>In 2013-2015 period, one family, Sciaenidae, had percentage contribution to total catch biomass higher than 5% (Fry & Miller, 2016). It is possible that no individual species had contributions over 5%, however, we considered all the species in this family as "main". These species are presented in Table 13, section 5.2.1.</p> <p>The same species also ranked high as mean biomass per hectare during the bycatch survey (Tonks <i>et al.</i>, 2008). No vulnerable species have been identified among the species or groups with percentage contribution over 2% but less than 5%, thus they do not classify as "main".</p> <p>Zhou <i>et al.</i>, (2015) applied SAFE to 150 species of teleosts (138 species, including all "main" species) and elasmobranchs identified in Bycatch Monitoring Program (AFAMA SO) in 2001-2005.</p> <p>The conclusion of this SAFE assessment was:</p> <p>" We conclude that the impacts of fishing on the species examined, expressed as instantaneous fishing mortality rates, are less than the maximum rates that would be sustainable. Clearly, a key explanation of these findings is that a low proportion of the species' distribution ranges is being trawled as a result of low fishing effort." (Zhou <i>et al.</i>, 2015).</p> <p>Bycatch survey results showed high catch rates and bycatch of portunid crabs, mostly <i>Charybdis callianassa</i>, (5.7% of total biomass, Tonks <i>et al.</i>, 2008), although averages for portunid crabs in the last 10 years show percentage contributions less than 1% total biomass.</p>

PI 2.2.1		The fishery does not pose a risk of serious or irreversible harm to the bycatch species or species groups and does not hinder recovery of depleted bycatch species or species groups		
		<p>Although <i>C. callianassa</i> was not reported in AFMA datasets on its own, its catch was most likely included in "Portunidae, Polybiidae - undifferentiated" (0.7%). In CSIRO surveys datasets, portunid crabs made small percentage contributions as well, with species percentage usually less than 0.05%, except for <i>Portunus armatus</i> (0.2%) (Fry & Miller, 2006, Annex). Portunid crabs were not included in the Ecological risk assessments, however, their sustainability was assessed in studies of benthic biodiversity and were found to be one of the most robust groups due to high recoverability rates (Hill <i>et al.</i>, 2002, Haywood <i>et al.</i>, 2005).</p> <p>There is a high degree of certainty that all bycatch species in the red-legged banana subfishery are within biologically base limits and the red-legged banana UoA does not pose a risk of serious or irreversible harm. This scoring issue's requirement is met at SG60, SG80 and SG100 by the red-legged banana prawn UoA.</p>		
b	Guide post	If main bycatch species are outside biologically based limits there are mitigation measures in place that are expected to ensure that the fishery does not hinder recovery and rebuilding.	If main bycatch species are outside biologically based limits there is a partial strategy of demonstrably effective mitigation measures in place such that the fishery does not hinder recovery and rebuilding.	
	Met?	N/A	N/A	
	Justification			
c	Guide post	If the status is poorly known there are measures or practices in place that are expected to result in the fishery not causing the bycatch species to be outside biologically based limits or hindering recovery.		
	Met?	N/A		
	Justification			
References		<p>Dell, Q., Brewer, D. T., Griffiths, S. P., Heales, D. S. and Tonks, M. L. (2009), Bycatch in a tropical schooling – penaeid fishery and comparisons with a related, specialised trawl regime. Fisheries Management and Ecology, 16: 191–201. doi:10.1111/j.1365-2400.2009.00655.x.</p> <p>Fry, G and Miller, M. (2016). NPF Bycatch Data Summaries for Marine Stewardship Council Audit. Report for NPFI and AFMA</p> <p>Fry, G.C., Barwick, M, Lawrence, E. and Tonks, M. (2015) Monitoring interactions with bycatch species using crew-member observer data collected in the Northern Prawn Fishery: 2013 – 2014. Final Report to AFMA; R2013/0806. CSIRO, Australia. Pp. 218.</p>		

PI 2.2.1	The fishery does not pose a risk of serious or irreversible harm to the bycatch species or species groups and does not hinder recovery of depleted bycatch species or species groups
	<p>Griffiths, S., Kenyon, R., Bulman, C., Dowdney, J., Williams, A., Sporcic, M. and Fuller, M. 2007. Ecological Risk Assessment for Effects of Fishing: Report for the Northern Prawn Fishery. Report for the Australian Fisheries Management Authority, Canberra, 319pp.</p> <p>Stobutzki, I.C., Miller, M.J., Jones, P., Salini, J.P. 2001a. Bycatch diversity and variation in a tropical Australian penaeid fishery: the implications for monitoring. Fisheries Research 53: 283–301.</p> <p>Svane, I., Rodda, K. and Thomas, P. (2007). Prawn fishery by-catch and discards: marine ecosystem analysis - population effects. FRDC Report 2003/023. 404 pp.</p> <p>Tonks, M.L., Griffiths, S.P., Heales, D.S., Brewer, D.T., and Dell, Q. 2008. Species composition and temporal variation of prawn trawl bycatch in the Joseph Bonaparte Gulf, northwestern Australia. Fisheries Research 89: 276-293.</p> <p>Zhou, S. and Griffiths, S.P. 2008. Sustainability assessment for fishing effects (SAFE): a new quantitative ecological risk assessment method and its application to elasmobranch bycatch in an Australian trawl fishery. Fisheries Research 91: 56-68.</p> <p>Zhou, S., Griffiths, S.P. and Miller, M. 2009. Sustainability assessment for fishing effects (SAFE) on highly diverse and data-limited fish bycatch in a tropical prawn trawl fishery. Marine and Freshwater Research 60: 563-570.</p> <p>Zhou, S. (2011). Sustainability assessment of fish species potentially impacted in the Northern Prawn Fishery: 2007-2009. Report to the Australia Fisheries Management Authority, Canberra, Australia. February 2011.</p>

OVERALL PERFORMANCE INDICATOR SCORE:

UoA: Brown Tiger Prawn

scoring element issue	bycatch species
PI 2.2.1a	100
PI 2.2.1b	N/A
PI 2.2.1c	N/A
Total	100
PI 2.1.1 overall	100

100

UoA: Grooved Tiger Prawn

scoring element issue	bycatch species
PI 2.2.1a	100
PI 2.2.1b	N/A
PI 2.2.1c	N/A
Total	100
PI 2.1.1 overall	100

100

UoA: Blue Endeavour Prawn

scoring element issue	bycatch species
PI 2.2.1a	100
PI 2.2.1b	N/A
PI 2.2.1c	N/A

100

PI 2.2.1		The fishery does not pose a risk of serious or irreversible harm to the bycatch species or species groups and does not hinder recovery of depleted bycatch species or species groups		
Total		100		
PI 2.1.1 overall		100		
UoA: Red Endeavour Prawn			100	
<div><div>scoring element</div><div>issue</div></div>		bycatch species		
PI 2.2.1a		100		
PI 2.2.1b		N/A		
PI 2.2.1c		N/A		
Total		100		
PI 2.1.1 overall		100		
UoA: White Banana Prawn			100	
<div><div>scoring element</div><div>issue</div></div>		bycatch species		
PI 2.2.1a		100		
PI 2.2.1b		N/A		
PI 2.2.1c		N/A		
Total		100		
PI 2.1.1 overall		100		
UoA: Red Legged Banana Prawn			100	
<div><div>scoring element</div><div>issue</div></div>		bycatch species		
PI 2.2.1a		100		
PI 2.2.1b		N/A		
PI 2.2.1c		N/A		
Total		100		
PI 2.1.1 overall		100		
CONDITION NUMBER (if relevant):				

Evaluation Table for PI 2.2.2

PI 2.2.2		There is a strategy in place for managing bycatch that is designed to ensure the fishery does not pose a risk of serious or irreversible harm to bycatch populations		
Scoring Issue		SG 60	SG 80	SG 100
a	Guide post	There are measures in place, if necessary, that are expected to maintain the main bycatch species at levels which are highly	There is a partial strategy in place, if necessary, that is expected to maintain the main bycatch species at levels which are highly	There is a strategy in place for managing and minimizing bycatch.

PI 2.2.2	There is a strategy in place for managing bycatch that is designed to ensure the fishery does not pose a risk of serious or irreversible harm to bycatch populations		
		likely to be within biologically based limits, or to ensure the fishery does not hinder their recovery and rebuilding.	likely to be within biologically based limits, or to ensure the fishery does not hinder their recovery and rebuilding.
	Met?	Y	Y
	Justification	<p>Bycatch Management in the NPF (applies to six UoAs: brown tiger prawn, grooved tiger prawn, blue endeavour prawn, red endeavour prawn, white banana prawn, red-legged banana prawn:</p> <p>In accordance with the Fisheries Management Act (FMA) 1991 and Commonwealth Policy on Fisheries Bycatch 2000, all fishery management plans require the development and implementation of bycatch action plans (BAPs) to ensure that bycatch is reduced to a minimum (AFMA 2008b). The first BAP in the NPF was implemented in 1998 (first fishery to implement BAP in Australia), with the introduction of TEDs, BRDs, reduced effort and implementation of spatial and temporal closures (NPFI, 2015). Since then, more than 50% reduction in bycatch has been achieved and now NPFI is moving to the implementation of a Bycatch Strategy based on AFMA Bycatch and Discarding Workplan 2014-2016 (AFMA, 2014). The vision of this strategy is " To reduce the capture of small fish and other bycatch in the Northern Prawn Fishery (NPF) by 30% within three years through a voluntary industry initiative" (NPFI, 2015). The objectives of the strategy are:</p> <ol style="list-style-type: none"> 1. Reduce the capture of small fish and other bycatch by 30% to continually improve and build on past successes in bycatch reduction; 2. Achieve bycatch reductions by July 2018; 3. Provide ongoing monitoring and reporting. <p>Also, the NPF Industry Pty Ltd is offering \$20,000 in cash incentives to encourage NPF skippers to develop and trial new and innovative approaches to reducing bycatch. Strict rules have been developed against which the performance of new innovations will be measured. Only those innovations which are tested and their performance validated by scientific trials in accordance with NPF TED and BRD testing protocol are eligible for consideration in the incentive program.</p> <p>The Strategy focusses on reducing bycatch in the three sub fisheries of the NPF: 1) Tiger Prawn Subfishery; 2) Banana Prawn Subfishery; and 3) Red-Legged Banana Subfishery. Bycatch reduction options examined as part of this Strategy include (but not be limited to): new and/or improved BRD designs, gear modifications, spatial and temporal approaches, triggers/move-on provisions.</p> <p>Regular risk assessments for bycatch species and on-going monitoring through fishery dependent (logbooks, CMOs) and independent (AFMA SO, CSIRO surveys) are also part of the bycatch management, ensuring that any changes in the level of risk will be identified and appropriate actions will be timely implemented.</p> <p>Measures designed to manage the impact on bycatch specifically (a plan for 30% reduction, codes of practice, incentives, BRDs) represent a "strategy", and it is understood how they work to achieve the required outcome (MSC, 2014 FCR v2, Table SA8, Definitions). These measures work together with other measures designed primarily to manage the impact on target species (effort control through gear restrictions and spatial closures) or ETPs (TEDs), to achieve an overall reduction in bycatch. In conclusion, there is a strategy to manage bycatch species in all six UoAs: brown tiger prawn, grooved tiger prawn, blue endeavour prawn, red endeavour prawn, white banana prawn, red-legged banana prawn.</p> <p>The requirement at SG60, SG80 and SG100 is met by all six UoAs.</p>	

PI 2.2.2		There is a strategy in place for managing bycatch that is designed to ensure the fishery does not pose a risk of serious or irreversible harm to bycatch populations		
b	Guide post	The measures are considered likely to work, based on plausible argument (e.g. general experience, theory or comparison with similar fisheries/species).	There is some objective basis for confidence that the partial strategy will work, based on some information directly about the fishery and/or species involved.	Testing supports high confidence that the strategy will work, based on information directly about the fishery and/or species involved.
	Met?	Y	Y	Y
	Justification	<p>The testing of the bycatch strategy includes scientific and industry trial for new BRDs which have to meet the requirements (>10% reduction of bycatch and <2.5% of target catch reduction) in order to be officially approved and used. The BRDs that are in use are regularly assessed for performance in order to continue to be legislated and maintained on the approved BRDs list (Burke <i>et al.</i>, 2012). Currently approved BRDs will remain in legislation until 30 June 2018 when a review will be undertaken and ineffective devices will be removed from the list (NORMAC, 2017).</p> <p>Testing supports high confidence that the strategy will work in all six UoAs. Since the implementation of the first BAP in the NPF, in 1998, with the introduction of TEDs, BRDs, reduced effort and implementation of spatial and temporal closures, more than 50% reduction in bycatch has been achieved (NPF, 2015). Moreover, the breakthrough achievement with the newly approved BRD, Kon's Covered Fisheyes (NORMAC, 2017), which reduces bycatch with more than 30% and at the same time increasing target catch, gives confidence that the uptake of this device by the fishing operators will be high and this will work towards achieving the goal of the new NPF Bycatch Strategy.</p> <p>The requirement is met at SG60, SG80 and SG100 (all UoAs).</p>		
c	Guide post		There is some evidence that the partial strategy is being implemented successfully.	There is clear evidence that the strategy is being implemented successfully.
	Met?		Y	Y
	Justification	<p>Compliance monitoring ensures that the strategy is implemented successfully in all three NPF subfisheries. A gear monitoring program is in place to monitor vessel fishing power and TED/BRD configurations. VMS data covers the whole fleet throughout the seasons to monitor position of vessels especially with respect to spatial and temporal closures (Dichmont <i>et al.</i>, 2014). Crew Observer training and coverage improved in recent years ensuring that best practices are employed in handling, measuring and recording the catch. Logbook recording is complied with, the logbook reports being compulsorily submitted to AFMA for validation (AFMA, 2016).</p> <p>The requirement is met at SG80 and SG100 (all UoAs).</p>		
d	Guide post			There is some evidence that the strategy is achieving its overall objective.
	Met?			Y

PI 2.2.2		There is a strategy in place for managing bycatch that is designed to ensure the fishery does not pose a risk of serious or irreversible harm to bycatch populations																	
	Justification	Since the implementation of the first BAP in the NPF, in 1998, with the introduction of TEDs, BRDs, reduced effort and implementation of spatial and temporal closures, more than 50% reduction in bycatch has been achieved (NPFI, 2015). Trialling new BRDs and adopting only the effective ones, as well as regular performance assessments of the existing one provides evidence on the actual bycatch reduction achieved (the overall objective). The requirement is met at SG100 (all UoAs).																	
References		<p>AFMA, 2008b. AFMA’s Program for Addressing Bycatch and Discarding in Commonwealth Fisheries: An Implementation Strategy. 9 pp. Retrieved from: http://www.afma.gov.au/wp-content/uploads/2014/11/NPF-Bycatch-and-Discard-Workplan-Nov2014.pdf</p> <p>AFMA, 2014a. Northern Prawn Fishery Bycatch and Discarding Workplan, November 2014 – October 2016. Retrieved from: http://www.afma.gov.au/wp-content/uploads/2014/11/NPF-Bycatch-and-Discard-Workplan-Nov2014.pdf</p> <p>AFMA, 2016, <i>Northern Prawn Fishery Directions and Closures</i>, Australian Fisheries Management Authority. Canberra, Australia.</p> <p>Burke A, Barwick M. and Jarrett A. (2012). Northern Prawn Fishery Bycatch Reduction Device Assessment. NPF Industry Pty Ltd</p> <p>Dichmont, C.M, Jarrett, A., Hill, F., Brown, M. (2014) Harvest Strategy for the Northern Prawn Fishery under Input Controls. AFMA</p> <p>NPFI, 2015. Northern Prawn Fishery Bycatch Strategy 2015-2018. 11pp. Retrieved from: http://www.afma.gov.au/wp-content/uploads/2014/02/NPF-Bycatch-Strategy-2015-18-FINAL-VERSION.pdf</p> <p>NORMAC (2017). Agenda Item 4.1. TED and BRD Update. NORMAC Meeting, 13 February, 2017</p>																	
OVERALL PERFORMANCE INDICATOR SCORE:																			
UoA: Brown Tiger Prawn		100																	
<table><tr><td>scoring element</td><td>All bycatch species</td></tr><tr><td>issue</td><td></td></tr><tr><td>PI 2.2.2a</td><td>100</td></tr><tr><td>PI 2.2.2b</td><td>100</td></tr><tr><td>PI 2.2.2c</td><td>100</td></tr><tr><td>PI 2.2.2d</td><td>100</td></tr><tr><td>Total</td><td>100</td></tr><tr><td>PI 2.2.2 overall</td><td>100</td></tr></table>				scoring element	All bycatch species	issue		PI 2.2.2a	100	PI 2.2.2b	100	PI 2.2.2c	100	PI 2.2.2d	100	Total	100	PI 2.2.2 overall	100
scoring element	All bycatch species																		
issue																			
PI 2.2.2a	100																		
PI 2.2.2b	100																		
PI 2.2.2c	100																		
PI 2.2.2d	100																		
Total	100																		
PI 2.2.2 overall	100																		
UoA: Grooved Tiger Prawn																			
<table><tr><td>scoring element</td><td>All bycatch species</td></tr><tr><td>issue</td><td></td></tr><tr><td>PI 2.2.2a</td><td>100</td></tr><tr><td>PI 2.2.2b</td><td>100</td></tr><tr><td>PI 2.2.2c</td><td>100</td></tr><tr><td>PI 2.2.2d</td><td>100</td></tr><tr><td>Total</td><td>100</td></tr><tr><td>PI 2.2.2 overall</td><td>100</td></tr></table>		scoring element	All bycatch species	issue		PI 2.2.2a	100	PI 2.2.2b	100	PI 2.2.2c	100	PI 2.2.2d	100	Total	100	PI 2.2.2 overall	100		
scoring element	All bycatch species																		
issue																			
PI 2.2.2a	100																		
PI 2.2.2b	100																		
PI 2.2.2c	100																		
PI 2.2.2d	100																		
Total	100																		
PI 2.2.2 overall	100																		
UoA: Blue Endeavour Prawn																			

PI 2.2.2		There is a strategy in place for managing bycatch that is designed to ensure the fishery does not pose a risk of serious or irreversible harm to bycatch populations	
<div><div>scoring element issue</div><div>PI 2.2.2a</div><div>PI 2.2.2b</div><div>PI 2.2.2c</div><div>PI 2.2.2d</div><div>Total</div><div>PI 2.2.2 overall</div></div>		<div>All bycatch species</div> <div>100</div> <div>100</div> <div>100</div> <div>100</div> <div>100</div> <div>100</div>	
UoA: Red Endeavour Prawn		<div><div>scoring element issue</div><div>PI 2.2.2a</div><div>PI 2.2.2b</div><div>PI 2.2.2c</div><div>PI 2.2.2d</div><div>Total</div><div>PI 2.2.2 overall</div></div>	<div>All bycatch species</div> <div>100</div> <div>100</div> <div>100</div> <div>100</div> <div>100</div> <div>100</div> <div>100</div>
UoA: White Banana Prawn		<div><div>scoring element issue</div><div>PI 2.2.2a</div><div>PI 2.2.2b</div><div>PI 2.2.2c</div><div>PI 2.2.2d</div><div>Total</div><div>PI 2.2.2 overall</div></div>	<div>All bycatch species</div> <div>100</div> <div>100</div> <div>100</div> <div>100</div> <div>100</div> <div>100</div> <div>100</div>
UoA: Red Legged Banana Prawn		<div><div>scoring element issue</div><div>PI 2.2.2a</div><div>PI 2.2.2b</div><div>PI 2.2.2c</div><div>PI 2.2.2d</div><div>Total</div><div>PI 2.2.2 overall</div></div>	<div>All bycatch species</div> <div>100</div> <div>100</div> <div>100</div> <div>100</div> <div>100</div> <div>100</div> <div>100</div>
CONDITION NUMBER			

Evaluation Table for PI 2.2.3

PI 2.2.3		Information on the nature and the amount of bycatch is adequate to determine the risk posed by the fishery and the effectiveness of the strategy to manage bycatch		
Scoring Issue		SG 60	SG 80	SG 100
a	Guide post	Qualitative information is available on the amount of main bycatch species taken by the fishery.	Qualitative information and some quantitative information are available on the amount of main bycatch species taken by the fishery.	Accurate and verifiable information is available on the catch of all bycatch species and the consequences for the status of affected populations.
	Met?	Y	Y	Y
	Justification	<p>Qualitative and quantitative information is available from multiple sources on bycatch species caught by each of the three subfisheries:</p> <ul style="list-style-type: none"> - fishery dependent: logbooks and CMO program; - fishery independent: AFMA Scientific Observers (AFMA SOs), NPF prawn monitoring program (by CSIRO), CSIRO historical surveys, research studies (Dichmont <i>et al.</i>, 2014; Fry <i>et al.</i>, 2015; Kenyon <i>et al.</i>, 2016, Stobutzki <i>et al.</i>, 2001a, 2001b, 2002; Tonks <i>et al.</i>, 2008; Dell <i>et al.</i>, 2009, Fry & Miller, 2016). <p>This information is regularly assessed and reported in the Bycatch Sustainability Assessment reports (Fry <i>et al.</i>, 2015) and Integrated Monitoring reports (Kenyon <i>et al.</i>, 2016) and used to regularly assess the risk from each subfishery, to bycatch species, using the ERAEF framework. Most bycatch species, the teleost and elasmobranchs, were assessed quantitatively at SAFE, cumulatively from the tiger prawn and banana prawn subfisheries (Zhou & Griffiths, 2008; Zhou <i>et al.</i>, 2009, Zhou, 2011). The invertebrate species that were not assessed PSA under “byproduct” component have very low percentage contributions to the catch in all three subfisheries, most well below 0.05%, and the impact was considered <i>de minimis</i>. All invertebrate species caught in prawn trawls in the NPF have been assessed for sustainability in benthic biodiversity and trawl impact studies (Hill <i>et al.</i>, 2002, Haywood <i>et al.</i>, 2005, Bustamante <i>et al.</i>, 2010) For all three subfisheries (all six UoAs) accurate and verifiable information (from fishery dependent and fishery-independent sources) is available on the catch of all bycatch species and the consequences for the status of affected populations. The requirement is met at SG60, SG80 and SG100 by all six UoAs.</p>		
b	Guide post	Information is adequate to broadly understand outcome status with respect to biologically based limits	Information is sufficient to estimate outcome status with respect to biologically based limits.	Information is sufficient to quantitatively estimate outcome status with respect to biologically based limits with a high degree of certainty.
	Met?	Y	Y	Y
	Justification	<p>Information is sufficient to quantitatively estimate the outcome status with respect to biologically based limits with high degree of certainty, in all six UoAs because bycatch species identified in the three subfisheries have been assessed quantitatively in risk assessments SAFE (teleosts and elasmobranchs) and in susceptibility and recoverability of benthic biodiversity and trawl impact studies for invertebrate. The requirement is met at SG60 SG80 and SG100 (all six UoAs).</p>		

PI 2.2.3		Information on the nature and the amount of bycatch is adequate to determine the risk posed by the fishery and the effectiveness of the strategy to manage bycatch		
c	Guide post	Information is adequate to support measures to manage bycatch.	Information is adequate to support a partial strategy to manage main bycatch species.	Information is adequate to support a strategy to manage bycatch species, and evaluate with a high degree of certainty whether the strategy is achieving its objective.
	Met?	Y	Y	Y
	Justification	Information is adequate to support a strategy to manage bycatch species, and evaluate with a high degree of certainty whether the strategy is achieving its objective in all three subfisheries. The main objective of the strategy is minimising bycatch overall. This is achieved through measure specifically designed to manage impact on bycatch (BRDs) combined with other measures that were designed primarily for managing impact on other components (effort control, monitoring). Compliance monitoring collects information on how the strategy is implemented and BRD testing allows evaluation of BRD performance and testing if the strategy is achieving its objective. Regular risk assessments and monitoring of “at risk” bycatch allows early identification of any increase in risk to bycatch populations and if new management measures need to be considered. Information is adequate to support a strategy to manage bycatch species, and evaluate with a high degree of certainty whether the strategy is achieving its objective. For all three subfisheries, the requirement is met at SG60, SG80 and SG100.		
d	Guide post		Sufficient data continue to be collected to detect any increase in risk to main bycatch species (e.g. due to changes in the outcome indicator scores or the operation of the fishery or the effectiveness of the strategy).	Monitoring of bycatch data is conducted in sufficient detail to assess ongoing mortalities to all bycatch species.
	Met?		Y	Y
	Justification	Sufficient data, fishery dependent and fishery independent, continue to be collected through a comprehensive NPF data collection, to detect any increase in risk to main bycatch species. Monitoring of bycatch data is conducted in sufficient detail to assess ongoing mortalities to all bycatch species in all three subfisheries. Observer coverage is greater in tiger prawn subfishery where the highest volume of bycatch is taken, but there is some coverage in each subfishery. AFMA SOs subsample trawl catch for the trawls they observe. The “at risk” bycatch species list is updated regularly through updated ERAs and these species are closely monitored in order to collect data for catch rate trend analyses. Ongoing mortalities for all species with meaningful contributions can be inferred from a combination fishery dependent and independent data in all three subfisheries. The requirement is met at SG80 and SG100 by all six UoAs.		
References		<p>Dell, Q., Brewer, D. T., Griffiths, S. P., Heales, D. S. and Tonks, M. L. (2009), Bycatch in a tropical schooling – penaeid fishery and comparisons with a related, specialised trawl regime. Fisheries Management and Ecology, 16: 191–201. doi:10.1111/j.1365-2400.2009.00655.x.</p> <p>Dichmont, C.M, Jarrett, A., Hill, F., Brown, M. (2014) Harvest Strategy for the Northern Prawn Fishery under Input Controls. AFMA</p>		

PI 2.2.3	Information on the nature and the amount of bycatch is adequate to determine the risk posed by the fishery and the effectiveness of the strategy to manage bycatch														
	<p>Fry, G and Miller, M. (2016). NPF Bycatch Data Summaries for Marine Stewardship Council Audit. Report for NPFI and AFMA</p> <p>Fry, G.C., Barwick, M, Lawrence, E. and Tonks, M. (2015) Monitoring interactions with bycatch species using crew-member observer data collected in the Northern Prawn Fishery: 2013 – 2014. Final Report to AFMA; R2013/0806. CSIRO, Australia. Pp. 218.</p> <p>Kenyon, R.A., Ellis, N., Donovan, A.G., van der Velde, T.D., Fry, G., Tonks, M., Cheers, S. and Dennis, D. 2016. An integrated monitoring program for the Northern Prawn Fishery 2012–2015. AFMA 2011/0811 Final Report. CSIRO Oceans and Atmosphere, Brisbane. 200 pp.</p> <p>Stobutzki, I.C., Miller, M.J., Jones, P., Salini, J.P. 2001a. Bycatch diversity and variation in a tropical Australian penaeid fishery: the implications for monitoring. <i>Fisheries Research</i> 53: 283–301.</p> <p>Stobutzki, I., Miller, M., & Brewer, D. 2001b. Sustainability of fishery bycatch: a process for assessing highly diverse and numerous bycatch. <i>Environmental Conservation</i>, 28(02), 167-181.</p> <p>Stobutzki, I. C., Miller, M. J., Heales, D. S., & Brewer, D. T. (2002). Sustainability of elasmobranchs caught as bycatch in a tropical prawn (shrimp) trawl fishery. <i>Fishery Bulletin</i>, 100(4), 800-821.</p> <p>Svane, I., Rodda, K. and Thomas, P. (2007). Prawn fishery by-catch and discards: marine ecosystem analysis - population effects. FRDC Report 2003/023. 404 pp.</p> <p>Tonks, M.L., Griffiths, S.P., Heales, D.S., Brewer, D.T., and Dell, Q. 2008. Species composition and temporal variation of prawn trawl bycatch in the Joseph Bonaparte Gulf, northwestern Australia. <i>Fisheries Research</i> 89: 276-293.</p> <p>Zhou, S. and Griffiths, S.P. 2008. Sustainability assessment for fishing effects (SAFE): a new quantitative ecological risk assessment method and its application to elasmobranch bycatch in an Australian trawl fishery. <i>Fisheries Research</i> 91: 56-68.</p> <p>Zhou, S., Griffiths, S.P. and Miller, M. 2009. Sustainability assessment for fishing effects (SAFE) on highly diverse and data-limited fish bycatch in a tropical prawn trawl fishery. <i>Marine and Freshwater Research</i> 60: 563-570.</p> <p>Zhou, S. (2011). Sustainability assessment of fish species potentially impacted in the Northern Prawn Fishery: 2007-2009. Report to the Australia Fisheries Management Authority, Canberra, Australia. February 2011.</p>														
OVERALL PERFORMANCE INDICATOR SCORE:															
CONDITION NUMBER (if relevant):															
UoA: Brown Tiger Prawn															
<table><tr><th>scoring element issue</th><th>All bycatch species</th></tr><tr><td>PI 2.2.3a</td><td>100</td></tr><tr><td>PI 2.2.3b</td><td>100</td></tr><tr><td>PI 2.2.3c</td><td>100</td></tr><tr><td>PI 2.2.3d</td><td>100</td></tr><tr><td>Total</td><td>100</td></tr><tr><td>PI 2.2.3 overall</td><td>100</td></tr></table>	scoring element issue	All bycatch species	PI 2.2.3a	100	PI 2.2.3b	100	PI 2.2.3c	100	PI 2.2.3d	100	Total	100	PI 2.2.3 overall	100	100
scoring element issue	All bycatch species														
PI 2.2.3a	100														
PI 2.2.3b	100														
PI 2.2.3c	100														
PI 2.2.3d	100														
Total	100														
PI 2.2.3 overall	100														
UoA: Grooved Tiger Prawn															
100															

PI 2.2.3		Information on the nature and the amount of bycatch is adequate to determine the risk posed by the fishery and the effectiveness of the strategy to manage bycatch	
<div> <div>scoring element</div> <div>issue</div> </div>	All bycatch species		
	PI 2.2.3a	100	
	PI 2.2.3b	100	
	PI 2.2.3c	100	
	PI 2.2.3d	100	
	Total	100	
	PI 2.2.3 overall	100	
UoA: Blue Endeavour Prawn			100
<div> <div>scoring element</div> <div>issue</div> </div>	All bycatch species		
	PI 2.2.3a	100	
	PI 2.2.3b	100	
	PI 2.2.3c	100	
	PI 2.2.3d	100	
	Total	100	
	PI 2.2.3 overall	100	
UoA: Red Endeavour Prawn			100
<div> <div>scoring element</div> <div>issue</div> </div>	All bycatch species		
	PI 2.2.3a	100	
	PI 2.2.3b	100	
	PI 2.2.3c	100	
	PI 2.2.3d	100	
	Total	100	
	PI 2.2.3 overall	100	
UoA: White Banana Prawn			100
<div> <div>scoring element</div> <div>issue</div> </div>	All bycatch species		
	PI 2.2.3a	100	
	PI 2.2.3b	100	
	PI 2.2.3c	100	
	PI 2.2.3d	100	
	Total	100	
	PI 2.2.3 overall	100	
UoA: Red Legged Banana Prawn			100
<div> <div>scoring element</div> <div>issue</div> </div>	All bycatch species		
	PI 2.2.3a	100	
	PI 2.2.3b	100	
	PI 2.2.3c	100	
	PI 2.2.3d	100	
	Total	100	
	PI 2.2.3 overall	100	

Evaluation Table for PI 2.3.1

PI 2.3.1		The fishery meets national and international requirements for the protection of ETP species							
		The fishery does not pose a risk of serious or irreversible harm to ETP species and does not hinder recovery of ETP species							
Scoring Issue		SG 60		SG 80			SG 100		
a	Guide post	Known effects of the fishery are likely to be within limits of national and international requirements for protection of ETP species.		The effects of the fishery are known and are highly likely to be within limits of national and international requirements for protection of ETP species.			There is a high degree of certainty that the effects of the fishery are within limits of national and international requirements for protection of ETP species.		
	Met?	Y		Y			Y		
	Justification	Subfishery	Scoring Elements UoAs	Marine Turtles	Sea snakes	Sea birds	Marine mammals	Saw fish	Signal hood's and Solenostomids
		Tiger	Brown Tiger	x	x	x	x	x	x
		Tiger	Grooved Tiger	x	x	x	x	x	x
		Tiger	Blue Endeavour	x	x	x	x	x	x
		Tiger	Red Endeavour	x	x	x	x	x	x
		Red-legged banana	Red-legged Banana	x	x	x	x	x	
White banana	White Banana	x	x	x	x	x	x		
Table: ETP interaction for each UoA									
While a high number of EPBC-listed species can be encountered in the NPF managed area, not all are likely to interact with prawn trawling. ETPs likely to interact with the three NPF subfisheries include marine mammals, marine turtles, sea snakes, sawfish, syngnathids (seahorses, seadragons, pipehorses and pipefish) and solenostomids (ghost pipefish) and seabirds.									
In general, it is illegal to kill, injure, take, trade, keep or move a EPBC listed species, a listed migratory species, or a listed marine species in a Commonwealth Area, without a permit. If this happens unintentionally, all interactions need to be immediately reported to the Department of the Environment and Energy (DoEE). The EPBC Act covers the requirements for species protected under international agreements. For some species, Australia applies stricter domestic measures to regulate import and export than required under the CITES convention, i.e. all species from Order Cetacea (whales, dolphins and porpoises) are treated as if they were included in Appendix I (DEH, 2002). Specific national requirements were									

PI 2.3.1	<p>The fishery meets national and international requirements for the protection of ETP species</p> <p>The fishery does not pose a risk of serious or irreversible harm to ETP species and does not hinder recovery of ETP species</p>
	<p>defined for marine turtles (DEH, 2003), blue whale (DoE, 2015a) and sawfish and riversharks (DoE, 2015b) in the form of national recovery plans.</p> <p>Marine Turtles</p> <p>All six species of marine turtles that occur in Australian waters are protected under the <i>Environment Protection and Biodiversity Conservation Act 1999</i> (EPBC Act), and various State and Territory legislation. The leatherback, loggerhead and olive ridley turtle are each listed as endangered under the EPBC Act which means that these species may become extinct if the threats to their survival continue. The green, hawksbill and flatback turtle are each listed as vulnerable, which means that they may become endangered if threats continue (DEH, 2003).</p> <p>International requirements. Marine turtles are recognised internationally as species of conservation concern. The six species found in Australia are listed in the 2000 IUCN (World Conservation Union) Red List of Threatened Animals. All marine turtle species occurring in Australian waters are listed on Appendix I of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). In addition, all marine turtles occurring in the Indo-Pacific region are a priority for conservation under the Convention on the Conservation of Migratory Species of Wild Animals (CMS). The flatback turtle is listed on Appendix II of the CMS and the other species are listed on both Appendices I and II. Australia is also a signatory to the CMS Memorandum of Understanding on the Conservation and Management of Marine Turtles and their Habitats of the Indian Ocean and South-East Asia (IOSEA MoU). The MoU is designed to facilitate national level and transboundary actions that will lead to the conservation of turtle populations and their habitats.</p> <p>National requirements, as set in the Recovery Plan for Marine Turtles in Australia, 2003, were to reduce mortality of the marine turtles and increase natural survivorship, develop programs to monitor and assess the size and the status of the populations and identify and protect habitats that are critical to survival for marine turtles. A prescribed management action for the NPF was to monitor the effectiveness of TEDs for all vessels in the NPF. The prescribed criteria for success were that marine turtle capture and mortality declines to levels approaching 5% of 1989-90 levels (>5000 turtles captured per year); less for loggerhead turtles (DEH, 2003), and this milestone has been surpassed (current level of interaction < 100 per year in the NPF, with most turtles caught in the tiger prawn subfishery and very few turtles in the white banana and red-legged banana subfisheries).</p> <p>There is a high degree of certainty that the effects of each of the six UoAs are within limits of national and international requirements for protection of marine turtle species. For all UoAs, the requirements at SG60, SG80 and SG100 are met.</p> <p>Sea snakes</p> <p>All sea snakes are protected under the EPBC Act as “marine”. There are no specific requirements and limits for sea snake species, other than minimising direct and indirect impacts and reporting of interactions. Sea snakes account for the highest number of tiger prawn subfishery interactions with ETPs. Sea snake species likely to be encountered in the NPF area are presented in Table 17 in this report (section 5.3.1). None of these species is listed as endangered. Although the highest number of ETP interactions in all UoAs are with snakes, this number is 10x less than early 1990s (50,000, in Milton, 2001) and post-capture survival has increased (from 50%, in Milton, 2001, to 64% (Milton <i>et al.</i>, 2008b). For the period 2011-2015, over 75% sea snakes caught in the tiger prawn subfishery and more than 80% sea snakes caught in the white banana and red-banana prawn subfisheries were released alive. There is a high degree of certainty that the effects of each of the six UoAs are within limits of national and international requirements for protection of sea snake species. For all UoAs, the requirements at SG60, SG80 and SG100 are met.</p>

PI 2.3.1	<p>The fishery meets national and international requirements for the protection of ETP species</p> <p>The fishery does not pose a risk of serious or irreversible harm to ETP species and does not hinder recovery of ETP species</p>
	<p>Marine Mammals</p> <p>Twenty species of cetaceans and a manatee (see Table 18) have been identified as potentially occurring in the NPF managed area (Griffiths <i>et al.</i>, 2007), however, direct interactions of the NPF subfisheries with marine mammals are very rare (2 dolphin interactions in tiger prawn subfishery and one dolphin interaction in red-legged banana subfishery).</p> <p>International requirements. Australia is party to the CITES convention that regulates international trade in endangered species and Australia applies stricter measures considering all cetaceans listed in Appendix II as if they are listed in Appendix I. Australia is also a party to the CMS and signatory to a number of agreements and memoranda of understanding developed under the convention, including the <i>Memorandum of Understanding for the Conservation of Cetaceans and their habitats in the Pacific Islands Region</i>⁶⁵ and <i>Memorandum of Understanding (MoU) on the Conservation and Management of Dugongs and their Habitats throughout their Range</i>⁶⁶. The requirements for these conventions are not to engage in trade on these protected species and minimise direct and indirect impact as to not further threat their survival and allow recovery. These requirements are integrated into the national requirements.</p> <p>National Requirements. The blue whale is listed as endangered and the sperm whale and Irrawaddy dolphin are listed as vulnerable under the EPBC Act. Currently, apart from the blue whale recovery plan (DoE, 2015a), there are no species-specific requirements for these ETPs. One action required in the blue whale recovery plan that is relevant to fisheries is to minimise vessel collisions. Vessel collisions with prawn trawls are unlikely at the speed trawlers operate (see Figure 30 in this report) (Vanderlaan and Taggart, 2007). Under the EPBC Act, all cetaceans (whales, dolphins and porpoises) are protected in Australian waters. The Australian Whale Sanctuary includes all Commonwealth waters from the 3 nautical mile state waters limit out to the boundary of the Exclusive Economic Zone. Within the Sanctuary it is an offence to kill, injure or interfere with a cetacean (DoE, 1992). Because the NPF was accredited with export approval under the EPBC Act, interaction with these species is not an offence if fishing operations are consistent with the NPF management Plan. Fishers are required to report all interactions in logbooks (AFMA, 2017).</p> <p>There is a high degree of certainty that the effects of each of the six UoAs are within limits of national and international requirements for protection of sea snake species. For all UoAs, the requirement at SG60, SG80 and SG100 is met.</p> <p>Seabirds</p> <p>Seabirds include any species of bird that spends a significant part of their life eating or breeding at sea, such as the albatross, petrels and shearwaters. Interactions with seabirds can happen when boats are trawling and the bird comes into contact with the wires used to drag the net along⁶⁷.</p> <p>National and international requirements. All seabirds are protected under the EPBC Act. None of the 12 species of seabirds (see Table 19) that have been identified as occurring in the NPF area are listed as threaten under the EPBC Act. All species are listed as marine and some are listed under one or more of the agreements: Jamba, Camba and Rokamba⁶⁸. None of these species are on listed on Appendix I of CITES. There are no specific limits and requirements defined for these species. The only requirements are to minimize direct and indirect impacts</p>

⁶⁵ <http://www.cms.int/en/legalinstrument/pacific-islands-cetaceans>

⁶⁶ <http://www.cms.int/en/legalinstrument/dugong>

⁶⁷ <http://www.afma.gov.au/portfolio-item/seabirds/>

⁶⁸ http://www.environment.gov.au/biodiversity/migratory-species/migratory-birds#International_cooperation

PI 2.3.1	<p>The fishery meets national and international requirements for the protection of ETP species</p> <p>The fishery does not pose a risk of serious or irreversible harm to ETP species and does not hinder recovery of ETP species</p>
	<p>of the fishery on marine bird species. There have been no reported direct interactions of the three subfisheries with birds in the period 2011-2015. Indirect impacts are also minimized in the NPF subfisheries through a considerable reduction in the fleet size (less boats that can be followed) and fishing effort, leading to a lower trawl footprint (less areal overlap with birds' distribution ranges) and a decrease in small fish and soft bodied invertebrates bycatch (birds' preferred food) by 8% when TEDs and BRDs are used. The newly approved BRD, Kon's Covered Fisheyes BRD, which reduces small bycatch by 36.7% and at the same time, it increases prawn catch by 0.5% (NORMAC, 2017) has the potential to further reduce the indirect effects on birds by reducing the quantity of discards.</p> <p>There is a high degree of certainty that the effects of each of the six UoAs are within limits of national and international requirements for protection of seabird species. For all UoAs, the requirement at SG60, SG80 and SG100 is met.</p> <p>Sawfish</p> <p>In Australia, at least four species of sawfish are found. Three of these, the largetooth sawfish (<i>Pristis pristis</i>), green sawfish (<i>P. zijsron</i>) and the dwarf sawfish (<i>P. clavata</i>), are currently listed as vulnerable under the EPBC Act 1999, while the narrow sawfish (<i>Anoxypristis cuspidate</i>) is not vulnerable in Australia. All <i>Pristis</i> species are EPBC listed as migratory and are declared endangered (narrow and dwarf sawfish) or critically endangered (smalltooth, largetooth and green sawfish) on the IUCN Red List⁶⁹. Although sawfish species are endangered globally, the Australian sawfish populations are probably the healthiest in the world (Stevens <i>et al.</i>, 2008).</p> <p>There are reported interactions with all four species but only the narrow and the green sawfish were commonly caught during fishery independent surveys, the other two species being exceptionally rare</p> <p>International requirements. All sawfish species, family Pristidae, are listed in CITES Appendix I, trade in these species or any products from sawfish being prohibited. They are also listed in both CMS Appendix I (endangered migratory species) and Appendix II (migratory species conserved through agreements)⁷⁰. Australia is a signatory country for the CMS <i>Memorandum of Understanding on the Conservation of Migratory Sharks</i>⁷¹ which includes sawfish species and aims to achieve favourable conservation status for the species concerned, throughout their range. CITES requirements are met because the NPF was accredited with export approval under the EPBC Act Part 13 that prohibits trade in species listed in Appendix I of CITES. The CMS requirements are integrated in the national requirements.</p> <p>National requirements. A combined recovery plan for the three sawfish species listed as vulnerable under the EPBC Act and two species of river shark, was released in November 2015 (DoE, 2015b). The recovery plan considers international requirements for conservation of sawfish across their range, and identifies actions to be taken, to ensure long-term sustainability of the species (DoE, 2015b).</p> <p>The actions required by the recovery plan, that are relevant to commercial trawl fisheries, are already in place or under consideration, in the NPF management. To summarise, these actions refer to:</p> <ul style="list-style-type: none"> • compliance to the management measures to minimise direct and indirect effects on populations- in place

⁶⁹ <http://www.iucnredlist.org>

⁷⁰ <http://www.cms.int/en/page/appendix-i-ii-cms>

⁷¹ <http://www.cms.int/sharks/>

PI 2.3.1		<p>The fishery meets national and international requirements for the protection of ETP species</p> <p>The fishery does not pose a risk of serious or irreversible harm to ETP species and does not hinder recovery of ETP species</p>		
		<ul style="list-style-type: none"> • creating new managements arrangements to further mitigate adverse impacts- under considerations • improving monitoring and data validation-ongoing • improving fishers' awareness on sawfish conservation needs and training in species identification (DoE, 2015b)- ongoing <p>There is a high degree of certainty that the effects of each of the six UoAs are within limits of national and international requirements for protection of sawfish species. For all UoAs, the requirement at SG100 is met.</p> <p>Syngnathids and Solenostomids</p> <p>The NPF interacts with species from the families Syngnathidae (seahorses, seadragons, pipefishes and pipehorses) and Solenostomidae (ghost pipefish). Forty-four species of syngnathids and solenostomids were identified as potentially occurring in the NPF managed area (Griffiths <i>et al.</i>, 2007) but only two species are commonly caught, the pipefish <i>Trachyrhamphus longirostris</i> and the seahorse <i>Hippocampus hystrix</i> (Fry <i>et al.</i>, 2015). Most interactions with this group occur in the tiger prawn subfishery, while in the white banana, and in the red-legged banana subfisheries interactions with these syngnathids and solenostomids are exceptionally rare.</p> <p>National and International Requirements. Families Syngnathidae and Solenostomidae are EPBC listed as marine, since 2001. It is an offence to kill, injure, take or trade syngnathids and solenostomids in, or from, a Commonwealth area. Actions undertaken in accordance with an accredited management regime such as the NPF Management Plan, or in accordance with a permit under which the action is approved, are not an offence. If interactions with these species occur, and it does not constitute an offence under the Act and it was not authorised by a permit, then the EPBC Act requires that the interaction be reported. <i>Hippocampus spp.</i> from family Syngnathidae are listed on CITES Appendix II, their international trade being regulated⁷². There are no other international requirements for syngnathids and solenostomids. Because the NPF was granted export approval by the DoE until 2019 and because the NPF Management Plan was accredited under the EPBC Act by the DoEE, any activity that is conducted according to the plan meet national and international requirements. Under this management plan, in the NPF tiger prawn subfishery all interactions with syngnathids and solenostomids are compulsorily reported and caught animals are quickly returned to the water. There is a high degree of certainty that the effects of each of the six UoAs are within limits of national and international requirements for protection of syngnathids and solenostomids. For all UoAs, the requirements at SG60, SG80 and SG100 are met.</p>		
b	Guide post	Known direct effects are unlikely to create unacceptable impacts to ETP species.	Direct effects are highly unlikely to create unacceptable impacts to ETP species.	There is a high degree of confidence that there are no significant detrimental direct effects of the fishery on ETP species.
	Met?	Y	Y	Y (partially)
	Justification	<p>Marine Turtles</p> <p>Over 90% of turtle interaction occur in the tiger prawn subfishery. The highest number of species identified interactions are with green turtles, although an important number of interactions are with “unidentified” turtles, although an identification guide is available for</p>		

⁷² <https://cites.org/eng/app/appendices.php>

PI 2.3.1	<p>The fishery meets national and international requirements for the protection of ETP species</p> <p>The fishery does not pose a risk of serious or irreversible harm to ETP species and does not hinder recovery of ETP species</p>
	<p>the crew member and species identification has been improved in recent years (Fry <i>et al.</i>, 2015). More than 90% of the turtles caught in 2011-2015 were released alive (NPFI, 2016, unpublished).</p> <p>Since the introduction of TEDs in the NPF in 2000, catches of turtles have declined significantly (Brewer <i>et al</i> 2006). It has been estimated that since the introduction of TEDs in the NPF, turtle catches have decreased from about 5,000 – 6,000 per year (Poiner and Harris 1996; Robins <i>et al</i> 2003, in Fry <i>et al.</i>, 2015) to the current number of annual interactions (less than 70, in NPFI, 2016, unpublished) (Brewer <i>et al</i> 2004).</p> <p>Ongoing monitoring by fishery-dependent and fishery-independent programs is in place. However, due to the effectiveness of TEDs in the fishery, it is unlikely that sufficient catch data will be recorded in the future to carry out a robust catch rate trend assessment on these species. Brewer <i>et al</i> (2007) suggested that between 24,000 and 124,000,000 trawls were needed to detect an annual decline in catches of turtles in the NPF when TEDs were used.</p> <p>Fry <i>et al.</i>, (2015) assessed the sustainability of the NPF bycatch, including marine turtles. They found that turtles had a widespread distribution across northern Australia and mean catch rates were variable across 'Regions' and 'Years' in each of the three data sets used (CMOs, NPF prawn monitoring surveys, AFMA SOs). There appeared to be no general population declines for any of the turtle species or the 'Unidentified Cheloniidae' group from the AFMA scientific observer and NPF prawn population monitoring data (Fry <i>et al.</i>, 2015).</p> <p>Fry <i>et al.</i>, 2015 concluded that although it is difficult to quantify the effect of trawling on turtles with other impacts such as indigenous hunting for food, egg collecting and disruptions to turtle nesting sites caused by coastal infrastructure progress and other impacts such as pollution and ghost-fishing, there is strong evidence to indicate current commercial prawn trawling practices of using TEDs has minimal impact on turtle species populations. The turtles that continue to be captured while TEDs are used in the fishing gear are primarily taken during the winching-up of the nets, a late stage in the fishing operation. Most of these sea turtles are presumed to survive due to the short time they are in the trawl (Robins <i>et al.</i>, 2002). The mortality on turtles from commercial trawling has also been significantly reduced due to the effectiveness of TEDs at quickly removing these animals from the prawn trawl catch once they enter the net opening and travel down the net throat, thus, unobserved mortality is unlikely (Fry <i>et al.</i>, 2015).</p> <p>All marine turtle species have been risk assessed from the tiger and banana prawn subfisheries separately and the results were distributed to key biological researchers to provide expert opinion (see Table 16 and Table 22). Although all turtle species scored medium risk this was downgraded through expert override because turtles are excluded by TEDs and they also have wide distribution outside the fishing area (Griffiths <i>et al.</i>, 2007).</p> <p>There is a high degree of confidence that there are no significant detrimental direct effects of any of the six UoAs on marine turtle species. The requirement is met at SG60, SG80 and SG100.</p> <p>Sea snakes</p> <p>Sea snakes continue to be caught in significant numbers in all three subfisheries as shown in logbooks data summarised in Table 15, Table 21 and Table 25. In tiger prawn subfishery snakes were caught with an annual average of 5434 animals in 2011-2015, and about 75% were released alive. In the white banana prawns subfishery, an average of 1473 sea snakes were caught in the same period, with about 80% released alive, while in the red-legged banana subfishery, 249 sea snakes on average were caught, and >80% released alive. Some BRDs such as Popeye Fishbox, set at 70 meshes from the codend drawstring, were found to be efficient in reducing sea snake bycatch, however, positioning the BRDs closer to the codend drawstring leads to prawn losses as well (Milton <i>et al.</i>, 2008b). At the 2012 BRD assessment,</p>

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	<p>pop-eye fishbox BRD was not used in the NPF fleet (Burke <i>et al.</i>, 2012). However, the reduction in overall bycatch and especially exclusion of large bodied animals, through the use of TEDs, has led to 13% reduction in sea snake mortality, (Milton <i>et al.</i>, 2008b).</p> <p>Species identification for sea snakes is challenging because they need to be returned to the sea as quickly as possible to increase survivability and live sea snakes are dangerous to handle. The crew members from the CMO program were trained in data collection and recording, photographing and safe handling practices for sea snakes. Even though the quality of data collection by the CMOs has improved, there is still a high number of sea snake interactions reported as “unidentified” (Griffiths <i>et al.</i>, 2007).</p> <p>In 2007-2008 all sea snakes recorded in the NPF were risk assessed from the tiger prawn subfishery at ERAEF level 2, PSA (Griffiths <i>et al.</i>, 2007), and at level 2.5, SAFE (Milton <i>et al.</i>, 2008b). From the earlier studies, two species of sea snake were found potentially at risk from trawling (Milton 2001). These species, <i>Disteira kingii</i> and <i>Hydrophis pacificus</i> were mostly distributed within trawl grounds and had life history traits that made them vulnerable to increased mortality (late maturing, few young, and poor post-trawl survival) (Milton <i>et al.</i>, 2008b). However, at SAFE analysis, Milton <i>et al.</i> (2008b) found that catch rates of most species have not shown a measurable change since the early 1970s and fishing mortality was well below maximum sustainable fishing mortality reference points.</p> <p>SAFE results showed that the estimated fishing mortalities for sea snake species that interact were lower than the minimum unsustainable fishing mortality (set at natural mortality) and lower than maximum sustainable fishing mortality (set at 0.5 natural mortality). Even when the uncertainty was considered (95%CI) sea snake species fishing mortality from tiger prawn subfishery was lower than the reference points. Focusing on tiger prawn subfishery, where the risk to sea snakes is higher, provides a conservative measure of risk for the other two subfisheries.</p> <p>There appears to be a low risk of unsustainable trawl impacts of the NPF on sea snake populations in northern Australia with the current trawl fleet size and fishing practices (Milton <i>et al.</i>, 2008). Even the BRDs used in the NPF so far are not efficient in removing sea snake bycatch, this is compensated by the significant reduction in fishing effort, the low trawl footprint, the existence of permanently closed areas and the fact that all impacted species have wide distribution in unfished areas (Milton <i>et al.</i>, 2008b).</p> <p>At the latest bycatch sustainability assessment, there was sufficient data available to undertake the catch rate trend analysis for seven sea snake species (<i>Aipysurus eydouxii</i>, <i>Aipysurus laevis</i>, <i>Astrotia stokesii</i>, <i>Disteira major</i>, <i>Hydrophis elegans</i>, <i>Hydrophis ornatus</i> and <i>Lapemis curtus</i>) (Fry <i>et al.</i>, 2015). None of these species showed clear declines in catches from 2003 to 2013 during either the crew-member observer program or the AFMA scientific observer program and CSIRO’s NPF prawn population monitoring surveys (Fry <i>et al.</i>, 2015).</p> <p>Considering all the information presented, in the tiger NPF, all possible measures to minimise sea snake bycatch are undertaken and even though the number of interactions is still high, this is much lower than in the early 1990s (50,000, in Milton, 2001) and post-capture survival has increased (Milton <i>et al.</i>, 2008b).</p> <p>Species level identification for sea snakes is challenging for crew members however this is partially compensated for by the improvements in CMO training and data collections and catch trends were possible to be assessed for seven species. Direct effects from any of the six UoAs are highly unlikely to create unacceptable impacts to sea snake species, although some uncertainty remains, since the interactions are not reported at species level. The requirement is met at SG60 and SG80 but not at SG100.</p> <p>Marine Mammals</p>

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	<p>Whales and dugong interactions have never been recorded in the NPF history. Trawlers operate at relatively low speeds (3.24 knots average, Bishop, 2003 in Zhou, 2011). At such speeds, it is highly unlikely that any big size cetacean or dugong will be seriously injured if they would come in direct contact with a trawler. Vanderlaan and Taggart (2007) found that the speed a ship is travelling when it strikes a whale is directly linked to the severity of the injury the whale will sustain and at trawler's speed, the probability for serious injury is very low (<5%) (Figure 30).</p> <p>During 2011-2015 period, two common dolphin interactions were reported from the tiger prawn subfishery and one from red-legged banana subfishery (NPFI, 2016, unpublished data). All marine mammal species have been risk assessed at Level 2 PSA within the ERAEF framework, in 2007. The common dolphin, scored "low risk" despite of the few interactions recorded since 2011. All the other mammal species scored as "medium risk" which was downgraded by expert override by the NPFRAG. The reason for downgrade was that some of these species are too large to be caught in a prawn trawl and for the smaller species, TEDs allow escape (Griffiths <i>et al.</i>, 2007). The remaining interactions with dolphins occur at the cod's drawstrings or in try nets (small nets that can be used when searching for prawns) which do not have TEDs. There is a high degree of confidence that there are no significant detrimental direct effects of any of the six UoAs on marine turtle species. The requirement is met at SG60, SG80 and SG100.</p> <p>Seabirds</p> <p>The only data available on the distribution of marine bird species in the NPF area is outdated but it may still be relevant. Previous research has shown that the islands in the southern gulf support large breeding colonies of the crested tern (<i>Sterna bergii</i>), least frigatebird (<i>Fregata ariel</i>), brown booby (<i>Sula leucogaster</i>) and roseate tern (<i>Sterna dougallii</i>) as well as small colonies of other species (Garnett and Crowley 1987a, 1987b; Walker 1992, in Blaber & Milton, 1994). There are also significant roosts of the least frigatebird at Weipa and Mornington Island (Blaber & Milton, 1994). The CSIRO undertook two summer cruises in 1990 and 1991 to study the fish and benthos of the Gulf of Carpentaria and at the same time, a census of the seabirds was conducted (Blaber & Milton, 1994). During the surveys, only the crested tern, common tern (<i>Sterna hirundo</i>), lesser frigatebird and the brown booby followed the trawls and actively fed on discards, thus these were the only species at risk to be caught in the gear or risk of collision. The common tern is not listed of birds in ERAEF species list in 2007. The species is a seasonal visitor during summer.</p> <p>In the risk assessment report, the authors noted that there have been no historical bird interactions in the NPF (Griffiths <i>et al.</i>, 2007). 5 gull-billed tern interactions have been reported in the tiger prawn subfishery in 2006, year not included in the risk assessment. Since 2007, however, no bird interactions have occurred (MRAG, 2012, NPFI, 2016, unpublished data). This fact was validated by fishery independent and dependent observers.</p> <p>All marine bird species have been risk assessed at ERAEF level 2, PSA, and apart from the streaked shearwater (medium risk) all scored low risk from the tiger prawn subfishery. Streak shearwater scored medium risk due to missing of several productivity attributes, while susceptibility score was low. The score was downgraded by the NPFRAG experts based on the species never being captured (Griffiths <i>et al.</i>, 2007).</p> <p>Because seabirds are not usually caught or tangled in the prawn trawl gear, there is a high degree of confidence that there are no significant detrimental direct effects of any of the six UoAs on seabirds. The requirement is met at SG60, SG80 and SG100.</p> <p>Sawfish</p> <p>In the tiger prawn subfishery, in a five-year period (2011-2015), 1219 sawfish interactions (yearly average = 244) have been reported (see Table 15), with 75% of the animals released</p>

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	<p>alive. In the white banana prawn subfishery, 750 sawfish were caught in the same period (150 yearly average), with over 80% released alive, while in the red-legged banana, 128 sawfish were caught (yearly average = 26), with 72% released alive. It is possible that not all sawfish that are returned to the sea alive survive.</p> <p>The <i>Anoxypristis cuspidata</i> was the most common sawfish species recorded in the NPF, around 97% of all sawfish captured during monitoring programs were from this one species, thus, it is very likely that most “unidentified” sawfish interactions are with this species. The distribution of <i>Anoxypristis cuspidata</i> was widespread, from western Joseph Bonaparte Gulf to Weipa in the east (Fry, 2015). This species is not listed as vulnerable and it is not included in the sawfish and river sharks recovery plan (DoE, 2015b).</p> <p>Monitoring programs indicate that catches of the different species of sawfish are remaining constant. It is difficult to determine statistically significant trends though, because of the low number of interactions. With ongoing monitoring, the power of analysis will increase and the uncertainty in trends will be reduced (Fry <i>et al.</i>, 2015).</p> <p>In the NPF, the need for sawfish protection has been identified early on, since the first risk assessments by Stobutzki <i>et al.</i> (2001b, 2002). Sawfish vulnerability was identified based on the high susceptibility of the species to capture (being demersal) and mortality (due to their rostrum entanglement in the net not allowing escape), and the low capacity to recover (low productivity, long lived animals) if the population becomes depleted (Stobutzki <i>et al.</i> 2000; Stobutzki <i>et al.</i> 2002; Zhou and Griffiths 2008).</p> <p>Sawfish species were risk assessed at ERAEF level 2, PSA and 2.5, SAFE (Griffiths <i>et al.</i>, 2007; Zhou & Griffiths in 2008; Zhou in 2011, Zhou <i>et al.</i>, 2015. Although sawfish species scored as high risk at PSA, at SAFE, which is a more quantitative assessment, using species attributes and the actual fishing impact, sawfish scored low risk, even when the uncertainty was considered (90% Confidence Interval). Sawfish species continue to be monitored and AFMA and the NPF are committed to improve species identification and find ways to eliminate sawfish bycatch.</p> <p>There is a high degree of confidence there are no significant direct effects from any of the six UoAs on narrow sawfish. The requirement is met at SG60, SG80 and SG100.</p> <p>Direct effects from any of the six UoAs are highly unlikely to create unacceptable impacts to the other three sawfish species, especially to green sawfish which is the second commonly caught, although some uncertainty remains, since not all the interactions are not reported at species level. The requirement is met at SG60 and SG 80 but not at SG100.</p> <p>Syngnathids and Solenostomids</p> <p>Most syngnathids interactions occur in the tiger prawn subfishery (62 annual average in 2011-2015), while in the white banana prawn subfishery this are very rare, with a maximum of three per year. No interactions with syngnathids and solenostomids were reported in the red-legged banana subfishery.</p> <p>Syngnathids are particularly susceptible to fishing pressures because their biology is characterised by relatively low population densities; low productivity. Shokri <i>et al.</i> (2009) found that most species are more localised than previously thought, and, according to these authors, preserving habitats is one of the most important factors in protecting seahorses. Syngnathids tend to use only certain parts of the suitable habitat, for example, they have been recorded occupying the edges of seagrass beds or macroalgae-dominated reefs and leaving large areas unoccupied (Scales 2010). Most species associate strongly with site, presumably with localised reproduction, although some solenostomids, such as the blue-finned ghost pipefish, may have a prolonged larval stage that may permit longer range dispersal (Kuitert 2009 in DSEWPac, 2012).</p>

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	<p>More than ten species of syngnathids were included in the bycatch sustainability assessment from 2006-2014 monitoring data (Fry <i>et al.</i>, 2015). There were three species of syngnathids recorded by the crew-member observers; <i>Trachyrhamphus longirostris</i>, <i>Hippocampus zebra</i> and <i>Trachyrhamphus sp.</i> The most common species was <i>T. longirostris</i>, occurring in about 2.5% of trawls since 2006, although another 114 trawls recorded catches of syngnathids where individuals were not identified to species as they were released immediately after capture and could not be identified only from photographs (Fry <i>et al.</i>, 2015). From AFMA SO program, <i>T. longirostris</i> was recorded in 72 of the 3239 trawls (2% of all trawls). Similarly, <i>T. longirostris</i>, was the most commonly caught species (in 63 trawls) with only two other species being recorded during the NPF prawn population monitoring surveys. However, most syngnathids caught were not identified to species due to the difficulty in positive identification from photographs (Fry <i>et al.</i>, 2015). A trend analysis of catch rate was possible only for <i>T. longirostris</i> so far and no decline was identified. An application to take, keep and move up to 100 landed dead syngnathids per year is currently under consideration to be approved by the DoEE⁷³. This will allow proper identification and collection of life-history information for each species of syngnathid tiger prawn subfishery interacts with.</p> <p>Syngnathids and solenostomids were risk assessed within the ERAEF framework. The level 2 assessment (PSA), considered all species of syngnathids and solenostomids potentially occurring in the NPF area and the risk was assessed separately from the tiger prawn subfishery and from the banana prawn subfishery. All species scored as low risk white, apart from one syngnathid and one solenostomid which scored medium risk from the tiger prawn subfishery. The syngnathid, <i>Hippocampus spinosissimus</i> scored medium risk due to spatial uncertainty, while the solenostomid, <i>Solenostomus cyanopterus</i>, for missing productivity attributes (Griffiths <i>et al.</i>, 2007). These two species have not been reported in the tiger prawn subfishery monitoring data but it is possible they are included in the “unidentified” group. The uncertainty will be lowered when the permit for research will be granted by the DoEE and each species will be possible to be identified.</p> <p>At the level 2.5 assessment, SAFE, only the species that have been recorded as captured by the fishery before 2007 were included <i>Trachyrhamphus longirostris</i> and <i>Hippocampus queenslandicus</i> and <i>Filicampus tigris</i> (Griffiths <i>et al.</i>, 2007). Currently, <i>H. queenslandicus</i> and <i>H. spinosissimus</i> are considered same species. At SAFE assessment syngnathid species scored low risk from tiger prawn and banana prawn subfisheries cumulatively (Zhou & Griffiths, 2008, Zhou, 2011). All syngnathids and solenostomids that occur in the NPF area have wide distributions (although maybe patchy) in unfished areas and most species have preference for structured habitats (usually seagrass beds or reef habitat) that occur within permanently closed areas. Also, tiger prawn subfishery’s footprint is very low compared to the NPF managed area, NPF trawl footprint currently being about 1.6%.</p> <p>The number of annual interactions of the tiger prawn subfishery with syngnathids and solenostomids was variable between 2011-2015, with a maximum of 140 in 2013. The animals caught are likely to represent a very small proportion of the population.</p> <p>For the most commonly caught syngnathid, <i>T. longirostris</i>, there is a high degree of confidence that there are no significant detrimental direct effects of the tiger prawn subfishery UoAs (brown tiger prawn, grooved tiger prawn, blue endeavour prawn and red endeavour prawn) on this species. The requirement is met at SG60, SG80 and SG100.</p> <p>For all the other species of syngnathids and solenostomids, direct effects from brown tiger prawn, grooved tiger prawn, blue endeavour prawn and red endeavour prawn UoAs are highly unlikely to create unacceptable impacts. Because of the difficulty to identify species there is</p>

⁷³ <http://www.environment.gov.au/biodiversity/threatened/permits/e2016-0127>

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		<p>higher uncertainty about species distributions and biology, and possibility of localised depletions. The requirement is met at SG60 and SG80.</p> <p>For white banana prawn and red-legged prawn subfisheries there is a high degree of confidence that there are no significant detrimental direct effects on syngnathids and solenostomids. The requirement is met at SG60, SG80 and SG100.</p>		
c	Guide post		Indirect effects have been considered and are thought to be unlikely to create unacceptable impacts	There is a high degree of confidence that there are no significant detrimental indirect effects of the fishery on ETP species.
	Met?		Y	Y(partially)
	Justification	<p>Marine Turtle</p> <p>The tiger prawn, white banana prawn and red-legged banana prawn subfisheries do not overlap with key breeding or aggregation areas and fishing for prawns does not disrupt turtles' habitat. Other indirect effects, such as discarding biological and non-biological material have been assessed at ERAEF level 1, SICA, and were not considered significant (Griffiths <i>et al.</i>, 2007). There is a high degree of confidence that there are no significant detrimental indirect effects of any of the six UoAs on turtle species. The requirement is met at SG80 and SG100.</p> <p>Sea snakes</p> <p>Indirect effects of the tiger prawn and banana prawn subfisheries have been considered during ERAEF at SICA level and it was concluded that these were not significant (Griffiths <i>et al.</i>, 2007). The risk from the red-legged banana prawn subfishery was not assessed separately but this was included in the risk level for the banana and tiger subfisheries because at the time of the risk assessment subfisheries were defined by the season (banana and tiger). There is a high degree of confidence that there are no significant detrimental indirect effects of any of the six UoAs prawn subfishery on sea snake populations. The requirement is met at SG80 and SG100.</p> <p>Marine Mammals</p> <p>Dolphins are known to follow prawn trawlers and feed on discarded bycatch (Wassenberg & Hill, 1990; Hill & Wassenberg, 2000, Svane, 2005). There is no clear evidence to demonstrate this would be harmful for dolphin populations (Svane, 2005). Chilvers and Corkeron (2001), showed that bottlenose dolphin may form different social structures with certain groups following trawls and others foraging in seagrass. This would suggest, according to the authors, that trawling can have different impact on different groups of dolphins and seasonal closures of the fishery would affect trawler foragers by food depletion (Chilvers and Corkeron, 2001). Ansmann <i>et al.</i>, 2012, however, have found that social structures are not fixed but they represent a "complex adaptive system that is resilient to disturbance". Tiger prawn trawling indirect effects on dolphins' behavior have been assessed at SICA and considered negligible because discarding is very limited spatially (Griffiths <i>et al.</i>, 2007). There is a high degree of confidence that there are no significant detrimental indirect effects of any of the six UoAs on dolphin populations. The requirement is met at SG80 and SG100.</p> <p>Seabirds</p> <p>Indirect effects on bird populations have been considered at SICA, level 1 of the ERAEF process and it was concluded that although the NPF prawn trawls do not impact on birds, the trawl discards may significantly affect the behavior and movements of the populations of</p>		

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	<p>birds. The effect on birds of the significant reduction in food availability during the closed season when discards are not available, is unknown (Griffiths <i>et al.</i>, 2007).</p> <p>Seabirds scavenging near fishing vessels, are commonly observed around the world. However, there is little information on the relative importance of discarded by-catch as food and the natural availability of food sources. The number of seabirds scavenging in NPF managed area has not been studied. Studies in Torres Strait Prawn Fishery in the northern Great Barrier Reef showed that only a minor part of prawn trawlers discards is consumed by birds and this occurred mainly during the day (Hill & Wassenberg, 1990; Hill & Wassenberg, 2000). In Torres Strait area (the closest to the NPF area), common and crested terns and lesser and greater frigatebirds were feeding on discards during the day. In tiger prawn subfishery this bird species can only feed for a short time at dusk, because the fishery operates at night (Griffiths <i>et al.</i>, 2007). In white banana and red-legged banana subfisheries may have a higher impact on birds feeding on discards because these subfisheries operate day and night.</p> <p>Birds feed mainly on small fish and soft bodied invertebrates (squid and cuttlefish). While the BRDs did not have a significant effect in reducing small fish bycatch so far, the significant reduction in fishing effort leading to a very low trawl footprint, reduced the quantity of the discarded bycatch and the area affected. Indirect effects are highly unlikely to create unacceptable impact to marine birds, however, because there have been no studies of population trends in bird species that actively feed on discards, some uncertainty remains. Indirect effects from the NPF subfisheries have been considered and are thought to be unlikely to create unacceptable impacts. The requirement is met at SG80 by all six UoAs but not at SG100.</p> <p>Sawfish</p> <p>Indirect effects on sawfish populations, such as interfering with their feeding or breeding behaviour, were considered low at ERA Level 1, SICA (green sawfish was assessed under a “worst scenario” approach, Griffiths <i>et al.</i>, 2007). In addition, sawfish pupping grounds are entirely within permanently closed areas. There is a high degree of confidence there are no significant detrimental indirect effects from the NPF subfisheries on sawfish species. The requirement is met at SG80 and SG100 by all six UoAs.</p> <p>Syngnathids and solenostomids</p> <p>Indirect effects on syngnathids and solenostomids were assessed at ERAEF level 1 (SICA) when assessing TEP component (threaten, endangered and protected) and they were not considered unacceptable. Breeding habitats for syngnathids and solenostomids are sheltered areas of seagrass or coral reef/ rubble, which are inaccessible to prawn trawling or protected in permanently closed areas. The syngnathids and the solenostomids eat small invertebrates and fish larvae, thus the populations are not likely to be affected by the tiger prawn subfishery’s removals. Indirect effects from any of the six UoAs are thought to be unlikely to create unacceptable impact to syngnathids, although, because species identification for syngnathids and solenostomids and information on their distribution are limited the degree of confidence is not high. The requirement is met at SG80 by all six UoAs but not at SG100.</p>
References	<p>AFMA, 2017, <i>Northern Prawn Fishery Directions and Closures</i>, Australian Fisheries Management Authority. Canberra, Australia. Retrieved from: http://www.afma.gov.au/wp-content/uploads/2017/03/Final-NPF-Directions-and-Closures-2017.pdf</p> <p>Ansmann, I. C., Parra, G. J., Chilvers, B. L., & Lanyon, J. M. (2012). Dolphins restructure social system after reduction of commercial fisheries. <i>Animal Behaviour</i>, 84(3), 575-581. doi:10.1016/j.anbehav.2012.06.009</p>

<p>PI 2.3.1</p>	<p>The fishery meets national and international requirements for the protection of ETP species</p> <p>The fishery does not pose a risk of serious or irreversible harm to ETP species and does not hinder recovery of ETP species</p>
	<p>Brewer DT, Heales DS, Milton C, Dell Q, Fry G, Venables B and Jones P. 2006. The impact of turtle excluder devices and bycatch reduction devices on diverse tropical marine communities in Australia's northern prawn trawl fishery. <i>Fisheries Research</i> 81: 176-188.</p> <p>Brewer DT, Griffiths S, Heales DS, Zhou S, Tonks M, Dell Q, Taylor BT, Miller M, Kuhnert P, Keys S, Whitelaw W, Burke A and Raudzens E. 2007. Design, trial and implementation of an integrated long-term bycatch monitoring program road tested in the Northern Prawn Fishery. Final Report FRDC Project 2002/035. CSIRO Cleveland. http://frdc.com.au/research/Documents/Final_reports/2002-035-DLD.PDF</p> <p>Blaber SJM and Milton DA (1994) Distribution of seabirds at sea in the Gulf of Carpentaria, Australia. <i>Marine and Freshwater Research</i> 45, 445-454. https://doi-org.elibrary.jcu.edu.au/10.1071/MF9940445</p> <p>Burke A, Barwick M. and Jarrett A. (2012). Northern Prawn Fishery Bycatch Reduction Device Assessment. NPF Industry Pty Ltd</p> <p>Chilvers BL, Corkeron PJ (2001) Trawling and bottlenose dolphins' social structure. <i>Proceedings of the Royal Society, London B</i> 268: 1901–1905.</p> <p>DoE (2015a). Conservation Management Plan for the Blue Whale—A Recovery Plan under the Environment Protection and Biodiversity Conservation Act 1999, Commonwealth of Australia. Retrieved from: http://www.environment.gov.au/biodiversity/threatened/publications/recovery/blue-whale-conservation-management-plan</p> <p>DoE (2015b). Sawfish and River Sharks Multispecies Recovery Plan, Commonwealth of Australia 2015. Available at: http://www.environment.gov.au/biodiversity/threatened/publications/recovery/sawfish-river-sharks-multispecies-recovery-plan</p> <p>DEH, 2002. Listing of CITES Species Declaration of stricter domestic measure. Environment Protection and Biodiversity Conservation Act 1999. Commonwealth of Australia. Retrieved from: http://www.comlaw.gov.au/comlaw/Legislation/LegislativeInstrument1.nsf/0/BEB3FDF5A B7C1AC9CA2572740001BF54/%24file/stricterdomesticmeasuredeclarationandlist.pdf</p> <p>DEH, 2003. <i>Recovery Plan for Marine Turtles in Australia</i>. Commonwealth of Australia. Retrieved from: http://www.environment.gov.au/system/files/resources/6d26f4aa-751e-4b72-9ab0-984a1d6e0fea/files/marine-turtles.pdf</p> <p>DoE, 1992, Intergovernmental Agreement on the Environment. Retrieved from: http://www.environment.gov.au/about-us/esd/publications/intergovernmental-agreement</p> <p>Department of Sustainability, Environment, Water, Population and Communities (DSEWPoC) (2012). <i>Marine bioregional plan for the North Marine Region</i>. Prepared under the <i>Environment Protection and Biodiversity Conservation Act 1999</i>. Available from: http://www.environment.gov.au/topics/marine/marine-bioregional-plans/north. In effect under the EPBC Act from 27-Aug-2012.</p> <p>Fry, G.C., Barwick, M, Lawrence, E. and Tonks, M. (2015) Monitoring interactions with bycatch species using crew-member observer data collected in the Northern Prawn Fishery: 2013 – 2014. Final Report to AFMA; R2013/0806. CSIRO, Australia. Pp. 218.</p> <p>Griffiths, S., Kenyon, R., Bulman, C., Dowdney, J., Williams, A., Sporcic, M. and Fuller, M. 2007. Ecological Risk Assessment for Effects of Fishing: Report for the Northern Prawn Fishery. Report for the Australian Fisheries Management Authority, Canberra, 319pp.</p> <p>Hill BJ Wassenberg TJ (1990) Fate of discards from Prawn Trawlers in Torres Strait. <i>Marine and Freshwater Research</i> 41, 53-64. https://doi-org.elibrary.jcu.edu.au/10.1071/MF9900053</p>

PI 2.3.1	<p>The fishery meets national and international requirements for the protection of ETP species</p> <p>The fishery does not pose a risk of serious or irreversible harm to ETP species and does not hinder recovery of ETP species</p>
	<p>Milton, D.A., Zhou, S., Fry, G.C. Dell, Q. (2008b). Risk assessment and mitigation for sea snakes caught in the Northern Prawn Fishery. Final report on FRDC Project 2005/051. CSIRO Cleveland, pp. 123.</p> <p>Milton, D.A. (2001). Assessing the susceptibility to fishing of populations of rare trawl bycatch: sea snakes caught by Australia's Northern Prawn Fishery. <i>Biological Conservation</i> 101, 281-290.</p> <p>NORMAC (2017). Agenda Item 4.1. TED and BRD Update. NORMAC Meeting, 13 February, 2017</p> <p>Robins, C.M., A.M. Goodspeed, I. Poiner & B.D. Harch (2002). Monitoring the catch of turtles in the Northern Prawn Fishery. <i>Fisheries Research and Development Corporation</i>. Department of Agriculture, Fisheries & Forestry: Canberra.</p> <p>Scales, H. (2010). Advances in the ecology, biogeography and conservation of seahorses (genus <i>hippocampus</i>). <i>Progress in Physical Geography</i>, 34(4), 443-458. doi:10.1177/0309133310364928</p> <p>Stobutzki, I. C., Miller, M. J., Heales, D. S., & Brewer, D. T. (2002). Sustainability of elasmobranchs caught as bycatch in a tropical prawn (shrimp) trawl fishery. <i>Fishery Bulletin</i>, 100(4), 800-821.</p> <p>Stevens JD, McAuley RB, Simpfendorfer CA and Pillans RD. 2008. Spatial distribution and habitat utilisation of sawfish (<i>Pristis</i> spp) in relation to fishing in northern Australia. <i>A report to the Department of the Environment, Water, Heritage and the Arts</i>. CSIRO and Western Australia Department of Fisheries. http://www.environment.gov.au/coasts/publications/pubs/sawfish-report.pdf</p> <p>Svane, I. (2005). Occurrence of dolphins and seabirds and their consumption of by-catch during trawling in Spencer Gulf, South Australia. <i>Fisheries Research</i>. 76: 317-327.</p> <p>Vanderlaan, A. S. M., & Taggart, C. T. (2007). Vessel collisions with whales: the probability of lethal injury based on vessel speed. <i>Marine Mammal Science</i>, 23(1), 144-156. doi:10.1111/j.1748-7692.2006.00098.x</p> <p>Wassenberg, T. J., and Hill, B. J. (1990). Partitioning of material discarded from prawn trawlers in Moreton Bay. <i>Australian Journal of Marine and Freshwater Research</i> 41, 27-36.</p> <p>Zhou, S. and Griffiths, S.P. 2008. Sustainability assessment for fishing effects (SAFE): a new quantitative ecological risk assessment method and its application to elasmobranch bycatch in an Australian trawl fishery. <i>Fisheries Research</i> 91: 56-68.</p> <p>Zhou, S., Griffiths, S.P. and Miller, M. 2009. Sustainability assessment for fishing effects (SAFE) on highly diverse and data-limited fish bycatch in a tropical prawn trawl fishery. <i>Marine and Freshwater Research</i> 60: 563-570.</p> <p>Zhou, S. (2011). Sustainability assessment of fish species potentially impacted in the Northern Prawn Fishery: 2007-2009. Report to the Australia Fisheries Management Authority, Canberra, Australia. February 2011.</p> <p>Zhou, S., Buckworth, R.C., Miller, M., and Jarrett, A. 2015. A SAFE analysis of bycatch in the Joseph Bonaparte Gulf fishery for Red-legged Banana Prawns. CSIRO Oceans and Atmosphere Flagship, Brisbane, Australia.</p>
OVERALL PERFORMANCE INDICATOR SCORE:	
UoA: Brown Tiger Prawn	90

PI 2.3.1	<p>The fishery meets national and international requirements for the protection of ETP species</p> <p>The fishery does not pose a risk of serious or irreversible harm to ETP species and does not hinder recovery of ETP species</p>						
<div>scoring element</div> <div>issue</div>	Turtles	Sea snakes	Marine Mammals	Sea birds	Saw fish	Syngnathids and solenostomids	
PI 2.3.1a	100	100	100	100	100	100	
PI 2.3.1b	100	80	100	100	80	80	
PI 2.3.1c	100	100	100	80	100	80	
Total	100	95	100	95	95	85	
PI 2.3.1 overall	90						
<p>UoA: Grooved Tiger Prawn</p> <div>scoring element</div> <div>issue</div> <div>PI 2.3.1a</div> <div>PI 2.3.1b</div> <div>PI 2.3.1c</div> <div>Total</div> <div>PI 2.3.1 overall</div> <div>90</div>							
<p>UoA: Blue Endeavour Prawn</p> <div>scoring element</div> <div>issue</div> <div>PI 2.3.1a</div> <div>PI 2.3.1b</div> <div>PI 2.3.1c</div> <div>Total</div> <div>PI 2.3.1 overall</div> <div>90</div>							
<p>UoA: Red Endeavour Prawn</p> <div>scoring element</div> <div>issue</div> <div>PI 2.3.1a</div> <div>PI 2.3.1b</div> <div>PI 2.3.1c</div> <div>Total</div> <div>PI 2.3.1 overall</div> <div>90</div>							
<p>UoA: White Banana Prawn</p> <div>scoring element</div> <div>issue</div> <div>95</div>							

PI 2.3.1		The fishery meets national and international requirements for the protection of ETP species					
		The fishery does not pose a risk of serious or irreversible harm to ETP species and does not hinder recovery of ETP species					
PI 2.3.1a		100	100	100	100	100	100
PI 2.3.1b		100	80	100	100	80	100
PI 2.3.1c		100	100	100	80	100	100
Total		100	95	100	95	95	100
PI 2.3.1 overall		95					
UoA: Red Legged Banana Prawn							
scoring element issue		Turtles	Sea snakes	Marine Mammals	Sea birds	Saw fish	Syngnathids and solenostomids
PI 2.3.1a		100	100	100	100	100	100
PI 2.3.1b		100	80	100	100	80	100
PI 2.3.1c		100	100	100	80	100	100
Total		100	95	100	95	95	100
PI 2.3.1 overall		95					
CONDITION NUMBER (if relevant):							

PI 2.3.2		The fishery has in place precautionary management strategies designed to: <ul style="list-style-type: none"> • Meet national and international requirements; • Ensure the fishery does not pose a risk of serious harm to ETP species; • Ensure the fishery does not hinder recovery of ETP species; and • Minimise mortality of ETP species. 		
Scoring Issue				
a	Guide post	There are measures in place that minimise mortality of ETP species, and are expected to be highly likely to achieve national and international requirements for the protection of ETP species.	There is a strategy in place for managing the fishery's impact on ETP species, including measures to minimise mortality, which is designed to be highly likely to achieve national and international requirements for the protection of ETP species.	There is a comprehensive strategy in place for managing the fishery's impact on ETP species, including measures to minimise mortality, which is designed to achieve above national and international requirements for the protection of ETP species.
	Met?	Y	Y	Y
	Justification	ETP species are managed in the NPF within the Bycatch Strategy (NPFI, 2015) which conforms to the latest Bycatch and Discarding Workplan (AFMA, 2014a) and extends the		

PI 2.3.2	<p>The fishery has in place precautionary management strategies designed to:</p> <ul style="list-style-type: none"> • Meet national and international requirements; • Ensure the fishery does not pose a risk of serious harm to ETP species; • Ensure the fishery does not hinder recovery of ETP species; and • Minimise mortality of ETP species.
	<p>NPF Harvest Strategy (Dichmont <i>et al.</i>, 2014). There are no subfishery specific management measures for ETPs, all three subfisheries having to comply to the same measures.</p> <p>Applicable to ETPs only, according to MSC definition, “comprehensive strategy” is a complete and tested strategy made up of linked monitoring, analyses, and management measures and responses.</p> <p>With the introduction of the NPF Bycatch Strategy, the NPF adopted a comprehensive strategy that focuses on ETP and “at risk species”, plus addresses bycatch reduction overall. Management actions are informed by fishery dependent and fishery independent monitoring.</p> <p>Data from monitoring programs is regularly analysed and reported: bycatch and ETPs sustainability reports (every three years, e.g. Fry <i>et al.</i>, 2015), integrated prawn monitoring reports (for the NPF prawn monitoring program in GoC, every two years, e.g. Kenyon <i>et al.</i>, 2015), BRD performance assessments (next one in 2018, source: NORMAC, 2017). The information obtained from monitoring and research studies is used to regularly assess the risk from each subfishery to the affected species, including ETPs, through ecological risk assessments within ERAEF ranked risk framework developed jointly by AFMA and CSIRO (Griffiths <i>et al.</i>, 2007, Zhou & Griffiths, 2008, Zhou <i>et al.</i>, 2009, Zhou, 2011, Zhou <i>et al.</i>, 2015). A revision of SAFE assessments is scheduled to be completed in 2017. Any identified increase in risk for any ETP species would trigger as response, revision of the risk level by the Bycatch Subcommittee and expert panel and update the NPF priority list. Nevertheless, AFMA and NPFI are proactive (not waiting for an increase in risk) in their ongoing efforts to gear innovations and improvement of the mitigation measure to ensure the effects of the three subfisheries are above the national and international requirements (see Table 14). Defined and measurable performance indicators specific for ETP species, and milestones, are presented in Table 14 (Section 5.2.2, Bycatch Management). The strategy is tested through testing the TEDs and BRDs performance on reducing ETP interactions, as well as assessing the status of the affected populations through monitoring and sustainability assessments.</p> <p>Specific measures</p> <p><i>Turtle Excluder Device</i></p> <p>The use of TEDs (together with an approved BRD) is compulsory in the NPF since 2000. With the use of TEDs, the NPF has been very successful in reducing the incidental capture of turtles significantly from approximately 5700 in the late 1980s to less than 100 per year. The use of TEDs has also reduced the incidental capture of large elasmobranchs. Brewer <i>et al.</i>, 2006 found that TED reduced the capture of narrow sawfish, the most commonly caught sawfish, with 73%, but the effect on the other sawfish species was not statistically significant. Smaller mammals and protected sharks may also be excluded through TEDs. Even though the use of TEDs did not reduce the number of sea snakes caught, it was found to increase sea snakes post-capture survival due to the exclusion of large bodied animal (Brewer <i>et al.</i>, 2006).</p> <p>TEDs are combinations of structures with rigid or semirigid bars with a maximum of bar spacing of 120mm, and an escape opening of at least 700 mm. The escape opening can be placed upward or downward (Figure 30).</p> <p>TEDs must be constructed, installed, and maintained in accordance with minimum technical specifications as defined by the US National Oceanic and Atmospheric Administration (NOAA), to ensure the NPF maintains export approval to the US. In July 2016, officers from NOAA visited Australia to conduct inspections of Australia’s TEDs and to find resolution to</p>

PI 2.3.2	<p>The fishery has in place precautionary management strategies designed to:</p> <ul style="list-style-type: none"> • Meet national and international requirements; • Ensure the fishery does not pose a risk of serious harm to ETP species; • Ensure the fishery does not hinder recovery of ETP species; and • Minimise mortality of ETP species.
	<p>the inconsistencies between NPF standards and US standards. AFMA, NOAA and industry have collaborated on the best way forward for meeting the US best practice gear specifications with specific attention on the use of floats for bottom shooting TEDs and correct measurements of flap overlap (NORMAC, 2017).</p> <p>Bycatch Reduction Devices. At least one BRD must be used in combination with TEDs. Operators have worked closely with scientists and Government to trial TEDs and Bycatch BRDs to find the best combinations that would meet legislative requirements and ensure an environmentally sustainable fishery while also benefiting the operator (i.e. excluding turtles and other large animals and reducing small fish bycatch without prawn loss). In 2001, the AFMA legislated for the mandatory use of TEDs to be used in combination with BRDs. Various BRDs were tested specifically to mitigate ETP catch.</p> <p>One approved BRD was proven to reduce sea snake catch. Popeye Fishbox trials in 2006 revealed that this design can deliver an 87% reduction in catches of sea snakes when installed at 70 meshes from the codend drawstrings (Raudzens, 2007 in Burke <i>et al.</i>, 2012). Adoption of this device has been hampered to date by concerns regarding crew safety. Trialling a modified Popeye Fishbox has been identified as an action under the new bycatch strategy's implementation workplan (NPFI, 2015). No other BRDs were proven efficient in reducing ETP interactions. There is no data yet on the potential ETP catch reductions when using the newly approved BRD, Kon's covered fisheyes.</p> <p>Training and Dissemination of Information</p> <p>NPF Closures and Directions. An annual brochure with current gear regulations and spatial and temporal closures is provided by AFMA. This brochure includes, apart from the current gear regulations and closures, information about the ETPs and monitoring programs and reporting of interactions, about the ETPs identification guide and how to obtain it, and about incentives and opportunities to get involved in CMO program or BRD testing.</p> <p>Protected species identification Guide. To help operators accurately report their protected species interactions, AFMA has produced a protected species identification guide. This guide covers the range of protected species that AFMA managed fisheries do, or have the potential to interact with during their normal fishing operations. The guide provides pictures of these species along with an indicative distribution and key biological information. All NPF boats have been provided with a copy of this identification guide (AFMA, 2017).</p> <p>CMO Training Workshops. The CMO program is a cost-effective manner to obtain additional data on ETP interactions and "at risk" bycatch species, including sawfish, sea snakes, turtles, and syngnathids, and other species identified as being potentially 'at risk' through the Ecological Risk Assessment (ERA) process.</p> <p>Annual workshops are held for CMOs to undertake training and receive support from NPFI, CSIRO scientists and AFMA staff. CMO workshops are designed to provide a valuable learning experience for participants, and are typically held in July prior to the start of the tiger prawn season. The NPFI is responsible for management of the CMO program, including recruiting, training and supporting CMOs, as well as data entry, preliminary analysis, and reporting. In 2011 NPFI implemented a new incentive scheme to generate increased recruitment of CMOs, influence improved retention of CMOs both within and between years, and to enhance the volume and quality of information collected. This has proven to be a significant success. An increase in interest to be involved in the program has been observed since 2011, as well as an increase in the number of CMOs submitting data. Assessment has</p>

PI 2.3.2	<p>The fishery has in place precautionary management strategies designed to:</p> <ul style="list-style-type: none"> • Meet national and international requirements; • Ensure the fishery does not pose a risk of serious harm to ETP species; • Ensure the fishery does not hinder recovery of ETP species; and • Minimise mortality of ETP species. 			
		<p>shown the data quality is of a high standard and is used in combination with CSIRO scientific surveys and AFMA observer data to measure and assess trends in catch rates of the TEP and 'at-risk' species being monitored (AFMA, 2017).</p> <p>Alternative measure under considerations</p> <p>Currently new measures to mitigate sawfish bycatch are considered, and a research application is currently waiting for approval by FRDC. The project will investigate a novel sawfish mitigation device using electric pulse to deter the animals from entering the trawl net. Also, AFMA expects that upcoming CSIRO work in PNG will provide information for the NPF on reducing sawfish interactions. This work will be trialling top and bottom shooting TEDs without the mesh flaps over the openings (this is one of the main locations sawfish get their rostrums stuck as they are escaping via the TED) (Laird, 2016, email communication).</p> <p>Gear modifications so far did not prove efficient to reduce interactions with syngnathids and solenostomids. These interactions are significant only in the tiger prawn subfishery and are managed through all the other measures: ongoing monitoring, population trend assessments and trawl footprint control, which does not overlap with usually preferred habitats of these groups. An application for a permit to keep annually up to 100 dead syngnathids from trawl bycatch is waiting for approval by the DoEE. This will serve for a study to reduce knowledge gaps about species composition of the syngnathid bycatch, their life history and biology and species distribution in the NPF area (Fry <i>et al.</i>, 2015).</p> <p>Non-specific measures</p> <p>Other measures such as permanent and seasonal closures which offer protection to habitats important for ETP species survival and reproduction, substantial decrease in fishing effort after 2006 and trawl footprint control through VMS, contribute to mitigate ETP interactions positively affect ETP populations. Specific and non-specific measure work together and ensure the effects of the three subfisheries are under the limits of national and international requirements.</p> <p>NPF strategy for managing impacts on ETP species is a complete and tested strategy made up of linked monitoring, analyses, and management measures and responses, thus it is a comprehensive strategy for managing impacts from all six UoAs, including measures to achieve above national and international requirements for the protection of ETP species. The requirement is met at SG60, SG80 and SG100.</p>		
b	Guide post	The measures are considered likely to work, based on plausible argument (e.g., general experience, theory or comparison with similar fisheries/species).	There is an objective basis for confidence that the strategy will work, based on information directly about the fishery and/or the species involved.	The strategy is mainly based on information directly about the fishery and/or species involved, and a quantitative analysis supports high confidence that the strategy will work.
	Met?	Y	Y	Y

PI 2.3.2		<p>The fishery has in place precautionary management strategies designed to:</p> <ul style="list-style-type: none"> • Meet national and international requirements; • Ensure the fishery does not pose a risk of serious harm to ETP species; • Ensure the fishery does not hinder recovery of ETP species; and • Minimise mortality of ETP species. 		
	Justification	<p>The strategy is mainly based on information directly about the fishery and/or species involved. The strategy is based on information from ongoing monitoring programs, regular sustainability assessments for the affected species (Fry <i>et al.</i>, 2015), integrated monitoring reports on ETPs catch rate distributions in the GoC (Kenyon <i>et al.</i>, 2016), ecological risk assessments (Griffiths <i>et al.</i>, 2007, Milton <i>et al.</i>, 2008b, Zhou & Griffiths, 2008, Zhou <i>et al.</i>, 2009, Zhou, 2011), gear modifications (TEDs and BRDs) innovations testing (scientific and commercial testing) (Brewer <i>et al.</i>, 2006, Burke <i>et al.</i>, 2012). ETP populations trends and subfisheries' impacts (monitoring, risk assessments, sustainability assessments) are based on both, qualitative and quantitative information. BRD and TED testing provide quantitative quantify the actual reduction in ETP catch.</p> <p>The strategy is mainly based on information directly about the fishery and/or species involved, and a quantitative analysis supports high confidence that the strategy will work. The requirement is met at SG60, SG80 and SG100 by all six UoAs.</p>		
c	Guide post		There is evidence that the strategy is being implemented successfully.	There is clear evidence that the strategy is being implemented successfully.
	Met?		Y	Y
	Justification	<p>Northern Prawn Fishery operators must report all interactions with protected species in paper form or electronic logbook. Gear configuration monitoring and surveys, ensure compliance with gear regulations prescribed in the annual NPF directions and closures document (AFMA, 2017). VMS monitoring ensures compliance with the closed areas and footprint control. The VMS unit must remain switched on at all times including when the boat is in port. The concession holder must ensure the VMS is reporting correctly before going out to sea for the first time and that no interference occurs with the correct operation of the VMS unit (AFMA, 2017). Compliance monitoring ensures proper handling of the ETP catch by the crew and use of the prescribed practices as to not pose an increased risk to the species. There is no evidence of systematic noncompliance in the last 5 years (AFMA 2016-2017). Crew Observer training and coverage improved in recent years ensuring that best practices are employed in handling, measuring and recording the catch. Logbook recording is complied with, the logbook reports being compulsorily submitted to AFMA for validation (AFMA, 2016).</p> <p>There is clear evidence that the strategy is being implemented successfully. For all six UoAs the requirement is met at SG80 and SG100</p>		
d	Guide post			There is evidence that the strategy is achieving its objective.
	Met?			Partially
	Justification	<p>Since compulsory use of TEDs has been introduced in the NPF, marine turtle interactions have reduced to 1% of the 1998 level. Although gear modification to reduce sea snakes catch</p>		

PI 2.3.2	<p>The fishery has in place precautionary management strategies designed to:</p> <ul style="list-style-type: none"> • Meet national and international requirements; • Ensure the fishery does not pose a risk of serious harm to ETP species; • Ensure the fishery does not hinder recovery of ETP species; and • Minimise mortality of ETP species.
	<p>were not successfully adopted due to safety concerns for the crew, through a combination of footprint control, significant reduction in trawl footprint, and effort intensity, permanently closed areas, current level of sea snake catch is less than 1% of the level in 1990s (Milton <i>et al.</i>, 2008b). Post-capture survival rates of the sea snakes have increased from about 51% to over 65% due to the exclusion of large animals by TEDs (Milton <i>et al.</i>, 2008b). Gear modifications were not proven efficient for sawfish other than the narrow sawfish and syngnathids and solenostomids, however, there are indications that no population declines occurred overtime and alternative measures for these species are under consideration. Only tiger prawn subfishery interacts in a more significant way with syngnathids and solenostomids (about 60 annually) while in the other two subfisheries, interactions are null or exceptionally rare. Direct interactions with marine mammals and seabirds are exceptionally rare in tiger prawn subfishery and red-legged banana prawn subfishery null in the white banana prawn subfishery. This is due to low speed trawling, gear configuration prevents direct catch of large mammals and TED excludes smaller ones and specific measure are not necessary for this group (Griffiths <i>et al.</i>, 2007). Gear configuration does not pose a high risk for seabird entanglements or direct capture (Griffiths <i>et al.</i>, 2007). However, potential indirect effects to birds (feeding of discards) in the NPF have not been studied and are unknown, although the amount of discarded bycatch has reduced significantly with the reduction in footprint and fishing effort.</p> <p>There is evidence that the strategy (in all UoAs) is achieving its objective for turtles, sea snakes and narrow sawfish and marine mammals. The requirement is met at SG100.</p> <p>For sawfish species, other than narrow sawfish, and for syngnathids and solenostomids, there is no evidence yet that the strategy is achieving its objective. N/A</p> <p>While the direct impact from the three subfisheries to seabirds are negligible, indirect impacts are unknown and it is not clear if the strategy (reduction in discarded bycatch) is achieving its objective. N/A</p>
References	<p>AFMA, 2014a. Northern Prawn Fishery Bycatch and Discarding Workplan, November 2014 – October 2016. Retrieved from: http://www.afma.gov.au/wp-content/uploads/2014/11/NPF-Bycatch-and-Discard-Workplan-Nov2014.pdf</p> <p>AFMA, 2017, <i>Northern Prawn Fishery Directions and Closures</i>, Australian Fisheries Management Authority. Canberra, Australia. Retrieved from: http://www.afma.gov.au/wp-content/uploads/2017/03/Final-NPF-Directions-and-Closures-2017.pdf</p> <p>Brewer DT, Heales DS, Milton C, Dell Q, Fry G, Venables B and Jones P. 2006. The impact of turtle excluder devices and bycatch reduction devices on diverse tropical marine communities in Australia's northern prawn trawl fishery. <i>Fisheries Research</i> 81: 176-188.</p> <p>Burke A, Barwick M. and Jarrett A. (2012). Northern Prawn Fishery Bycatch Reduction Device Assessment. NPF Industry Pty Ltd</p> <p>Dichmont, C.M, Jarrett, A., Hill, F., Brown, M. (2014) Harvest Strategy for the Northern Prawn Fishery under Input Controls. AFMA</p> <p>Fry, G.C., Barwick, M, Lawrence, E. and Tonks, M. (2015) Monitoring interactions with bycatch species using crew-member observer data collected in the Northern Prawn Fishery: 2013 – 2014. Final Report to AFMA; R2013/0806. CSIRO, Australia. Pp. 218.</p>

PI 2.3.2	<p>The fishery has in place precautionary management strategies designed to:</p> <ul style="list-style-type: none">• Meet national and international requirements;• Ensure the fishery does not pose a risk of serious harm to ETP species;• Ensure the fishery does not hinder recovery of ETP species; and• Minimise mortality of ETP species.																																																	
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scoring element issue	Turtles	Sea snakes	Marine Mammals	Sea birds	Saw fish	Syngnats and solenostomids																																												
PI 2.3.2a	100	100	100	100	100	100																																												
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PI 2.3.2c	100	100	100	100	100	100																																												
PI 2.3.2d	100	100	100	80	80	80																																												
Total	100	100	100	95	95	95																																												
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PI 2.3.2	The fishery has in place precautionary management strategies designed to:					
	<ul style="list-style-type: none">• Meet national and international requirements;					
	<ul style="list-style-type: none">• Ensure the fishery does not pose a risk of serious harm to ETP species;					
	<ul style="list-style-type: none">• Ensure the fishery does not hinder recovery of ETP species; and					
	<ul style="list-style-type: none">• Minimise mortality of ETP species.					

			als			solenost omids		
PI 2.3.2a	100	100	100	100	100	100		
PI 2.3.2b	100	100	100	100	100	100		
PI 2.3.2c	100	100	100	100	100	100		
PI 2.3.2d	100	100	100	80	80	80		
Total	100	100	100	95	95	95		
PI 2.3.2 overall	95							

UoA: Blue Endeavour Prawn								95
scoring element issue	Turtles	Sea snakes	Marine Mammals	Sea birds	Saw fish	Syngnathids and solenost omids		
PI 2.3.2a	100	100	100	100	100	100		
PI 2.3.2b	100	100	100	100	100	100		
PI 2.3.2c	100	100	100	100	100	100		
PI 2.3.2d	100	100	100	80	80	80		
Total	100	100	100	95	95	95		
PI 2.3.2 overall	95							

UoA: Red Endeavour Prawn								95
scoring element issue	Turtles	Sea snakes	Marine Mammals	Sea birds	Saw fish	Syngnathids and solenost omids		
PI 2.3.2a	100	100	100	100	100	100		
PI 2.3.2b	100	100	100	100	100	100		
PI 2.3.2c	100	100	100	100	100	100		
PI 2.3.2d	100	100	100	80	80	80		
Total	100	100	100	95	95	95		
PI 2.3.2 overall	95							

UoA: White Banana Prawn								95
scoring element issue	Turtles	Sea snakes	Marine Mammals	Sea birds	Saw fish	Syngnathids and solenost omids		
PI 2.3.2a	100	100	100	100	100	100		
PI 2.3.2b	100	100	100	100	100	100		
PI 2.3.2c	100	100	100	100	100	100		
PI 2.3.2d	100	100	100	80	80	80		
Total	100	100	100	95	95	95		

PI 2.3.2	<p>The fishery has in place precautionary management strategies designed to:</p> <ul style="list-style-type: none"> • Meet national and international requirements; • Ensure the fishery does not pose a risk of serious harm to ETP species; • Ensure the fishery does not hinder recovery of ETP species; and • Minimise mortality of ETP species. 						
PI 2.3.2 overall	95						
UoA: Red Legged Banana Prawn							
<div>scoring element</div> <div>issue</div>	Turtles	Sea snakes	Marine Mammals	Sea birds	Saw fish	Syngnathids and solenostomids	95
PI 2.3.2a	100	100	100	100	100	100	
PI 2.3.2b	100	100	100	100	100	100	
PI 2.3.2c	100	100	100	100	100	100	
PI 2.3.2d	100	100	100	80	80	80	
Total	100	100	100	95	95	95	
PI 2.3.2 overall	95						
CONDITION NUMBER (if relevant):							

PI 2.3.3		Relevant information is collected to support the management of fishery impacts on ETP species, including: <ul style="list-style-type: none">Information for the development of the management strategy;Information to assess the effectiveness of the management strategy; andInformation to determine the outcome status of ETP species.		
Scoring Issue		SG 60	SG 80	SG 100
a	Guide post	Information is sufficient to qualitatively estimate the fishery related mortality of ETP species.	Sufficient information is available to allow fishery related mortality and the impact of fishing to be quantitatively estimated for ETP species.	Information is sufficient to quantitatively estimate outcome status of ETP species with a high degree of certainty.
	Met?	Y	Y	N
	Justification	There are a number of monitoring processes in place <ul style="list-style-type: none">A fishery-wide (including all three subfisheries) daily catch and effort logbook program under which interactions with ETPs are required to be recorded;		

PI 2.3.3		Relevant information is collected to support the management of fishery impacts on ETP species, including: <ul style="list-style-type: none">• Information for the development of the management strategy;• Information to assess the effectiveness of the management strategy; and• Information to determine the outcome status of ETP species.		
		<ul style="list-style-type: none">• Scientific and Crew-Member Observer programs with higher cover in the tiger prawn subfishery, where the highest number of ETP interactions occur. These programs collect detailed data on ETPs with species identification as far as possible;• Independent pre-season surveys (NPF prawn monitoring program) which collect data on ETP catch rates in order to estimate their abundance and distribution within the Gulf of Carpentaria where the most fishing effort occurs.• A gear monitoring program to monitoring program to monitor vessel fishing power and TED/BRD configurations. Mandatory data is collected through the program, including vessel length, beam, depth, engine power, sonar, trawl speed and TED/BRD configurations. <p>Data from monitoring programs is regularly analysed and reported: bycatch and ETPs sustainability reports (every three years, e.g. Fry <i>et al.</i>, 2015), integrated prawn monitoring reports (for the NPF prawn monitoring program in GoC, every two years, e.g. Kenyon <i>et al.</i>, 2015), BRD performance assessments (next one in 2018, source: NORMAC, 2017). The information obtained from monitoring and research studies is used to regularly assess the risk from each subfishery to the affected species, including ETPs, through ecological risk assessments within ERAEF ranked risk framework developed jointly by AFMA and CSIRO (Griffiths <i>et al.</i>, 2007, Zhou & Griffiths, 2008, Zhou <i>et al.</i>, 2009, Zhou, 2011, Zhou <i>et al.</i>, 2015). A revision of SAFE assessments is scheduled to be completed in 2017.</p> <p>Sufficient information is available to allow fishery related mortality and the impact of fishing from all six UoAs to be quantitatively estimated for all ETP species. The requirement is met at SG60 and SG 80 by all six UoAs.</p> <p>Because not all interactions can be identified to species level, information is not sufficient to quantitatively estimate outcome status of ETP species with a high degree of certainty. The requirement at SG100 is not met in any of the six UoAs.</p>		
b	Guide post	Information is adequate to broadly understand the impact of the fishery on ETP species.	Information is sufficient to determine whether the fishery may be a threat to protection and recovery of the ETP species.	Accurate and verifiable information is available on the magnitude of all impacts, mortalities and injuries and the consequences for the status of ETP species.
	Met?	Y	Y	N
	Justifi cation	Information is sufficient to determine whether any of the three subfisheries may be a threat to protection and recovery of the ETP species because all interactions with ETPs are reported, there is ongoing monitoring, ETP species are risk assessed regularly. For all UoAs, the requirement is met at SG 80. Accurate and verifiable information is not available on the magnitude of all impacts, mortalities and injuries and the consequences for the status of ETP species, mainly because not all ETPs can be identified and reported to species level and a significant number of interactions with every ETP group are reported as “unidentified”. In this way interactions with more vulnerable species of the group cannot be accurately separated from interactions with more robust species of the groups. This is the case especially for sawfish, where, although monitoring has identified that 97% of the interactions are with		

PI 2.3.3		Relevant information is collected to support the management of fishery impacts on ETP species, including: <ul style="list-style-type: none">Information for the development of the management strategy;Information to assess the effectiveness of the management strategy; andInformation to determine the outcome status of ETP species.		
		narrow sawfish (not vulnerable), this cannot be verified for all sawfish interactions with commercial fishing in all three subfisheries. SG100 is not met by any of the six UoAs.		
c	Guide post	Information is adequate to support measures to manage the impacts on ETP species.	Information is sufficient to measure trends and support a full strategy to manage impacts on ETP species.	Information is adequate to support a comprehensive strategy to manage impacts, minimize mortality and injury of ETP species, and evaluate with a high degree of certainty whether a strategy is achieving its objectives.
	Met?	Y	Y	Y
	Justification	Information is sufficient to measure trends and support a full strategy to manage impacts on ETPs species in the three NPF subfisheries, although for some species, trends cannot be statistically significant because due to the effectiveness of the measures to reduce interactions, sufficient catch data cannot be collected. Nevertheless, no populations declines have been identified for any ETP species or groups (Fry <i>et al.</i> , 2015). All ETP species have also been assessed for risk, irrespective of the level of interactions, at PSA. For groups with significant interactions, like sawfish and snakes, these have been assessed at SAFE, which is a more quantitative measure of risk comparing fishing mortality to reference points consistent with MSY. Even though not all interactions are reported to species level, a comprehensive strategy is still possible to manage subfisheries impacts on ETP groups and evaluate with high degree of certainty whether the strategy is achieving its objectives. The requirement is achieved at SG60, SG80 and SG100 by all six UoAs.		
References		AFMA (2016-2017). National Compliance and Enforcement Programme (2016-2017). Available at http://www.afma.gov.au/wp-content/uploads/2016/08/National-Compliance-and-Enforcement-Program-2016-17.pdf Fry, G.C., Barwick, M, Lawrence, E. and Tonks, M. (2015) Monitoring interactions with bycatch species using crew-member observer data collected in the Northern Prawn Fishery: 2013 – 2014. Final Report to AFMA; R2013/0806. CSIRO, Australia. Pp. 218. Griffiths, S., Kenyon, R., Bulman, C., Dowdney, J., Williams, A., Sporcic, M. and Fuller, M. 2007. Ecological Risk Assessment for Effects of Fishing: Report for the Northern Prawn Fishery. Report for the Australian Fisheries Management Authority, Canberra, 319pp. Kenyon, R.A., Deng, R., Donovan, A., van der Velde, T. and Fry, G. (2016). An integrated monitoring program for the Northern Prawn Fishery 2015/18. Report to the Australian Fisheries Management Authority, Project 2015/0810. CSIRO. Brisbane. NORMAC (2017). Agenda Item 4.1. TED and BRD Update. NORMAC Meeting, 13 February, 2017 Zhou, S. and Griffiths, S.P. 2008. Sustainability assessment for fishing effects (SAFE): a new quantitative ecological risk assessment method and its application to elasmobranch bycatch in an Australian trawl fishery. Fisheries Research 91: 56-68. Zhou, S., Griffiths, S.P. and Miller, M. 2009. Sustainability assessment for fishing effects (SAFE) on highly diverse and data-limited fish bycatch in a tropical prawn trawl fishery. Marine and Freshwater Research 60: 563-570.		

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scoring element issue	Turtles	Sea snakes	Marine Mammals	Sea birds	Saw fish	Syngnats and solenostomids																																					
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scoring element issue	Turtles	Sea snakes	Marine Mammals	Sea birds	Saw fish	Syngnats and solenostomids																																					
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scoring element issue		Turtles	Sea snakes	Marine Mammals	Sea birds	Saw fish	Syngnathids and solenostomids		
PI 2.3.3a		80	80	80	80	80	80		
PI 2.3.3b		80	80	80	80	80	80		
PI 2.3.3c		100	100	100	100	100	100		
Total		85	85	85	85	85	85		
PI 2.3.3 overall		85							

UoA: White Banana Prawn									85
scoring element issue		Turtles	Sea snakes	Marine Mammals	Sea birds	Saw fish	Syngnathids and solenostomids		
PI 2.3.3a		80	80	80	80	80	80		
PI 2.3.3b		80	80	80	80	80	80		
PI 2.3.3c		100	100	100	100	100	100		
Total		85	85	85	85	85	85		
PI 2.3.3 overall		85							

UoA: Red Legged Banana Prawn									85
scoring element issue		Turtles	Sea snakes	Marine Mammals	Sea birds	Saw fish	Syngnathids and solenostomids		
PI 2.3.3a		80	80	80	80	80	80		
PI 2.3.3b		80	80	80	80	80	80		
PI 2.3.3c		100	100	100	100	100	100		
Total		85	85	85	85	85	85		
PI 2.3.3 overall		85							

Evaluation Table for PI 2.4.1

PI 2.4.1		The fishery does not cause serious or irreversible harm to habitat structure, considered on a regional or bioregional basis, and function		
Scoring Issue		SG 60	SG 80	SG 100
a	Guide post	The fishery is unlikely to reduce habitat structure and function to a point	The fishery is highly unlikely to reduce habitat structure and function to a	There is evidence that the fishery is highly unlikely to reduce habitat structure and function to a point

PI 2.4.1		The fishery does not cause serious or irreversible harm to habitat structure, considered on a regional or bioregional basis, and function		
		where there would be serious or irreversible harm.	point where there would be serious or irreversible harm.	where there would be serious or irreversible harm.
	Met?	Y	Y	Y white banana UoA, N all other UoAs
	Justification	<p>Although no comprehensive habitat mapping is available for the NPF managed area, data of geomorphology, sedimentology and biodiversity allowed several studies to predict the types and distributions of broad spatial patterns or habitats at regional scale in the GoC and the JBG (Pitcher <i>et al.</i>, 2016, Przeslawski <i>et al.</i>, 2011). These were used to identify main and minor habitats.</p> <p>At NPF ERAEF, 157 fine scale habitats have been identified from photographic data, geomorphic unit mapping, literature, and expert opinion. These habitats were classified on the basis of substratum, geomorphology, and dominant fauna. The list of coastal margin and inner shelf habitats has been generated from limited seafloor image data of inshore fringing reefs in waters ~15-50m (Geoscience Australia Survey 276: SS04/2005 Harris, 2005, in Griffiths <i>et al.</i>, 2007), literature and expert opinion. Poor knowledge of outer shelf and upper slope seabed habitats required that these habitat types be inferred from (1) the presence of known coarse-scale habitat types i.e. 'geomorphic features' (Harris <i>et al.</i>, 2003, in Griffiths <i>et al.</i>, 2007) and (2) the presence of fine-scale habitats known from better known adjacent or similar fishery areas where surveys have taken place in Griffiths <i>et al.</i>, 2007). These fine scale habitat types were not used for the classification in "main" and "minor" due to higher uncertainty about their distribution and ranges within the NPF managed area.</p> <p>Main Habitats.</p> <p>Tiger prawn subfishery (brown tiger prawn, grooved tiger prawn, blue endeavour prawn, red endeavour prawn UoAs). The most affected type of habitat is the one associated with assemblage #9 (Figure 31), along the western side of the GoC, with only 7% closed areas and with a trawl footprint of 13%, trawled 1.9 times per year (see Table 27). This habitat is characterised by high variability of water temperature at the surface, as well as at the sea bottom. The main geomorphic feature is shelf, while terrace is a less extensive feature north of Groote Eylandt (Post <i>et al.</i>, 2006). The sediments in this region have variable mud content and are muddier than in the eastern and southern part of the GoC (Haywood <i>et al.</i>, 2005, fig. 5.3-18). The biotic community comprises mainly deposit-feeding spatangoids (heart urchins) and sand dollars, with a lower biodiversity than in eastern and northern GoC (Hill <i>et al.</i>, 2002). This groups belong to Echinoidea family. Although Hill <i>et al.</i> (2002) found that at fishing effort levels before 2000 echinoids were one of the least sustainable group (high depletion rate and low recovery rate), Haywood <i>et al.</i>, (2005) found this group to be resilient to moderate intensity prawn trawling (low depletion rate). Long <i>et al.</i>, (1995, in Hill <i>et al.</i>, 2002) found that spatangoid echinoids made up 60% of the biomass of the 107 dredge samples taken across the Gulf of Carpentaria and that five taxa accounted for 87% of the sampled biomass. The remaining 841 taxa accounted for only 13% of the biomass. Rarely caught species - those captured in 3 or fewer trawls - were found mainly in the eastern and northern sections of the GoC, thus not in the assemblage #9 area. The most important environmental factors associated with rare species distributions were the oxygen and the temperature (Hill <i>et al.</i>, 2002).</p> <p>More recent benthic impact studies did not find a significant overall impact at current levels of trawling (Bustamante <i>et al.</i>, 2010), although some habitat-forming species may be vulnerable to trawling. In assemblage #9 the mean abundance of habitat-forming benthos was low compared with other sampled assemblages, although gorgonians and bryozoans are present and they and some others do occur patchily at high abundance. According to Pitcher <i>et al.</i>, 2016, these vulnerable types occur in places potentially accessible to and removable by trawls and may be at risk at least locally within assemblages, if not at regional landscape scale. Bustamante <i>et al.</i> (2010) have also shown these species to be negatively related to trawl</p>		

PI 2.4.1	The fishery does not cause serious or irreversible harm to habitat structure, considered on a regional or bioregional basis, and function
	<p>intensity along trawl effort gradients, suggesting that there may have been depletion impacts by repetitive trawling at local scales (Bustamante <i>et al.</i> 2010). The actual risk from tiger prawn trawling and vulnerability of these habitat-forming benthos is not currently clear. At a larger landscape scale, some of these benthic species may be more widely distributed in areas where prawn trawling does not occur (Pitcher <i>et al.</i>, 2016). Nevertheless, corals and anemones and most bryozoans appear to be restricted to assemblage #2 (Pitcher <i>et al.</i>, 2016), where tiger prawn trawling occurs on small areas.</p> <p>There is a low overlap of the tiger prawn fishing effort with assemblage #2, in the southern GoC, around Mornington Island. The trawl footprint in assemblage #2 area is only 5.7% with a trawl intensity of 1.4 times per year, with only small proportion of this being from tiger prawn subfishery.</p> <p>This assemblage occurs on coastal margins and innershelf habitats with sediments with high percentage of sand content and low percentage of mud (Ellis & Pitcher, 2009). Long <i>et al.</i> (1995, in Hill <i>et al.</i>, 2002) found the biotic community in eastern and southern GoC comprised mainly of sessile suspension-feeding sponges, zoantharians, pennatulaceans, bivalve molluscs and ascidians (Hill <i>et al.</i>, 2002). Haywood <i>et al.</i>, 2005, surveyed east and west Mornington regions of the GoC and did not find zoantharians or other cnidarians, but found that sponges dominated in the eastern side. Hill <i>et al.</i> (2002) have shown that molluscs had high sustainability from prawn trawling. Attached invertebrates (e.g. sponges) were shown to be vulnerable to trawls but many of them had a well developed ability to recover from trawl damage (Hill <i>et al.</i>, 2002). In Haywood <i>et al.</i> (2005) depletion experiments, bryozoans, gastropods, phaeophyta and holothuroids were less resilient to prawn trawling. These species also had lower recovery rates in Hill <i>et al.</i> (2002) study. According to Pitcher <i>et al.</i> (2016), most vulnerable habitat-forming benthos is distributed within assemblage #2, and they are potentially affected by tiger prawn trawling.</p> <p>Assemblage #14 also classifies as "main habitat" for tiger prawn fishery. It occurs on innershelf habitats on sediments with high percentage of sand content and low percentage of mud content. This type of habitat is resilient to prawn trawling, with macrofauna with high recovery rates (Hill <i>et al.</i>, 2002). Although no benthic studies have been undertaken in Arnhem Land region, 25% of assemblage #14 is closed to trawling and only 4% trawled. Geomorphic features and sediment type are similar to assemblage #2 where overall trawling impact was not found to be significant (Bustamante <i>et al.</i>, 2010 did not find significant trawling effects in the GoC). The occurrence of sensitive habitat-forming species in this assemblage is not known, however, only a small percentage of this assemblage is affected by tiger prawn trawling.</p> <p>Apart from the direct impact of trawls on the biota, trawling may have indirect effects. The most commonly cited disturbance is the suspension of fine sediments. A study by Hiddink <i>et al.</i> (in Haywood <i>et al.</i>, 2005) showed that the impacts of trawling were greatest in areas with low levels of natural disturbance, while the impact of trawling was small in areas with high rates of natural disturbance. The Gulf of Carpentaria has a high incidence of cyclones – around three per annum. In the shallow waters of the Gulf, these major natural events represent a significant disturbance. In the Haywood <i>et al.</i> (2005) study for example the authors found that sponges had been moved around by a cyclone. The seabed biota of the Gulf presumably is adapted to coping with this disturbance.</p> <p>Also, Sainsbury (1988, in Haywood <i>et al.</i>, 2005) found that trawling can affect stock abundances of fish indirectly by affecting structures and organisms that serve as habitat and food. In addition, it is likely that an abundant supply of discards may benefit a range of scavengers on trawl grounds, changing communities' species composition. Haywood <i>et al.</i> (2005) however, concluded that the state of the habitats impacted by trawling in the NPF is not a steady state that favours the fast growing of 'weedy' species over the slow growing ones but a highly dynamic one in which the seabed biota is changing in response to factors other than trawling.</p>

PI 2.4.1	<p>The fishery does not cause serious or irreversible harm to habitat structure, considered on a regional or bioregional basis, and function</p>
	<p>White banana prawn subfishery (white banana prawn UoA). Main habitats for white banana prawn subfishery are the same as for tiger prawn subfishery, although with different overlap. White banana subfishery overlaps mostly with assemblage #2, and in a lesser extent, with assemblages #9 and #14. The characteristics of these types of habitat are as presented for tiger prawn subfishery. Direct impact of the banana prawn subfishery is very low as the gear does not make contact with the sea bottom. Indirect impacts however may occur due to bycatch discards. Bycatch in the white banana prawn subfishery is lower than in the tiger prawn subfishery, thus the discards are lower. As mentioned for the tiger prawn subfishery impacts, Haywood <i>et al.</i> (2005) found that indirect effects from prawn trawling in the GoC where not significant.</p> <p>Red-legged banana prawn subfishery (red-legged banana prawn UoA). The JBG is an area of soft substrate expanses with localised rocky outcrops, gravel deposits, and raised features. Benthic communities are exposed to strong tidal currents, high turbidity, and substantial sediment mobility, with disturbance decreasing offshore. High turbidity exists in the inner JBG, particularly during the wet season (Przeslawski <i>et al.</i>, 2011). The main habitat for red-legged banana prawn subfishery is the habitat corresponding to assemblage #17. There is a very low overlap of the fishing effort with assemblage #17. The trawl footprint is 1.4% with a fishing intensity of about 1.6 times per year.</p> <p>While prawn trawling, benthic impacts have not been studied in this area and no comprehensive habitat mapping is available, Przeslawski <i>et al.</i>, (2011) from Geoscience Australia, produced a spatial of seabed environments for the JBG and Timor Sea region (JBG-TS). The authors identified and described significant habitats and communities in the area of interest (. Data were sourced from existing literature, including publicly available industry data as well as data collected from two seabed mapping surveys to the Van Diemen Rise in the Eastern Timor Sea in 2009 and 2010.</p> <p>By comparing mapped trawling effort in JBG area (Figure 34 and Figure 35) with habitat distribution in Figure 36, red-legged banana prawn subfishery operates on infaunal plain, characterised by flat geomorphology, soft sediments and scattered epifauna, biota being dominated by infauna. Trawl impact to epifauna is most likely low and localised, however trawling can potentially occur over sponge gardens. Sponges were shown to be susceptible to catch but they also have high recoverability rates (Hill <i>et al.</i>, 2002). The impact of red-legged banana prawn trawl fishery on potentially occurring sponge gardens is not known, although if there is an impact, it affects a very small proportion of the sponge garden habitat (see Figure 36).</p> <p>Minor habitats. Habitats associated with all the other predicted assemblages suffer very low levels of impact from trawling (Figure 23), although, there is little information on the nature of these impacts.</p> <p>ERA for Habitats in the NPF</p> <p>At the 2007 NPF ERAEF, photographic data, geomorphic unit mapping, literature, and expert opinion were used to classify 157 fine scale habitat types on the basis of substratum, geomorphology, and dominant fauna. Out of the 157 habitat types, only 50 were subject to trawling. No habitats were found to be at high risk and 17 of the habitats where trawling can occur were assessed to be at medium risk. Most of these habitats contained seagrass that was not protected at the time of writing the ERA report. These were coastal margin habitats (0-25 m), which also include several soft sediment seabed types but which were dominated by seagrass communities which were not in protected areas (Griffiths <i>et al.</i>, 2007). There have been records of seagrass at depths of 20 m in the less turbid south-west Gulf (Coles <i>et al.</i>, 2004) but it is not clear if currently these seagrass beds are affected by trawling, however, most of the seagrass beds occur in areas permanently closed to prawn trawling (Dichmont <i>et al.</i>, 2014).</p> <p>Considering all available information, the tiger prawn subfishery (brown tiger prawn, grooved tiger prawn, blue endeavour prawn and red endeavour prawn UoAs) is highly unlikely to</p>

PI 2.4.1	The fishery does not cause serious or irreversible harm to habitat structure, considered on a regional or bioregional basis, and function
	<p>reduce habitat structure and function to a point where there would be serious or irreversible harm. There is evidence of reduction in the overall impact from the tiger prawn subfishery (Bustamante <i>et al.</i>, 2010), although vulnerable habitat-forming species may be affected at local scale. The requirement is met at SG60 and SG 80 but not at SG100.</p> <p>There is evidence that the white banana subfishery (white banana prawn UoA) is highly unlikely to reduce habitat structure and function to a point where there would be serious or irreversible harm, especially because the gear does not come in contact with the seabed and benthic communities. Vulnerable habitat-forming species are not susceptible to be caught in white banana prawn trawls and there is no risk of localised depletions. White banana prawn fishing occurs on small areas of the predicted assemblages. Indirect effects on habitat due to discarded bycatch in the GoC were not significant (Haywood <i>et al.</i>, 2005). The requirement is met at SG60, SG80 and SG100.</p> <p>The red-legged banana subfishery (red-legged banana prawn UoA) is highly unlikely to reduce habitat structure and function to a point where there would be serious or irreversible harm, especially because fishing occurs on a very small area of the predicted habitat type, and over 80% of the habitat is unaffected. As no trawl impact on benthic community studies have been undertaken in the JBG, there is no evidence for this. The requirement is met at SG60 and SG80 but not at SG100.</p>
References	<p>Bustamante, R.H., C.M. Dichmont, N. Ellis, S. Griffiths, W.A. Rochester, M.A. Burford, P.C. Rothlisberg, Q. Dell, M. Tonks., H. Lozano-Montes, R. Deng, T. Wassenberg, T.A. Okey, A. Revill, T. van der Velde, C. Moeseneder, S. Cheers, A. Donovan, T. Taranto, G. Salini, G. Fry, S. Tickell, R. Pascual, F. Smith, and E. Morello (2010). Effects of trawling on the benthos and biodiversity: Development and delivery of a Spatially-explicit Management Framework for the Northern Prawn Fishery. Final report to the project FRDC 2005/050. CSIRO Marine and Atmospheric Research, Cleveland, P382. Retrieved from: http://frdc.com.au/research/Documents/Final_reports/2005-050-DLD.pdf</p> <p>Coles, R, Smit, N, McKenzie, L, Roelofs, A, Haywood, M & Kenyon, R (2004). Seagrasses. In: National Oceans Office. Description of Key Species Groups in the Northern Planning Area. National Oceans Office, Hobart, Australia. Retrieved from: https://www.environment.gov.au/system/files/resources/7e5f88ec-4573-4f4d-8190-e25f8f1d6650/files/n-key-species.pdf</p> <p>Dichmont, C.M, Jarrett, A., Hill, F., Brown, M. (2014) Harvest Strategy for the Northern Prawn Fishery under Input Controls. AFMA</p> <p>Griffiths, S., Kenyon, R., Bulman, C., Dowdney, J., Williams, A., Sporicic, M. and Fuller, M. 2007. Ecological Risk Assessment for Effects of Fishing: Report for the Northern Prawn Fishery. Report for the Australian Fisheries Management Authority, Canberra, 319pp.</p> <p>Hill BJ, Haywood M, Venables B, Gordon SR, Condie S, Ellis N, R, Tyre A, Vance D, Dunn J, Mansbridge J, Moeseneder C, Bustamante R and Pantus F, (2002). Surrogates I - Predictors, impacts, management and conservation of the benthic biodiversity of the Northern Prawn Fishery. Final Report on FRDC Project 2000/160. CSIRO, Cleveland. 425 pp.</p> <p>Haywood M, Hill B, Donovan A, Rochester W, Ellis N, Welna A, Gordon S, Cheers S, Forcey K, Mcleod I, Moeseneder C, Smith G, Manson F, Wassenberg T, Thomas Steve, Kuhnert P, Laslett G, Buridge C and Thomas Sarah. (2005). Quantifying the effects of trawling on seabed fauna in the Northern Prawn Fishery. Final Report on FRDC Project 2002/102. CSIRO, Cleveland. 488 pp.</p> <p>Post, A.L. (2006). Physical surrogates for benthic organisms in the southern Gulf of Carpentaria, Australia: Testing and application to the Northern Planning Area.</p> <p>Pitcher, C.R., Ellis, N., Althaus, F., Williams, A., McLeod, I., Bustamante, R., Kenyon, R., Fuller, M. (2016) <i>Implications of current spatial management measures for AFMA ERAs for habitats — FRDC Project No 2014/204</i>. CSIRO Oceans & Atmosphere, Published Brisbane, November 2015, 50 pages.</p>

PI 2.4.1	The fishery does not cause serious or irreversible harm to habitat structure, considered on a regional or bioregional basis, and function
OVERALL PERFORMANCE INDICATOR SCORE:	
Brown Tiger Prawn UoA	80
Grooved Tiger Prawn UoA	80
Blue Endeavour Prawn UoA	80
Red Endeavour Prawn UoA	80
White Banana Prawn UoA	100
Red-Legged Banana Prawn UoA	80
CONDITION NUMBER (if relevant):	

PI 2.4.2		There is a strategy in place that is designed to ensure the fishery does not pose a risk of serious or irreversible harm to habitat types		
Scoring Issue		SG 60	SG 80	SG 100
a	Guided post	There are measures in place, if necessary, that are expected to achieve the Habitat Outcome 80 level of performance.	There is a partial strategy in place, if necessary, that is expected to achieve the Habitat Outcome 80 level of performance or above.	There is a strategy in place for managing the impact of the fishery on habitat types.
	Met ?	Y	Y	Y
	Justification	Habitat impacts are managed by footprint control. This is realised through a system of spatial and temporal closures adopted by the NPF to protect vulnerable habitats such as seagrass beds and coral and rocky reefs, as well as to address economic objectives of the fishery. About 19.6% of the NPF area (0-150 m) is permanently closed in CMRs, ~0.2% in MPAs and ~0.7% under fishery regulation — the total closed is 20.5% (Pitcher <i>et al.</i> , 2016). Furthermore, the entire fishery is closed for 5.5 months each year. Another important measure was the reduction in fishing effort from 286 vessels in 1981 to 52 vessels in 2009. The annual footprint of the NPF trawl fishery is currently 1.6% overall. The most affected habitat is the tiger prawn main habitat where most fishing effort from tiger prawn subfishery occurs. However, the trawl footprint here is low, currently about 13%, and it is not expected to increase. There is a strategy for managing the impact of the fishery on habitat types for all six UoAs. The requirement is met at SG60, SG80 and SG100.		
b	Guided post	The measures are considered likely to work, based on plausible argument (e.g. general experience, theory or	There is some objective basis for confidence that the partial strategy will work, based on information directly about	Testing supports high confidence that the strategy will work, based on information directly about the fishery and/or habitats involve.

PI 2.4.2		There is a strategy in place that is designed to ensure the fishery does not pose a risk of serious or irreversible harm to habitat types		
		comparison with similar fisheries/habitats).	the fishery and/or habitats involved.	
	Met ?	Y	Y	Y
	Justification	Evidence that this strategy works and achieving its objective can be drawn from studies of trawl impact on biodiversity. Moreover, only a very small percentage of the NPF managed area is trawled, in areas with high natural variability and disturbance thus, impact from sources other than prawn fishing are likely to be more significant for the changes in the structure and function of the habitats in the NPF managed area. Haywood et al (2005) found that the state of the habitats impacted by trawling in the NPF is not a steady state that favours the fast growing or 'weedy' species over the slow growing ones but a highly dynamic one in which the seabed biota is changing in response to factors other than trawling. Moreover, simulation of the food web processes demonstrated that the reduction of fishing (from 286 vessels in 1981 to 52 vessels in 2009) has resulted in clear reductions of the overall impacts on biomass (bycatch) and trophic levels, this including the reduction of overall impacts on the structure and function of the habitat. Testing supports high confidence that the strategy will work, based on information directly about the fishery and habitats involved, for the NPF overall (all six UoAs). The requirement is met at SG60, SG80 and SG100.		
c	Guided post		There is some evidence that the partial strategy is being implemented successfully.	There is clear evidence that the strategy is being implemented successfully.
	Met ?		Y	Y
	Justification	VMS monitoring to demonstrate avoidance of closed areas and that trawl foot print is maintained at low levels in all affected habitats. There is clear evidence that the strategy is being implemented successfully in all three subfisheries. The requirement is met at SG80 and SG100 by all six UoAs.		
d	Guided post			There is some evidence that the strategy is achieving its objective.
	Met ?			Y
	Justification	Studies have shown that the significant reduction in fishing effort in the NPF has led to a decrease in risk of depletion for benthic macrofauna, and the current levels of trawling did not affect biodiversity overall (Bustamante <i>et al.</i> , 2010). The requirement is met at SG100 by all six UoAs.		
References		<p>Pitcher, C.R., Ellis, N., Althaus, F., Williams, A., McLeod, I., Bustamante, R., Kenyon, R., Fuller, M. (2016) <i>Implications of current spatial management measures for AFMA ERAs for habitats — FRDC Project No 2014/204</i>. CSIRO Oceans & Atmosphere, Published Brisbane, November 2015, 50 pages.</p> <p>Bustamante, R.H., C.M. Dichmont, N. Ellis, S. Griffiths, W.A. Rochester, M.A. Burford, P.C. Rothlisberg, Q. Dell, M. Tonks., H. Lozano-Montes, R. Deng, T. Wassenberg, T.A. Okey, A. Revill, T. van der Velde, C. Moeseneder, S. Cheers, A. Donovan, T. Taranto, G. Salini, G. Fry, S. Tickell, R. Pascual, F. Smith, and E. Morello (2010). Effects of trawling</p>		

PI 2.4.2	There is a strategy in place that is designed to ensure the fishery does not pose a risk of serious or irreversible harm to habitat types		
	on the benthos and biodiversity: Development and delivery of a Spatially-explicit Management Framework for the Northern Prawn Fishery. Final report to the project FRDC 2005/050. CSIRO Marine and Atmospheric Research, Cleveland, P382. Retrieved from: http://frdc.com.au/research/Documents/Final_reports/2005-050-DLD.pdf		
OVERALL PERFORMANCE INDICATOR SCORE:			
Brown Tiger Prawn UoA			
scoring element		Habitat	100
issue			
PI 2.4.2a		100	
PI 2.4.2b		100	
PI 2.4.2c		100	
PI 2.4.2d		100	
Total		100	
Grooved Tiger Prawn UoA			
scoring element		Habitat	100
issue			
PI 2.4.2a		100	
PI 2.4.2b		100	
PI 2.4.2c		100	
PI 2.4.2d		100	
Total		100	
Blue Endeavour Prawn UoA			
scoring element		Habitat	100
issue			
PI 2.4.2a		100	
PI 2.4.2b		100	
PI 2.4.2c		100	
PI 2.4.2d		100	
Total		100	
Red Endeavour Prawn UoA			
scoring element		Habitat	100
issue			
PI 2.4.2a		100	
PI 2.4.2b		100	
PI 2.4.2c		100	
PI 2.4.2d		100	
Total		100	
White Banana Prawn UoA			
scoring element		Habitat	100
issue			
PI 2.4.2a		100	
PI 2.4.2b		100	
PI 2.4.2c		100	
PI 2.4.2d		100	
Total		100	
Red-Legged Banana Prawn UoA			
scoring element		Habitat	100
issue			
PI 2.4.2a		100	
PI 2.4.2b		100	
PI 2.4.2c		100	

PI 2.4.2	There is a strategy in place that is designed to ensure the fishery does not pose a risk of serious or irreversible harm to habitat types		
PI 2.4.2d	100		
Total	100		
CONDITION NUMBER (if relevant):			

PI 2.4.3		Information is adequate to determine the risk posed to habitat types by the fishery and the effectiveness of the strategy to manage impacts on habitat types		
Scoring Issue		SG 60	SG 80	SG 100
a	Guide post	There is basic understanding of the types and distribution of main habitats in the area of the fishery.	The nature, distribution and vulnerability of all main habitat types in the fishery are known at a level of detail relevant to the scale and intensity of the fishery.	The distribution of habitat types is known over their range, with particular attention to the occurrence of vulnerable habitat types.
	Met?	Y	Y	Y White Banana Prawn UoA N all other UoAs
	Justification	<p>Although the distribution of the habitat types was possible to be predicted, comprehensive, fine scale habitat mapping is not available for habitats in the NPF managed area. The vulnerability of all potentially occurring habitats was assessed at ERA and habitats that occur on trawling grounds scored low risk (Griffiths <i>et al.</i>, 2007). Vulnerable habitat forming species may occur in places potentially accessible to trawling and may be at risk at least locally within assemblages, if not at regional landscape scale (Pitcher <i>et al.</i>, 2016). This information is less relevant for the white banana subfishery where fishing is off the seabed, in the water column, thus, vulnerable habitat is not susceptible to direct impact.</p> <p>The nature, distribution and vulnerability of all main habitat types in the fishery are known at a level of detail relevant to the scale and intensity of the fishery and this is valid for all six UoAs. The requirement is met at SG60 and SG80. The distribution of habitat types is not known over their range at fine scale, thus particular attention to the occurrence of vulnerable habitat types on trawl grounds cannot be applied, even though all known vulnerable habitat types occur within permanently closed areas. The requirement is not met at SG100 by any of the tiger prawn and red-legged banana subfisheries (brown tiger prawn, grooved tiger prawn, blue endeavour prawn and red-legged banana prawn UoAs).</p> <p>Considering the fishing gear in white banana prawn fishery does not overlap with the depth where benthic habitats are, the distribution of habitat types and their range, with particular attention to the occurrence of vulnerable habitat types is not relevant. The requirement is met at SG100 by default.</p>		
b	Guide post	Information is adequate to broadly understand the nature of the main impacts of gear use on the main habitats, including spatial overlap of habitat with fishing gear.	Sufficient data are available to allow the nature of the impacts of the fishery on habitat types to be identified and there is reliable information on the spatial extent of interaction, and	The physical impacts of the gear on the habitat types have been quantified fully.

PI 2.4.3		Information is adequate to determine the risk posed to habitat types by the fishery and the effectiveness of the strategy to manage impacts on habitat types		
			the timing and location of use of the fishing gear.	
	Met?	Y	Y	Y White Banana Prawn N all other UoAs
	Justification	<p>The effects of trawling on benthic biodiversity and habitats has been studied in detail and this research offers reliable information on the nature of the impacts and on the spatial extent of the interaction, the timing and the location of use of gear. The sustainability of the benthic species and communities was studied based on productivity and susceptibility attributes. Recoverability rates and depletion rates were studied and different scenarios of increasing/decreasing fishing effort, as well as modifying the spatial management were modeled (Hill <i>et al.</i>, 2002, Haywood <i>et al.</i>, 2005, Bustamante <i>et al.</i>, 2010). Also, habitat types were identified and risk assessed. However, these studies focused on the Gulf of Carpentaria. There is a higher uncertainty about the nature of the impact in JBG (red-legged banana prawn subfishery), although the fishing effort in this subfishery is currently very low and habitat information is available (Przeslawski <i>et al.</i>, 2011). Habitat ranges are only predicted and no comprehensive habitat mapping is available either in the GoC or JBG. Sufficient data are available to allow the nature of the impacts of the fishery (all six UoAs) on habitat types to be identified and there is reliable information on the spatial extent of interaction, and the timing and location of use of the fishing gear but the physical impacts have not been fully quantified. The requirement is met at SG60 and SG80 by all six UoAs but not at SG100.</p> <p>Considering the fishing gear in white banana prawn fishery does not overlap with the depth where benthic habitats are, physical impact of gear on benthic habitats are minimal. The requirement is met at SG100 by default.</p>		
c	Guide post		Sufficient data continue to be collected to detect any increase in risk to habitat (e.g. due to changes in the outcome indicator scores or the operation of the fishery or the effectiveness of the measures).	Changes in habitat distributions over time are measured.
	Met?		Y	Y White Banana Prawn N all other UoAs
	Justification	<p>Sufficient data continue to be collected to detect any increase in risk to habitats through VMS monitoring that allows to estimate the trawl footprint in habitats associated with the predicted species assemblages. While research may be undertaken in the future to measure habitat distribution changes over time, this is not currently an ongoing objective of the management. The requirement is achieved at SG80 by all six UoAs but not at SG100.</p> <p>Considering the fishing gear in white banana prawn fishery does not overlap with the depth where benthic habitats are and physical impact of gear on benthic habitats are minimal the requirement is met at SG100 by default.</p>		
References		Bustamante, R.H., C.M. Dichmont, N. Ellis, S. Griffiths, W.A. Rochester, M.A. Burford, P.C. Rothlisberg, Q. Dell, M. Tonks., H. Lozano-Montes, R. Deng, T. Wassenberg, T.A. Okey, A. Revill, T. van der Velde, C. Moeseneder, S. Cheers, A. Donovan, T. Taranto, G. Salini, G. Fry, S. Tickell, R. Pascual, F. Smith, and E. Morello (2010). Effects of trawling on the benthos		

PI 2.4.3	Information is adequate to determine the risk posed to habitat types by the fishery and the effectiveness of the strategy to manage impacts on habitat types															
	<p>and biodiversity: Development and delivery of a Spatially-explicit Management Framework for the Northern Prawn Fishery. Final report to the project FRDC 2005/050. CSIRO Marine and Atmospheric Research, Cleveland, P382. Retrieved from: http://frdc.com.au/research/Documents/Final_reports/2005-050-DLD.pdf</p> <p>Griffiths, S., Kenyon, R., Bulman, C., Dowdney, J., Williams, A., Sporcic, M. and Fuller, M. 2007. Ecological Risk Assessment for Effects of Fishing: Report for the Northern Prawn Fishery. Report for the Australian Fisheries Management Authority, Canberra, 319pp.</p> <p>Hill BJ, Haywood M, Venables B, Gordon SR, Condie S, Ellis N, R, Tyre A, Vance D, Dunn J, Mansbridge J, Moeseneder C, Bustamante R and Pantus F, (2002). Surrogates I - Predictors, impacts, management and conservation of the benthic biodiversity of the Northern Prawn Fishery. Final Report on FRDC Project 2000/160. CSIRO, Cleveland. 425 pp.</p> <p>Haywood M, Hill B, Donovan A, Rochester W, Ellis N, Welna A, Gordon S, Cheers S, Forcey K, Mcleod I, Moeseneder C, Smith G, Manson F, Wassenberg T, Thomas Steve, Kuhnert P, Laslett G, Buridge C and Thomas Sarah. (2005). Quantifying the effects of trawling on seabed fauna in the Northern Prawn Fishery. Final Report on FRDC Project 2002/102. CSIRO, Cleveland. 488 pp.</p> <p>Pitcher, C.R., Ellis, N., Althaus, F., Williams, A., McLeod, I., Bustamante, R., Kenyon, R., Fuller, M. (2016) <i>Implications of current spatial management measures for AFMA ERAs for habitats — FRDC Project No 2014/204</i>. CSIRO Oceans & Atmosphere, Published Brisbane, November 2015, 50 pages.</p> <p>Przeslawski, R., Daniell, J., Anderson, T., Barrie, J.V., Heap, A., Hughes, M., Li, J., Potter, A., Radke, R., Siwabessy, J., Tran, M., Whiteway, T., Nichol, S. 2011. Seabed Habitats and Hazards of the Joseph Bonaparte Gulf and Timor Sea, Northern Australia. Geoscience Australia, Record 2011/40, 69pp.</p>															
OVERALL PERFORMANCE INDICATOR SCORE:																
Brown Tiger Prawn UoA																
<table><tr><th>issue</th><th>scoring element</th><th>Habitat</th></tr><tr><td>PI 2.4.3a</td><td></td><td>80</td></tr><tr><td>PI 2.4.3b</td><td></td><td>80</td></tr><tr><td>PI 2.4.3c</td><td></td><td>80</td></tr><tr><td>Total</td><td></td><td>80</td></tr></table>	issue	scoring element	Habitat	PI 2.4.3a		80	PI 2.4.3b		80	PI 2.4.3c		80	Total		80	80
issue	scoring element	Habitat														
PI 2.4.3a		80														
PI 2.4.3b		80														
PI 2.4.3c		80														
Total		80														
Grooved Tiger Prawn UoA																
<table><tr><th>issue</th><th>scoring element</th><th>Habitat</th></tr><tr><td>PI 2.4.3a</td><td></td><td>80</td></tr><tr><td>PI 2.4.3b</td><td></td><td>80</td></tr><tr><td>PI 2.4.3c</td><td></td><td>80</td></tr><tr><td>Total</td><td></td><td>80</td></tr></table>	issue	scoring element	Habitat	PI 2.4.3a		80	PI 2.4.3b		80	PI 2.4.3c		80	Total		80	80
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Blue Endeavour Prawn UoA																
<table><tr><th>issue</th><th>scoring element</th><th>Habitat</th></tr><tr><td>PI 2.4.3a</td><td></td><td>80</td></tr><tr><td>PI 2.4.3b</td><td></td><td>80</td></tr><tr><td>PI 2.4.3c</td><td></td><td>80</td></tr><tr><td>Total</td><td></td><td>80</td></tr></table>	issue	scoring element	Habitat	PI 2.4.3a		80	PI 2.4.3b		80	PI 2.4.3c		80	Total		80	80
issue	scoring element	Habitat														
PI 2.4.3a		80														
PI 2.4.3b		80														
PI 2.4.3c		80														
Total		80														

PI 2.4.3	Information is adequate to determine the risk posed to habitat types by the fishery and the effectiveness of the strategy to manage impacts on habitat types														
Red Endeavour Prawn UoA			80												
<table><tr><th>scoring element</th><th>Habitat</th></tr><tr><td>issue</td><td></td></tr><tr><td>PI 2.4.3a</td><td>80</td></tr><tr><td>PI 2.4.3b</td><td>80</td></tr><tr><td>PI 2.4.3c</td><td>80</td></tr><tr><td>Total</td><td>80</td></tr></table>		scoring element		Habitat	issue		PI 2.4.3a	80	PI 2.4.3b	80	PI 2.4.3c	80	Total	80	
scoring element	Habitat														
issue															
PI 2.4.3a	80														
PI 2.4.3b	80														
PI 2.4.3c	80														
Total	80														
White Banana Prawn UoA			100												
<table><tr><th>scoring element</th><th>Habitat</th></tr><tr><td>issue</td><td></td></tr><tr><td>PI 2.4.3a</td><td>100</td></tr><tr><td>PI 2.4.3b</td><td>100</td></tr><tr><td>PI 2.4.3c</td><td>100</td></tr><tr><td>Total</td><td>100</td></tr></table>		scoring element		Habitat	issue		PI 2.4.3a	100	PI 2.4.3b	100	PI 2.4.3c	100	Total	100	
scoring element	Habitat														
issue															
PI 2.4.3a	100														
PI 2.4.3b	100														
PI 2.4.3c	100														
Total	100														
Red-Legged Banana Prawn UoA			80												
<table><tr><th>scoring element</th><th>Habitat</th></tr><tr><td>issue</td><td></td></tr><tr><td>PI 2.4.3a</td><td>80</td></tr><tr><td>PI 2.4.3b</td><td>80</td></tr><tr><td>PI 2.4.3c</td><td>80</td></tr><tr><td>Total</td><td>80</td></tr></table>		scoring element		Habitat	issue		PI 2.4.3a	80	PI 2.4.3b	80	PI 2.4.3c	80	Total	80	
scoring element	Habitat														
issue															
PI 2.4.3a	80														
PI 2.4.3b	80														
PI 2.4.3c	80														
Total	80														
CONDITION NUMBER (if relevant):															

Evaluation Table for PI 2.5.1

PI 2.5.1		The fishery does not cause serious or irreversible harm to the key elements of ecosystem structure and function		
Scoring Issue		SG 60	SG 80	SG 100
a	Guide post	The fishery is unlikely to disrupt the key elements underlying ecosystem structure and function to a point where there would be a serious or irreversible harm.	The fishery is highly unlikely to disrupt the key elements underlying ecosystem structure and function to a point where there would be a serious or irreversible harm.	There is evidence that the fishery is highly unlikely to disrupt the key elements underlying ecosystem structure and function to a point where there would be a serious or irreversible harm.
	Met?	Y	Y	Y
	Justification	The impacts of trawling on the ecosystem have been studied in-depth in the GoC, the area with the highest trawl footprint (approx. 2.5%, estimated from Pitcher <i>et al.</i> , 2016). For the other two regions, the trawl footprint is too small compared to the spatial extent of the		

PI 2.5.1	The fishery does not cause serious or irreversible harm to the key elements of ecosystem structure and function
	<p>ecosystem (0.8% north of Arnhem Land, and 0.6% of JBG estimated from Pitcher <i>et al.</i>, 2016) to pose a risk of serious and irreversible harm to the structure and function of the ecosystem. In addition, fishing occurs in areas with high natural disturbance (i.e. frequent cyclones) and the effects of prawn fishing would be undistinguishable.</p> <p>Tiger Prawn Subfishery.</p> <p>There is a risk that by removing a species or a size range of the population, the food web dynamics may change. This may be due to an increase in prey species or competitive species, and possible declines of predators that rely on the species removed by trawling (Griffiths <i>et al.</i>, 2007). The tiger prawn subfishery generally processes and discards bycatch overboard at sea. Thus, besides removals, there is also the potential that discards provide additional food resources for sharks and birds, which may have the opposite effect on these species groups, and probably has flow-on effects through community.</p> <p>At ERAEF level 1, SICA, the effects of removing target species and incidentally caught species were assessed as minor, however, due some major reductions in fishing effort and trawl footprint took place since this assessment, these effects are currently smaller.</p> <p>Discarding effects on ecological communities were also assessed at SICA and were thought to most likely affect distribution of community if scavengers and predators (e.g. sharks and trevally) are attracted to discard sites. The intensity was scored as major because high historical volumes of bycatch that were discarded extensively (estimated 30,000 t per year). Since the ERAEF, major reductions in fishing effort took place and the multiannual trawl footprint was reduced to only 2.7% overall for all three subfisheries (Pitcher <i>et al.</i>, 2016). The quantity of the discarded bycatch, therefore, has been reduced because of the reduction in fishing effort as well as reduction in bycatch to prawn ratio based on AFMA SO recent data (Fry & Miller, 2016).</p> <p>Apart from the direct impact of trawls on the ecosystem, trawling may have indirect effects such as the suspension of fine sediments. The Gulf of Carpentaria, as well as the NPF managed area overall has a high incidence of cyclones and these major natural events represent a significant disturbance. Griffiths <i>et al</i> (2007) assessed these effects at SICA under Habitat component. Muddy sediments in particular were considered potentially likely to be resuspended in water column, with threat of translocation in strong current zones, alteration of sediment architecture for shallow infaunal species by mechanical action of gear on seafloor, and smothering of suspension feeding communities within the range of the gear activity. The intensity of these effects from the tiger prawn were scored as minor because if the occur, they are highly localised. The consequence score was minor because the area is prone to greater effects by natural disturbance phenomena (Griffiths <i>et al.</i>, 2007).</p> <p>Griffiths <i>et al.</i> (in Bustamante <i>et al</i> 2010, Appendix 9) used Ecopath with Ecosim model (EwE6) to explore the ecological effects of demersal trawling on the Gulf of Carpentaria ecosystem from 1970 to 2010. The authors explored the potential effects of the recent changed effort regimes from 2005-2010. It was found that tiger prawns could presumably play a keystone function in the ecosystem –i.e. they have a disproportionate + and - trophic effects despite their relative low biomass (Bustamante <i>et al.</i>, 2010). Due to this fact, it is conceivable that if historical level of high fishing intensity would have continued, the removal of tiger prawns would have resulted in serious negative consequences for the ecosystem's structure and function. However, according to the same study, the important reductions in the fishing effort, thus reduction in the tiger prawn removals, allowed recovery, as presented next.</p> <p>The model described well the historical dynamics of trawling over the past 40 years showing clear biodiversity impacts by lowering the mean trophic levels of the catches (TL). The main impacts occurred in the expansion 70s to 80s periods when the TL was the lowest. However, when fishing effort was reduced (in the mid to late 80s) the TL increased steadily to values in 2010 close to the ones estimated for the mid 70s (Bustamante <i>et al.</i>, 2010).</p> <p>The simulated historical effects of trawling showed to be positive and negative impacts on relative biomass of biodiversity. The small sharks, banana prawns, mud crabs, large</p>

PI 2.5.1	The fishery does not cause serious or irreversible harm to the key elements of ecosystem structure and function
	<p>gastropods (conchs) and echinoids (urchins) were the most negatively affected functional groups with reductions up to 50% (small sharks). Conversely, tiger prawns (150%), sand crabs and the large shark groups increased. The evaluation of the 2005-2010 reductions of fishing showed to have very small effects in the overall biomass of all functional groups, with biomass variation of <20%, with similar groups responding positively and negatively (Bustamante <i>et al.</i>, 2010). Ecosystem modelling results suggest that the ecosystem in the GoC has been largely influenced by trawling, but due to the drastic reduction of fishing (from 286 vessels in 1981 to 52 vessels in 2009) these impacts on biomass removal and trophic levels have been reduced. The authors hold that the rapid responses to fishing reduction suggested that the model means the GoC ecosystem is resilient to fishing, but it does not mean the fishing does not have impacts (Bustamante <i>et al.</i>, 2010).</p> <p>Dichmont <i>et al.</i> (in Bustamante <i>et al.</i>, 2010, Appendix 10), modelled the effects of different spatial management scenarios that included various forms of closures to fishing while achieving the biodiversity or specific fisheries management objectives. other than those for target species management, i.e. for ecosystem objectives (in Bustamante <i>et al.</i>, 2010). More exactly this was a Management Strategy Evaluation (MSE) extended from target species to ecosystem. The different closures were assessed in terms of benthic and ecosystem impact while assuming effort was shifted with no economic or target species impact (maintaining a bio-economic model of management with tiger prawns at MEY). Although the closures used in this paper were examples only, they offer information of the likely outcome of the actual MPAs that were introduced in 2012 (closing a larger area than the mocked up ones in this study)</p> <p>The main findings of the study were that either no or small changes in biomass were experienced for most functional groups in each closure scenario in relation to the base case scenario. These results also confirmed that most of the significant changes, both positive and negative occur in the main tiger fishing grounds, where most of the trawling for tiger-endavour prawns occurs. Negligible changes occurred in the inshore and offshore region where there is very little or no trawling. In general, all closures tended to predict increases in top predator groups like sharks that in turn fed on secondary consumers, like prawns, which could explain the decrease on prawn biomass within MPAs (Dichmont <i>et al.</i>, in Bustamante <i>et al.</i>, 2010).</p> <p>Some groups were predicted to have their biomass increased inside spatial closures like with sessile epibenthos, sea snakes, and sawfish while in others their predicted biomass decreases, as with echinoids, and bivalves for example. The authors also found that most groups that respond negatively to closures are those that are in general preys of secondary consumers and predatory groups like cephalopods and small crustaceans. Conversely, most top predatory groups increased their biomass inside and around closures. These findings are consistent with the expected underlying food web dynamics that is being imposed by trawling (Dichmont <i>et al.</i>, in Bustamante <i>et al.</i>, 2010).</p> <p>Ecosystem modelling studies (Griffiths <i>et al.</i>, in Bustamante <i>et al.</i>, 2010, Annex 9) have shown that even though prawn trawling clearly impacted the GoC ecosystem, the substantial reduction in the fishing effort and in trawl footprint led to changes in the positive direction. The fast response to these management actions shows the resilience of the ecosystem. The MSE for ecosystem impacts modeled scenarios (Dichmont <i>et al.</i>, in Bustamante <i>et al.</i>, 2010) have shown that the introduction of MPAs had the potential to protect biodiversity overall and especially some of the more susceptible ETPs such as sawfish and sea snakes, resulting in increased biomass in the MPAs closed areas. Currently, about 20% of the NPF managed area is closed to trawling in CMRs and MPAs, including previously trawled areas. This is much higher than the current annual and multiannual trawl footprint. Considering all the ecosystem impact research focused on the impacts from the tiger prawn subfishery and ERAEF assessments, there is evidence that the tiger prawn subfishery, at the current levels of activity, is highly unlikely to disrupt the key elements underlying ecosystem structure and function to a point where there would be a serious or irreversible harm. The requirement is</p>

PI 2.5.1	<p>The fishery does not cause serious or irreversible harm to the key elements of ecosystem structure and function</p>
	<p>met at SG60, SG80 and SG100 by all four UoAs: brown tiger prawn, grooved tiger prawn, blue endeavour prawn and red endeavour prawn.</p> <p>White Banana Prawn Subfishery</p> <p>At ERAEF level 1, SICA, the effects of removing target species and incidentally caught species in banana prawn fishery were assessed as minor, however, some major reductions in fishing effort and trawl footprint took place since this assessment reducing these effects even further. Currently, fishing in the NPF overall occurs in 1.6% annually (2.7% multiannual footprint) of the managed area and in white banana prawn subfishery, only for about 6 weeks each year. Most effort is concentrated in the eastern side of the Gulf of Carpentaria (Bold area) and fishing occurs day and night but localised due to targeting prawn schools. The bycatch quantity is lower than in the tiger prawn subfishery. The intensity of the impact was considered minor because studies have shown little detectable change in species composition even though prawn stock was fully fished (Griffiths <i>et al.</i>, 2007). Currently the fishing effort is even lower than at the time of the ERA and the gear does not make contact with the sea floor where the impacts of demersal trawling are usually most visible.</p> <p>Discarding effects on ecological communities from banana fishery were also assessed at SICA and were thought to most likely affect distribution of community if scavengers and predators (e.g. sharks and trevally) are attracted to discard sites. The intensity was scored as moderate because high volumes of bycatch were discarded extensively but less than in the tiger prawn subfishery. Consequence was scored as minor because the discards are quickly consumed and changes in scavenger species populations are temporary. Confidence was scored as high as extensive data documents discarding effects (Griffiths <i>et al.</i>, 2007). Since the ERAEF, major reductions in fishing effort took place and the multiannual trawl footprint was reduced to only 2.7% overall for all three subfisheries (Pitcher <i>et al.</i>, 2016). The quantity of the discarded bycatch and the impact from this activity therefore, have been reduced.</p> <p>Apart from the direct impact of trawls on the ecosystem, trawling may have indirect effects such as the suspension of fine sediments. White banana prawn subfishery is not likely to create suspension of fine sediments and turbidity because the gear is deployed within five meters above the sea bottom.</p> <p>Griffiths <i>et al.</i> (in Bustamante et al 2010, Appendix 9) used Ecopath with Ecosim model (EwE6) to explore the ecological effects of demersal trawling on the Gulf of Carpentaria ecosystem from 1970 to 2010. The model was calibrated for tiger prawn subfishery. Ecosystem modelling results suggest that the ecosystem in the GoC has been largely influenced by prawn trawling, but due to the drastic reduction of fishing (from 286 vessels in 1981 to 52 vessels in 2009) the impacts on biomass removal and trophic levels have been reduced. The authors hold that the rapid responses to fishing reduction suggested that the model means the GoC ecosystem is resilient to fishing (Bustamante <i>et al.</i>, 2010).</p> <p>Considering that fishing intensity and trawl impacts are lower in the white banana prawn subfishery, all the ecosystem impact research shows current overall impact is lower than in the past, plus the ERAEF assessments, there is evidence that the white banana prawn subfishery, is highly unlikely to disrupt the key elements underlying ecosystem structure and function to a point where there would be a serious or irreversible harm. The white banana prawn UoA meets the requirement at SG60, SG80 and SG100.</p> <p>Red-legged Banana Prawn Subfishery</p> <p>The current annual trawl footprint in the JBG is less than 1% (Pitcher <i>et al.</i>, 2016; Jarrett <i>et al.</i>, 2015). Although the ecological risk from the red-legged banana subfishery on communities was not assessed at ERAEF level 1, SICA, separately, it was included in the assessments for the tiger prawn and banana prawn fisheries, red-legged banana prawn subfishery being active in both banana and tiger season. The fishing effort in this subfishery is much lower than in the other two subfishery and the risk from this subfishery to ecosystem is lower. This is evidence that the red-legged banana prawn subfishery, is highly unlikely to disrupt the key elements underlying ecosystem structure and function to a point where there</p>

PI 2.5.1	The fishery does not cause serious or irreversible harm to the key elements of ecosystem structure and function
	would be a serious or irreversible harm. The red-legged banana prawn UoA meets the requirement at SG60, SG80 and SG100.
References	<p>Bustamante, R.H., C.M. Dichmont, N. Ellis, S. Griffiths, W.A. Rochester, M.A. Burford, P.C. Rothlisberg, Q. Dell, M. Tonks., H. Lozano-Montes, R. Deng, T. Wassenberg, T.A. Okey, A. Revill, T. van der Velde, C. Moeseneder, S. Cheers, A. Donovan, T. Taranto, G. Salini, G. Fry, S. Tickell, R. Pascual, F. Smith, and E. Morello (2010). Effects of trawling on the benthos and biodiversity: Development and delivery of a Spatially-explicit Management Framework for the Northern Prawn Fishery. Final report to the project FRDC 2005/050. CSIRO Marine and Atmospheric Research, Cleveland, P382. Retrieved from: http://frdc.com.au/research/Documents/Final_reports/2005-050-DLD.pdf</p> <p>Griffiths, S., Kenyon, R., Bulman, C., Dowdney, J., Williams, A., Sporcic, M. and Fuller, M. 2007. Ecological Risk Assessment for Effects of Fishing: Report for the Northern Prawn Fishery. Report for the Australian Fisheries Management Authority, Canberra, 319pp.</p> <p>Fry, G and Miller, M. (2016). NPF Bycatch Data Summaries for Marine Stewardship Council Audit. Report for NPFI and AFMA</p> <p>Jarrett, A., Dennis, D.M., Buckworth, R.C., Bustamante, R., Haywood, M.D.E, Fry, G. C., Tonks, M., Venables, W. and Barwick, M. NPF Industry Inc., CSIRO 2015 Synthesis of Existing Information, Analysis and Prioritisation of Future Monitoring Activities to Confirm Sustainability of the Red-legged Banana Prawn Sub-fishery in the Joseph Bonaparte Gulf</p> <p>Pitcher, C.R., Ellis, N., Althaus, F., Williams, A., McLeod, I., Bustamante, R., Kenyon, R., Fuller, M. (2016) <i>Implications of current spatial management measures for AFMA ERAs for habitats — FRDC Project No 2014/204</i>. CSIRO Oceans & Atmosphere, Published Brisbane, November 2015, 50 pages.</p>
OVERALL PERFORMANCE INDICATOR SCORE:	
Brown Tiger Prawn UoA	100
Grooved Tiger Prawn UoA	100
Blue Endeavour Prawn UoA	100
Red Endeavour Prawn UoA	100
White Banana Prawn UoA	100
Red-Legged Banana Prawn UoA	100
CONDITION NUMBER (if relevant):	

Evaluation Table for PI 2.5.2

PI 2.5.2		There are measures in place to ensure the fishery does not pose a risk of serious or irreversible harm to ecosystem structure and function		
Scoring Issue		SG 60	SG 80	SG 100
a	Guide post	There are measures in place, if necessary.	There is a partial strategy in place, if necessary.	There is a strategy that consists of a plan, in place.
	Met?	Y	Y	Y
	Justification	<p>The NPF Management Plan defines a long-term management objective consistent with achieving the outcomes expressed by MSC PI 2.5.1. Objective 1, Ensure the utilisation of the fishery resources within the Northern Prawn Fishery is consistent with the principles of ecologically sustainable development and the exercise of the precautionary principle (AFMA, 2012a). The combined measures to minimize impacts on each component of the ecosystem ensure that the UoCs do not pose a risk of serious or irreversible harm to the structure and function of the ecosystem.</p> <p>An important measure to reduce overall for ecosystem impact in all, tiger prawn, white banana prawn and red-legged banana prawn subfisheries, was the significant progressive reduction in fishing effort from 286 vessels in 1981 to 52 vessels in 2009. Currently, the most important measure is maintaining a low trawl footprint, which is the main measure in the habitat management strategy. The monitoring of the footprint allows a risk-based approach to evaluating potential impacts on the ecosystem. Management strategies defined for each of the other ecosystem components are in place, i.e. harvest controls and limits on retained catch, measures to minimise bycatch and ETP interactions, as presented in previous sections. These strategies combined together constitute a management plan to mitigate impacts from each subfishery on the ecosystem overall. The requirement is met at SG60, SG80 and SG100 by all six UoAs.</p>		
b	Guide post	The measures take into account potential impacts of the fishery on key elements of the ecosystem.	The partial strategy takes into account available information and is expected to restrain impacts of the fishery on the ecosystem so as to achieve the Ecosystem Outcome 80 level of performance.	<p>The strategy, which consists of a plan, contains measures to address all main impacts of the fishery on the ecosystem, and at least some of these measures are in place. The plan and measures are based on well-understood functional relationships between the fishery and the Components and elements of the ecosystem.</p> <p>This plan provides for development of a full strategy that restrains impacts on the ecosystem to ensure the fishery does not cause serious or irreversible harm.</p>
	Met?	Y	Y	Y
	Justification	<p>The management strategy focuses on minimising impacts on ecosystem through maintaining low trawl footprint, biomass levels of prawns and other retained species at target levels as well as minimizing bycatch and ETP interactions, in order to minimise the potential for trophic perturbations. Other arrangements, such as gear restrictions, spatial and seasonal closures, a limited number of vessels, ongoing monitoring and research, further minimise the potential for ecosystem impacts through reducing potential impacts on the ecosystem components (i.e. retained non-target species, bycatch, ETP species and habitats). The NPF</p>		

PI 2.5.2		There are measures in place to ensure the fishery does not pose a risk of serious or irreversible harm to ecosystem structure and function		
		<p>introduced measures to protect the ecosystem components early on, including closures to sensitive habitat, the use of TEDs, BRDs and monitoring programs. Ecosystem modelling indicates that the trawling activities in Gulf of Carpentaria in the last 40 years did not affect overall biodiversity and cannot be distinguished from other sources of variations in community structure (Dichmont <i>et al.</i>, in Bustamante <i>et al.</i>, 2010, Annex 9).</p> <p>The strategy for ecosystem impacts is based on well-understood functional relationships especially between the tiger prawn subfishery, which produces most impact, and the components and elements of the ecosystem. The focus on tiger prawn subfishery impacts is precautionary because the impacts from the other two subfisheries are lower. This plan provides for development of a full strategy that restrains impacts on the ecosystem to ensure the three subfisheries do not cause serious or irreversible harm. The ecosystem model of Dichmont <i>et al.</i>, (in Bustamante <i>et al.</i>, 2010, Annex 9) brings evidence that the fishery is highly unlikely to disrupt the key elements underlying ecosystem structure and function to a point where there would be a serious or irreversible harm. The requirement is met at SG60, SG80 and SG100 by all six UoAs.</p>		
c	Guide post	The measures are considered likely to work, based on plausible argument (e.g., general experience, theory or comparison with similar fisheries/ecosystems).	The partial strategy is considered likely to work, based on plausible argument (e.g., general experience, theory or comparison with similar fisheries/ecosystems).	The measures are considered likely to work based on prior experience, plausible argument or information directly from the fishery/ecosystems involved.
	Met?	Y	Y	Y
	Justification	<p>Ecosystem modelling indicates that the trawling activities in Gulf of Carpentaria in the last 40 years did not affect overall biodiversity and cannot be distinguished from other sources of variations in community structure (Dichmont <i>et al.</i>, in Bustamante <i>et al.</i>, 2010, Annex 9).</p> <p>In addition, different scenarios for a spatial management strategy have been evaluated (MSE for ecosystem impacts, Griffiths <i>et al.</i>, in Bustamante <i>et al.</i>, 2010, Annex 10) and the MPAs scenario predicted some of the best results for biodiversity overall and for ETP species such as sea snakes and sawfish, plus reverting the underlying food web dynamics that are being imposed by trawling to the untrawled state within the closed areas. In 2012, extensive Commonwealth Marine Reserves (CMR) for biodiversity protection were implemented and the effects predicted by the spatial management study (or better due to the extent of areas closed) are likely to be achieved. As other spatial management scenarios did not yield better predictions, even though the CMR network is not a measure of the NPF management, according to the study, these are likely to achieve the ecosystem outcome required by the MSC standards. The requirement is met by all six UoAs at SG60, SG80 and SG100.</p>		
d	Guide post		There is some evidence that the measures comprising the partial strategy are being implemented successfully.	There is evidence that the measures are being implemented successfully.
	Met?		Y	Y
	Justification	Evidence that the measures are being implemented successfully can be derived from VMS data that shows compliance with fishing effort and with various permanent and seasonal closures, compliance monitoring that shows there is no systematic non-compliance in the NPF, gear monitoring which assesses compliance with the legislated gear and gear modification. Crew Observer training and coverage improved in recent years ensuring that		

PI 2.5.2	There are measures in place to ensure the fishery does not pose a risk of serious or irreversible harm to ecosystem structure and function														
	<p>best practices are employed in handling, measuring and recording the catch. Logbook recording is complied with, the logbook reports being compulsorily submitted to AFMA for validation (AFMA, 2016).</p> <p>The requirement is met by all UoAs at SG80 and SG100.</p>														
References															
OVERALL PERFORMANCE INDICATOR SCORE:															
Brown Tiger Prawn UoA <table border="1"> <thead> <tr> <th>scoring element</th><th>Ecosystem</th></tr> </thead> <tbody> <tr> <td>issue</td><td></td></tr> <tr> <td>PI 2.5.2a</td><td>100</td></tr> <tr> <td>PI 2.5.2b</td><td>100</td></tr> <tr> <td>PI 2.5.2c</td><td>100</td></tr> <tr> <td>PI 2.5.2d</td><td>100</td></tr> <tr> <td>Total</td><td>100</td></tr> </tbody> </table>		scoring element	Ecosystem	issue		PI 2.5.2a	100	PI 2.5.2b	100	PI 2.5.2c	100	PI 2.5.2d	100	Total	100
scoring element	Ecosystem														
issue															
PI 2.5.2a	100														
PI 2.5.2b	100														
PI 2.5.2c	100														
PI 2.5.2d	100														
Total	100														
Grooved Tiger Prawn UoA <table border="1"> <thead> <tr> <th>scoring element</th><th>Ecosystem</th></tr> </thead> <tbody> <tr> <td>issue</td><td></td></tr> <tr> <td>PI 2.5.2a</td><td>100</td></tr> <tr> <td>PI 2.5.2b</td><td>100</td></tr> <tr> <td>PI 2.5.2c</td><td>100</td></tr> <tr> <td>PI 2.5.2d</td><td>100</td></tr> <tr> <td>Total</td><td>100</td></tr> </tbody> </table>		scoring element	Ecosystem	issue		PI 2.5.2a	100	PI 2.5.2b	100	PI 2.5.2c	100	PI 2.5.2d	100	Total	100
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issue															
PI 2.5.2a	100														
PI 2.5.2b	100														
PI 2.5.2c	100														
PI 2.5.2d	100														
Total	100														
Blue Endeavour Prawn UoA <table border="1"> <thead> <tr> <th>scoring element</th><th>Ecosystem</th></tr> </thead> <tbody> <tr> <td>issue</td><td></td></tr> <tr> <td>PI 2.5.2a</td><td>100</td></tr> <tr> <td>PI 2.5.2b</td><td>100</td></tr> <tr> <td>PI 2.5.2c</td><td>100</td></tr> <tr> <td>PI 2.5.2d</td><td>100</td></tr> <tr> <td>Total</td><td>100</td></tr> </tbody> </table>		scoring element	Ecosystem	issue		PI 2.5.2a	100	PI 2.5.2b	100	PI 2.5.2c	100	PI 2.5.2d	100	Total	100
scoring element	Ecosystem														
issue															
PI 2.5.2a	100														
PI 2.5.2b	100														
PI 2.5.2c	100														
PI 2.5.2d	100														
Total	100														
Red Endeavour Prawn UoA <table border="1"> <thead> <tr> <th>scoring element</th><th>Ecosystem</th></tr> </thead> <tbody> <tr> <td>issue</td><td></td></tr> <tr> <td>PI 2.5.2a</td><td>100</td></tr> <tr> <td>PI 2.5.2b</td><td>100</td></tr> <tr> <td>PI 2.5.2c</td><td>100</td></tr> <tr> <td>PI 2.5.2d</td><td>100</td></tr> <tr> <td>Total</td><td>100</td></tr> </tbody> </table>		scoring element	Ecosystem	issue		PI 2.5.2a	100	PI 2.5.2b	100	PI 2.5.2c	100	PI 2.5.2d	100	Total	100
scoring element	Ecosystem														
issue															
PI 2.5.2a	100														
PI 2.5.2b	100														
PI 2.5.2c	100														
PI 2.5.2d	100														
Total	100														
White Banana Prawn UoA <table border="1"> <thead> <tr> <th>scoring element</th><th>Ecosystem</th></tr> </thead> <tbody> <tr> <td>issue</td><td></td></tr> <tr> <td>PI 2.5.2a</td><td>100</td></tr> <tr> <td>PI 2.5.2b</td><td>100</td></tr> <tr> <td>PI 2.5.2c</td><td>100</td></tr> </tbody> </table>		scoring element	Ecosystem	issue		PI 2.5.2a	100	PI 2.5.2b	100	PI 2.5.2c	100				
scoring element	Ecosystem														
issue															
PI 2.5.2a	100														
PI 2.5.2b	100														
PI 2.5.2c	100														

PI 2.5.2		There are measures in place to ensure the fishery does not pose a risk of serious or irreversible harm to ecosystem structure and function		
PI 2.5.2d		100		
Total		100		
Red-Legged Banana Prawn UoA				
issue	scoring element	Ecosystem		100
PI 2.5.2a		100		
PI 2.5.2b		100		
PI 2.5.2c		100		
PI 2.5.2d		100		
Total		100		

Evaluation Table for PI 2.5.3

PI 2.5.3		There is adequate knowledge of the impacts of the fishery on the ecosystem		
Scoring Issue		SG 60	SG 80	SG 100
a	Guide post	Information is adequate to identify the key elements of the ecosystem (e.g., trophic structure and function, community composition, productivity pattern and biodiversity).	Information is adequate to broadly understand the key elements of the ecosystem.	
	Met?	Y	Y	
	Justification	<p>Long-term data sets are available for the NPF. Whilst most of the data have been collected for stock assessment of the target species, there have also been several studies that directly or indirectly provide data to identify key components of the ecosystem. Such studies have quantified levels of (i) by-product; (ii) by-catch; and (iii) interactions with ETPs. Several research projects have been conducted to obtain information on the impacts of prawn trawling on habitats and ecosystem (Hill <i>et al.</i>, 2002, Haywood <i>et al.</i>, 2005, Bustamante <i>et al.</i>, 2010).</p> <p>This project determined and evaluated the likely effects of trawling on the biodiversity and some known ecological processes. For this, historical datasets were used and data from a survey conducted in 2005. During the survey samples along a trawling intensity gradient and across all regions of the south-western GoC affected by trawling, while controlling for environmental variability. Also, information from all existing field surveys was used to in the construction of the food web, species distribution and risk assessment models (Bustamante <i>et al.</i>, 2010).</p> <p>The main project to approach trawling effects on ecosystem (Bustamante <i>et al.</i>, 2010) developed a multidisciplinary approach to quantitatively evaluate the ecological effects of trawling on the ecosystem, and delivered analytical tools to evaluate such effects in spatially-explicit contexts under multiple management objectives. The project was focused on the benthic-pelagic ecosystem of the tiger prawn subfishery fishing grounds in the Gulf of Carpentaria (GoC). The overarching goal of this project was to deliver, to support the NPF management with evidence-based advice with regard to the spatial management of trawling impacts and to allow the evaluation of alternative spatial management options addressing</p>		

PI 2.5.3		There is adequate knowledge of the impacts of the fishery on the ecosystem		
		<p>fishing impacts, while achieving fisheries economic objectives, as well as other conservation and environmental management goals (Bustamante <i>et al.</i>, 2010).</p> <p>Ecopath with Ecosim and Ecospace software was used to develop a trophic mass-balance (food-web) model of the GoC ecosystem. The <i>Ecopath</i> model was constructed for 1990 and forecasts were run for a 20-year time periods. The model incorporated 53 functional or trophic groups based on similarities in diet, habitat, foraging behaviour, size, consumption and rates of production, as well as 14 fishing fleets for which landings and effort data were available.</p> <p>The bioeconomic stock and ecological risk assessment models with the food web, effect of trawling and species distribution models, were integrated in a spatial management strategy evaluation framework (spatial MSE). The spatial MSE combined various tools designed for different objectives (e.g. stock, economics, risk, biomass, etc.), and it has the ability to evaluate multiple objectives, at multiple temporal, spatial and ecological scales.</p> <p>Information continues to be collected on the impacts of the fishery on the key ecosystem components at a sufficient level to detect any increased risk and update the risk assessment. Fishers are required to report all retained species catches, effort, any ETP species interactions and fishing location in daily logbooks.</p> <p>Information is sufficient to support the development of strategies to manage ecosystem impacts, especially the impacts from the tiger prawn subfishery and from the white banana prawn subfishery in GoC. In the JBG (red-legged banana subfishery) ecosystem modelling is not available, however, fishing effort and the trawl footprint are very low here (on less than 1% of the Gulf) and information on catch from logbooks and CMOs and SOs, as well as from VMS, is adequate to develop a strategy to manage ecosystem impacts at the scale of the fishery. The requirement is met at SG60 and SG80 by all six UoAs.</p>		
b	Guide post	Main impacts of the fishery on these key ecosystem elements can be inferred from existing information, and have not been investigated in detail.	Main impacts of the fishery on these key ecosystem elements can be inferred from existing information and some have been investigated in detail.	Main interactions between the fishery and these ecosystem elements can be inferred from existing information, and have been investigated in detail.
	Met?	Y	Y	Y
	Justification	<p>Fishers are required to report all retained species catches, effort, any ETP species interactions and fishing location in daily logbooks. Fishing activities (location and intensity) are also monitored by GPS coordinates (VMS) and effort. Independent bycatch surveys showed the relation between trawl intensity and the distribution and abundances of mobile and sessile benthic fauna as well as community structure (Haywood <i>et al.</i>, 2005). An ERAEF risk assessment has been conducted by CSIRO in 2007, assessing all ecosystem components at various levels: Level 1, SICA, for all components, Level 2, PSA, for target species, byproduct species, and ETPs that are potentially caught (Griffiths <i>et al.</i>, 2007). These levels of assessment were undertaken separately for the tiger prawn fishery (in tiger prawn season) and banana prawn fishery (in banana prawn season). Because it operates in both seasons, the risk from the red-banana prawn subfishery was assessed together with the risk from tiger prawn subfishery during the tiger prawn season and together with the risk from the white banana prawn subfishery during the banana season. A higher, more quantitative, level of assessment, SAFE, level 2.5, was applied for teleosts and elasmobranchs separately in the Gulf of Carpentaria (tiger prawn subfishery and banana prawn subfishery, Zhou & Griffiths, 2009; Zhou <i>et al.</i>, 2009; Zhou, 2011) and in the Joseph Bonaparte Gulf (red-legged banana prawn subfishery Zhou <i>et al.</i>, 2015). SAFE assessment was also applied for species of sea snakes incidentally caught in the NPF overall (Milton <i>et al.</i>, 2008b). An ecosystem model was</p>		

PI 2.5.3		There is adequate knowledge of the impacts of the fishery on the ecosystem		
		developed for the GoC and main interactions between the tiger prawn subfishery (the subfishery with highest levels of impact on ecosystem) and ecosystem elements have been investigated (Bustamante <i>et al.</i> , 2010). Present information suggests that main ecosystem impacts are known and there is sufficient detail in the research to infer main interactions from the existing information and have been investigated in detail for the mainly for the tiger prawn subfishery. Given the very low levels of impact from the other two subfisheries compared to the impacts from the tiger prawn subfishery, the focus on studying the latter is justified and precautionary. Main interactions from the withe banana subfishery and red-legged banana subfishery respectively with the ecosystem elements, can be inferred from the existing information and from these being studied in detailed for the tiger prawn subfishery. The requirement is met at SG60, SG80 and SG100 by all six UoAs.		
c	Guide post		The main functions of the Components (i.e., target, Bycatch, Retained and ETP species and Habitats) in the ecosystem are known.	The impacts of the fishery on target, Bycatch, Retained and ETP species are identified and the main functions of these Components in the ecosystem are understood.
	Met?		Y	Y
	Justification	<p>The impacts of each subfishery on the components of the ecosystem (target, bycatch, retained and ETP species, habitats etc) have been identified and subject to risk assessment through the EAERF process. Ecosystem impacts of the tiger prawn subfishery have also been assessed and modelled by Bustamante <i>et al.</i>, 2010, indicating that the current level of trawling activities in GoC does not affect overall biodiversity. Moreover, the long-time series of data available for the NPF from logbooks, along with bycatch and byproduct surveys and research studies, benthic impact studies and ecosystem modelling, support the conclusion that the ecosystem, even though it has been impacted by the three NPF subfisheries during the history of their operations, these are now much lower and the ecosystem is recovering (Haywood <i>et al.</i>, 2005, Bustamante <i>et al.</i>, 2010).</p> <p>Ongoing monitoring to assess the impacts of the three subfisheries on the components of the ecosystem is a core aspect of the management regime. Information is adequate to suggest the components of the ecosystem are understood. The requirement is met at SG80 and SG100 by all six UoAs.</p>		
d	Guide post		Sufficient information is available on the impacts of the fishery on these Components to allow some of the main consequences for the ecosystem to be inferred.	Sufficient information is available on the impacts of the fishery on the Components and elements to allow the main consequences for the ecosystem to be inferred.
	Met?		Y	Y
	Justification	<p>Data collection for each of the three subfisheries and research on the components and elements of the ecosystem allow some of the main consequences to be inferred, all six UoAs meeting SG80 requirements. Risk assessments of the components in the ecosystem, (target, retained, bycatch, ETP species, habitats, communities) have been conducted through the CSIRO-AFMA ERAEF process (Griffiths <i>et al.</i>, 2007). Ecosystem impacts, especially of the tiger prawn subfishery, in the GoC have also been modelled and assessed by Bustamante <i>et al.</i>, 2010, indicating that the current level of trawling activities in NPF does not affect overall biodiversity, and the significant reduction in fishing effort in recent decades led to positive changes in the ecosystem. Sufficient information is available on the impacts of the tiger prawn</p>		

PI 2.5.3		There is adequate knowledge of the impacts of the fishery on the ecosystem		
		subfishery on the components and elements to allow the main consequences for the ecosystem to be inferred. For white banana prawn and red-legged banana prawn, for which the impacts are much lighter, the information available from data collection in these fisheries, from risk assessments and from research studies from the tiger prawn subfishery, is sufficient to infer the main impact on the components and elements and to allow the main consequences for the ecosystem to be inferred. The requirement is met at SG80 and SG100 by all six UoAs.		
e	Guide post		Sufficient data continue to be collected to detect any increase in risk level (e.g., due to changes in the outcome indicator scores or the operation of the fishery or the effectiveness of the measures).	Information is sufficient to support the development of strategies to manage ecosystem impacts.
	Met?		Y	Y
	Justification	Information continues to be collected on the impacts of the NPF subfisheries on the key ecosystem components at a sufficient level to detect any increased risk and update the risk assessment. Fishers are required to report all retained species catches, effort, any ETP species interactions and fishing location in daily logbooks (Dichmont <i>et al.</i> , 2014). Fishing activities (location and intensity) are also monitored by VMS (Dichmont <i>et al.</i> , 2014). Data on ETP interactions, retained species and some bycatch species are collected and assessed by fishery independent programs (AFMA SOs, CSIRO's NPF prawn monitoring program, bycatch sustainability assessments, etc.) (e.g. Fry <i>et al.</i> , 2015, Kenyon <i>et al.</i> , 2015). Risk assessments are updated regularly, with the next risk assessment being scheduled for 2017. Information is sufficient to support the development of strategies to manage ecosystem impacts in all three subfisheries: tiger prawn subfishery, white banana prawn subfishery, red-legged banana prawn subfishery. The requirement is met at SG80 and SG00 by all UoAs.		
References		<p>Bustamante, R.H., C.M. Dichmont, N. Ellis, S. Griffiths, W.A. Rochester, M.A. Burford, P.C. Rothlisberg, Q. Dell, M. Tonks., H. Lozano-Montes, R. Deng, T. Wassenberg, T.A. Okey, A. Revill, T. van der Velde, C. Moeseneder, S. Cheers, A. Donovan, T. Taranto, G. Salini, G. Fry, S. Tickell, R. Pascual, F. Smith, and E. Morello (2010). Effects of trawling on the benthos and biodiversity: Development and delivery of a Spatially-explicit Management Framework for the Northern Prawn Fishery. Final report to the project FRDC 2005/050. CSIRO Marine and Atmospheric Research, Cleveland, P382. Retrieved from: http://frdc.com.au/research/Documents/Final_reports/2005-050-DLD.pdf</p> <p>Fry, G.C., Barwick, M, Lawrence, E. and Tonks, M. (2015) Monitoring interactions with bycatch species using crew-member observer data collected in the Northern Prawn Fishery: 2013 – 2014. Final Report to AFMA; R2013/0806. CSIRO, Australia. Pp. 218.</p> <p>Griffiths, S., Kenyon, R., Bulman, C., Dowdney, J., Williams, A., Sporcic, M. and Fuller, M. 2007. Ecological Risk Assessment for Effects of Fishing: Report for the Northern Prawn Fishery. Report for the Australian Fisheries Management Authority, Canberra, 319pp.</p> <p>Hill BJ, Haywood M, Venables B, Gordon SR, Condie S, Ellis N, R, Tyre A, Vance D, Dunn J, Mansbridge J, Moeseneder C, Bustamante R and Pantus F, (2002). Surrogates I - Predictors, impacts, management and conservation of the benthic biodiversity of the Northern Prawn Fishery. Final Report on FRDC Project 2000/160. CSIRO, Cleveland. 425 pp.</p> <p>Haywood M, Hill B, Donovan A, Rochester W, Ellis N, Welna A, Gordon S, Cheers S, Forcey K, Mcleod I, Moeseneder C, Smith G, Manson F, Wassenberg T, Thomas Steve, Kuhnert P, Laslett G, Buridge C and Thomas Sarah. (2005). Quantifying the effects of trawling on seabed fauna in the Northern Prawn Fishery. Final Report on FRDC Project 2002/102. CSIRO, Cleveland. 488 pp.</p>		

PI 2.5.3	There is adequate knowledge of the impacts of the fishery on the ecosystem																		
	<p>Kenyon, R.A., Deng, R., Donovan, A., van der Velde, T. and Fry, G. (2016). An integrated monitoring program for the Northern Prawn Fishery 2015/18. Report to the Australian Fisheries Management Authority, Project 2015/0810. CSIRO. Brisbane.</p> <p>Milton, D.A., Zhou, S., Fry, G.C. Dell, Q. (2008b). Risk assessment and mitigation for sea snakes caught in the Northern Prawn Fishery. Final report on FRDC Project 2005/051. CSIRO Cleveland, pp. 123.</p> <p>Zhou, S. and Griffiths, S.P. 2008. Sustainability assessment for fishing effects (SAFE): a new quantitative ecological risk assessment method and its application to elasmobranch bycatch in an Australian trawl fishery. Fisheries Research 91: 56-68.</p> <p>Zhou, S., Griffiths, S.P. and Miller, M. 2009. Sustainability assessment for fishing effects (SAFE) on highly diverse and data-limited fish bycatch in a tropical prawn trawl fishery. Marine and Freshwater Research 60: 563-570.</p> <p>Zhou, S. (2011). Sustainability assessment of fish species potentially impacted in the Northern Prawn Fishery: 2007-2009. Report to the Australia Fisheries Management Authority, Canberra, Australia. February 2011.</p> <p>Zhou, S., Buckworth, R.C., Miller, M., and Jarrett, A. 2015. A SAFE analysis of bycatch in the Joseph Bonaparte Gulf fishery for Red-legged Banana Prawns. CSIRO Oceans and Atmosphere Flagship, Brisbane, Australia.</p>																		
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Grooved Tiger Prawn UoA			100																
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PI 2.5.3d	100																		
PI 2.5.3e	100																		
Total	100																		
Brown Tiger Prawn UoA			100																
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scoring element	Ecosystem																		
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Total	100																		
Blue Endeavour Prawn UoA			100																
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scoring element	Ecosystem																		
issue																			
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PI 2.5.3b	100																		
PI 2.5.3c	100																		
PI 2.5.3d	100																		
PI 2.5.3e	100																		
Total	100																		
			100																

PI 2.5.3	There is adequate knowledge of the impacts of the fishery on the ecosystem		
Red Endeavour Prawn UoA			
scoring element		Ecosystem	
issue			
PI 2.5.3a		100	
PI 2.5.3b		100	
PI 2.5.3c		100	
PI 2.5.3d		100	
PI 2.5.3e		100	
Total		100	
White Banana Prawn UoA			
scoring element		Ecosystem	100
issue			
PI 2.5.3a		100	
PI 2.5.3b		100	
PI 2.5.3c		100	
PI 2.5.3d		100	
PI 2.5.3e		100	
Total		100	
Red-legged Banana Prawn UoA			
scoring element		Ecosystem	100
issue			
PI 2.5.3a		100	
PI 2.5.3b		100	
PI 2.5.3c		100	
PI 2.5.3d		100	
PI 2.5.3e		100	
Total		100	

7.1.3 Principle Three: Management

Evaluation Table for PI 3.1.1

PI 3.1.1		<p>The management system exists within an appropriate legal and/or customary framework which ensures that it:</p> <ul style="list-style-type: none"> Is capable of delivering sustainable fisheries in accordance with MSC Principles 1 and 2; and Observes the legal rights created explicitly or established by custom of people dependent on fishing for food or livelihood; and Incorporates an appropriate dispute resolution framework. 		
Scoring Issue		SG 60	SG 80	SG 100
a	Guide post	There is an effective national legal system and a framework for cooperation with other parties, where necessary, to deliver management outcomes consistent with MSC Principles 1 and 2	There is an effective national legal system and <u>organised and effective cooperation</u> with other parties, where necessary, to deliver management outcomes consistent with MSC Principles 1 and 2.	There is an effective national legal system and binding procedures governing cooperation with other parties which delivers management outcomes consistent with MSC Principles 1 and 2.
	Met?	Y	Y	Y
	Justification	<p>Australia is a signatory to a number of international agreements and conventions (which it applied within its EEZ). These include: <i>United Nations Convention on the Law of the Sea</i> (regulation of ocean space); <i>Convention on Biological Diversity and Agenda 21</i> (sustainable development and ecosystem based fisheries management); <i>Convention on International Trade in Endangered Species of Wild Fauna and Flora</i> (CITES; protection of threatened, endangered and protected species); <i>Code of Conduct for Responsible Fisheries</i> (standards of behaviour for responsible practices regarding sustainable development); <i>United Nations Fish Stocks Agreement</i>; and State Member of the <i>International Union for Conservation of Nature</i> (marine protected areas).</p> <p>The Offshore Constitutional Settlement provides for the Australian Commonwealth to manage fisheries beyond 3 nautical miles from the coast, or inside 3 miles if so delegated (e.g. the Northern Prawn Fishery).</p> <p>The fishery is managed by the Australian Fisheries Management Authority (AFMA) in accordance with the Fisheries Management Act (FMA) of 1991 and Fisheries Management Regulations 1992, the Fisheries Administration Act 1991 and the Fisheries (Administration) Regulations 1992. Commonwealth-managed fisheries are also subject to aspects of the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) and the Environment Protection and Biodiversity Conservation Regulations 2000. The NPF commercial export fisheries have been assessed using the Australian National ESD Framework for Fisheries, in particular, the <i>Guidelines for the Ecologically Sustainable Management of Fisheries</i> (the Guidelines; DEWR, 2007). The ESD includes the principles of ecologically sustainable target and bycatch species, ecological viability of bycatch species, and impact of the broader marine ecosystem.</p> <p>The Fisheries Administration Act establishes AFMA to manage Commonwealth fisheries. The overall objectives of the FMA 1991 form the basis for the management of all</p>		

PI 3.1.1		<p>The management system exists within an appropriate legal and/or customary framework which ensures that it:</p> <ul style="list-style-type: none">Is capable of delivering sustainable fisheries in accordance with MSC Principles 1 and 2; andObserves the legal rights created explicitly or established by custom of people dependent on fishing for food or livelihood; andIncorporates an appropriate dispute resolution framework.		
		<p>Commonwealth fisheries. The key EPBC Act 1999 requirements that apply relate to the need for a strategic assessment of the fishery management arrangements, and the management of protected areas and species.</p> <p>Binding procedures are explicit within these Acts. The Council of Australian Governments (COAG) Standing Councils are established to achieve COAG’s strategic themes by pursuing and monitoring priority issues of national significance which require sustained, collaborative effort and address key areas of shared Commonwealth, State and Territory responsibility and funding. COAG’s Standing Council on Primary Industries representation includes State, Territory and Commonwealth Ministers whose primary roles are to develop and implement policies and strategies for achieving agreed national approaches to biosecurity, productivity and sustainability of primary industries (including fisheries and forestry industries) and food security. Therefore, the national legal system and governing binding governance cooperation meets SG60, SG80 and SG100.</p>		
b	Guide post	The management system incorporates or is subject by law to a mechanism for the resolution of legal disputes arising within the system.	The management system incorporates or is subject by law to a transparent mechanism for the resolution of legal disputes which is considered to be effective in dealing with most issues and that is appropriate to the context of the fishery.	The management system incorporates or subject by law to a transparent mechanism for the resolution of legal disputes that are appropriate to the context of the fishery and has been tested and proven to be effective.
	Met?	Y	Y	Y
	Justification	<p>The consultation and decision making process in place actively seeks to avoid legal challenges. Four forms of dispute resolutions are as follows:</p> <p>(1) Sections 161 and 165 of the FMA provide appeal rights for decisions taken by AFMA through administrative means (internal AFMA review, appeal to the Administrative Appeals Tribunal and the Statutory Fishing Rights Allocation Review Panel) and judicial means through appeal to the Federal Court. These dispute resolution mechanisms have been tested (Weir & Loke, 2007) and proven to be effective. Cases such as <i>Arno Blank vs AFMA</i> (AAT, 2000) challenged the application of the precautionary principle. AFMA’s application of the precautionary principle was upheld.</p> <p>(2) Plans of Management (made pursuant to section 17) where AFMA must, in writing, after consultation and after <u>giving due consideration to any representations</u> mentioned in subsection (3), determine plans of management for all fisheries. Before determining a plan of management for a fishery, AFMA must prepare a draft of the plan and, by public notice: (a) state that it intends to determine a plan of management in respect of the fishery; and (b) invite interested persons to make representations in connection with the draft plan by a date specified in the notice, not being less than one month after the date of publication of the notice in the Gazette;</p> <p>(3) AFMA Agreement with the NPF contain a dispute mechanism clause which encourages</p>		

PI 3.1.1		<p>The management system exists within an appropriate legal and/or customary framework which ensures that it:</p> <ul style="list-style-type: none">Is capable of delivering sustainable fisheries in accordance with MSC Principles 1 and 2; andObserves the legal rights created explicitly or established by custom of people dependent on fishing for food or livelihood; andIncorporates an appropriate dispute resolution framework.		
		<p>both AFMA and the NPF to enter into Alternative Dispute Resolution process in an attempt to settle any dispute with the view to avoiding a Tribunal or Court.</p> <p>(4) Fishers are advised of their appeal rights and the processes involved. In addition to these processes, the consultation and advisory processes established by AFMA provide mechanisms for the airing and discussion of different perspectives on fisheries management and arguably serve to avoid potential legal disputes. Legal advice on management and appeals is provided by legal expertise within AFMA and by external, independent legal advisers as required. Historically one legal challenge was made to NPF 1989 Management Plan in relation to the compulsory reduction in effort within the. The main arguments were that the amendments to the plan to implement the reduction in effort were ultra vires, and the restructuring program represented an acquisition of rights on unjust terms under the constitution. The challenge was unsuccessful.</p> <p>Therefore, the national legal system provides for a transparent mechanism for the resolution of legal disputes and meets SG60, SG80 and SG100.</p>		
c	Guide post	The management system has a mechanism to generally respect the legal rights created explicitly or established by custom of people dependent on fishing for food or livelihood in a manner consistent with the objectives of MSC Principles 1 and 2.	The management system has a mechanism to observe the legal rights created explicitly or established by custom of people dependent on fishing for food or livelihood in a manner consistent with the objectives of MSC Principles 1 and 2.	The management system has a mechanism to formally commit to the legal rights created explicitly or established by custom of people dependent on fishing for food and livelihood in a manner consistent with the objectives of MSC Principles 1 and 2.
	Met?	Y	Y	Y
	Justification	<p>Special provision for ‘traditional fishing’ is made where they might apply in the contexts of both Commonwealth and State Fisheries Law. A system or mechanism to formally commit to the legal rights created explicit or established by custom on people dependent on fishing for food (non-commercial use) is enshrined in the <i>Native Title Act</i>”. This allows for special provision for ‘traditional fishing’ is made where they might apply in the contexts of both Commonwealth and State Fisheries Law.</p> <p>The Northern Prawn fishery is a specialist offshore commercial fishery. Indigenous rights are however considered in the context of The Aboriginal Land Act 1978 (NT) s 12(1) which empowers the Administrator to close the seas adjoining and within 2km of Aboriginal land, to others who are not Aborigines entitled by tradition to enter and use the seas in accordance with that tradition. Before doing so they may (and in case of dispute he must) refer a proposed sea closure to the Aboriginal Land Commissioner. These issues are taken into account through NORMAC consultation processes and in the context of closed areas discussions. Once seas are closed it is an offence for a person to enter or remain on these seas without a permit issued by the relevant Land Council. Therefore, the management system formally commits to the legal rights created explicitly or established by custom of people and meets SG60, SG80 and SG100.</p>		

PI 3.1.1	<p>The management system exists within an appropriate legal and/or customary framework which ensures that it:</p> <ul style="list-style-type: none">• Is capable of delivering sustainable fisheries in accordance with MSC Principles 1 and 2; and• Observes the legal rights created explicitly or established by custom of people dependent on fishing for food or livelihood; and• Incorporates an appropriate dispute resolution framework.	
References	<p>AFMA, http://www.afma.gov.au/</p> <p>Australian Government, Fisheries Management Act (FMA) of 1991. Available at http://www.austlii.edu.au/au/legis/cth/consol_act/fma1991193/</p> <p>Australian Government, Fisheries Management Regulations, 1992. Available at https://www.legislation.gov.au/Details/F2016C00617</p> <p>Australian Government, Fisheries Administration Act, 1991. Available at https://www.google.com.au/search?client=safari&rls=en&q=fisheries+administration+act+1991&ie=UTF-8&oe=UTF-8&gfe_rd=cr&ei=10J8WJe-As7u8wfTroXwBg</p> <p>Australian Government, Fisheries Administration Regulations, 1992. Available at https://www.legislation.gov.au/Series/F1996B03649</p> <p>Australian Government, Environment Protection and Biodiversity Act, 1999. Available at http://www.austlii.edu.au/au/legis/cth/consol_act/epabca1999588/</p> <p>Australian Government, Environment, Protection and Biodiversity Regulations, 2000. Available at https://www.legislation.gov.au/Series/F2000B00190</p> <p>The Council of Australian Governments (COAG) Standing Councils https://www.coag.gov.au/</p> <p>Weier A and Loke P (2007), Precaution and the Precautionary Principle: two Australian case studies, Productivity Commission, Commonwealth of Australia, 2007</p> <p>AAT, 2000. Administrative Appeals Tribunal, Arno Blank V AFMA, AAT 1027, 15 November, 2000 (http://www.austlii.edu.au/au/cases/cth/AATA/2000/1027.html)</p> <p>Government of Australia, Native Title Act, 1993</p> <p>Government of Australia, The Aboriginal Land Act 1978 (NT) s 12(1)</p>	
OVERALL PERFORMANCE INDICATOR SCORE:		100
CONDITION NUMBER (if relevant):		

Evaluation Table for PI 3.1.2

PI 3.1.2		The management system has effective consultation processes that are open to interested and affected parties. The roles and responsibilities of organisations and individuals who are involved in the management process are clear and understood by all relevant parties		
Scoring Issue		SG 60	SG 80	SG 100
a	Guide post	Organisations and individuals involved in the management process have been identified. Functions, roles and responsibilities are generally understood.	Organisations and individuals involved in the management process have been identified. Functions, roles and responsibilities are explicitly defined and well understood for key areas of responsibility and interaction.	Organisations and individuals involved in the management process have been identified. Functions, roles and responsibilities are explicitly defined and well understood for all areas of responsibility and interaction.
	Met?	Y	Y	Y
	Justification	<p>AFMA undertakes the day to day management of the Commonwealth fisheries under powers outlined in the FMA and Fisheries Administration Act 1991. Overarching policy direction is set by the Australian Government through the relevant Minister responsible for fisheries, acting upon advice from the Australian Government Department of Agriculture, Fisheries and Forestry.</p> <p>Roles and responsibilities are divided between the respective management organisation (AFMA), the Northern Prawn Industry Pty Ltd (http://npfindustry.com.au), the Northern Prawn Management Advisory Committee (NORMAC) (http://www.afma.gov.au/fisheries/committees/northern-prawn-management-advisory-committee/) and NPRAG (http://www.afma.gov.au/fisheries/committees/northern-prawn-resource-assessment-group/)</p> <p>As part of AFMA's partnership approach to fisheries management, it has established NORMAC, which is AFMA's main point of contact with client groups in the NPF and plays an important role in helping AFMA to fulfil its legislative functions and pursue its objectives (Smith <i>et al.</i>, 1999). The MAC comprises representatives of the NPF industry, environmental organisations, research interests and fishery managers. Permanent observers are also appointed, which may include the Department of Environment, Australian Bureau of Agriculture and Resource Economics (ABARES), and representatives of CSIRO. The role of the NORMAC is clearly defined (AFMA 2003, AFMA 2015a, AFMA 2011, AFMA 2015b). NORMAC provides advice to AFMA on a variety of issues, including the harvest strategy and other on-going measures required to manage the fishery, including the development of management plans, research priorities and projects for the fishery.</p> <p>The functions, roles and responsibilities are explicitly defined and well understood for all areas of responsibility and interaction and meet SG60, SG80 and SG100</p>		
b	Guide post	The management system includes consultation processes that obtain relevant information from the main affected parties, including local	The management system includes consultation processes that regularly seek and accept relevant information, including local knowledge. The management system demonstrates	The management system includes consultation processes that regularly seek and accept relevant information, including local knowledge. The management system demonstrates consideration

PI 3.1.2		<p>The management system has effective consultation processes that are open to interested and affected parties.</p> <p>The roles and responsibilities of organisations and individuals who are involved in the management process are clear and understood by all relevant parties</p>		
		knowledge, to inform the management system.	consideration of the information obtained.	of the information and explains how it is used or not used.
	Met?	Y	Y	Y
	Justification	<p>On key nonspecific Commonwealth fishery policy areas such as harvest strategy development and bycatch management plans, DAFF provide the opportunity for stakeholder consultation. Bodies consulted include government, the commercial fishing industry, environmental non-government organisations, the recreational fishing industry, state fisheries departments, scientific research organisations and government organisations. The formal process is for DAFF to provide a discussion paper. Throughout the consultation process, information about the review and how to make a submission is available online and in hardcopy on request. The review is advertised in several mediums including the Fisheries Research and Development Corporation's Fish Magazine and the AFMA website. The public consultation period is open for six weeks to give stakeholders the opportunity to consider their submissions and provide input. Feedback from the public consultation process is used to inform and develop the review of the harvest strategy policy. submissions were received and accepted until 11 January 2013. A summary of the submissions made is available on http://www.agriculture.gov.au/SiteCollectionDocuments/fisheries/domestic/harvest-strategy-policy/hspsummary.pdf, and the details of submissions made are available on http://www.agriculture.gov.au/fisheries/domestic/harvest_strategy_policy/review-submissions</p> <p>A final report on the review outcomes is available on: http://www.agriculture.gov.au/SiteCollectionDocuments/fisheries/environment/bycatch/report-harvest-strategy.pdf</p> <p>AFMA provides opportunities for public comment on fisheries management plans and holds around half of AFMA's Commission meetings in regional centres providing opportunities for direct access to AFMA Commissioners by stakeholders and the general public.</p> <p>NORMAC considers the wide range of information including local knowledge as part of its advisory processes. The minutes of NORMAC meeting are publicly available (AFMA, 2016d). These include rationale on how local knowledge has, or has not, been incorporated into management advice to the AFMA Commission. The AFMA Commission (and Parliament), may reject NORMAC advice. In respect to the AFMA Commission, NORMAC will always receive a letter from the Commission outlining any decisions made on NORMAC recommendations, including explanations as to acceptance or rejecting of NORMAC recommendations.</p> <p>The development of the demarcated closed and protected areas includes direct consultation with indigenous interests and ongoing awareness on traditional rights (Jarrett & Barwick, 2010). The NPF Directions and Closures booklet (AFMA, 2017) specifically includes information that has been developed in conjunction with indigenous groups on accessing aboriginal owned land and closed seas, and includes a number of closures that have been implemented taking into account indigenous interests (e.g., the protected area closures in Arnhem Bay, Dalumba Bay and Port Essington. There is a standing invitation for indigenous groups to attend NORMAC. There has also been considerable interaction on issues such as the development of proposed Indigenous Protected Areas in the Wellesley Island area. There have been two attendances by indigenous representatives at NORMAC on this issue in the past three years, and NPF also participated in the Carpentaria Land Council Indigenous Protected Area (CLC IPA) working group on this issue (Jarrett, 2016, pers com). As part of the co-management arrangements with AFMA, NPF is a member of the Dhimurru and</p>		

PI 3.1.2		<p>The management system has effective consultation processes that are open to interested and affected parties.</p> <p>The roles and responsibilities of organisations and individuals who are involved in the management process are clear and understood by all relevant parties</p>		
		<p>Yirralka IPA Advisory Groups as the representative for the NP. NPFI also provides input/comment on Sea Country management plans as and when they are proposed by the various indigenous groups (Jarrett, pers com, January, 2016).</p> <p>Evidence shows that the consultation processes regularly seek and accept relevant information, including local knowledge. The management system demonstrates consideration of the information and explains how it is used or not used. SG60, SG80 and SG100 are met.</p>		
c	Guide post		The consultation process provides opportunity for all interested and affected parties to be involved.	The consultation process provides opportunity and encouragement for all interested and affected parties to be involved, and facilitates their effective engagement.
	Met?		Y	Y
	Justifi cation	<p>DAFF consulted government organisations, the commercial fishing industry, environmental non-government organisations, the recreational fishing industry, state fisheries departments, scientific research organisations and government organisations. The department also developed a discussion paper for public consultation, as part of the review process. The discussion paper was released in November 2012 for a 6-week public consultation period (see above).</p> <p>AFMA holds an annual public meeting and holds around half of AFMA's Commission meetings in regional centres providing opportunities for direct access to AFMA Commissioners by stakeholders and the general public.</p> <p>NORMAC is made up of key stakeholders (see above). AFMA Commission decides on a fishery-by-fishery basis whether membership of a MAC should also reflect these wider community interests. However, there is no evidence that specific interest groups are excluded. Recreational interests are not present on the MAC as they are perceived to have no interaction with the prawn trawl fishery. The MAC considers the wide range of information including local knowledge as part of its advisory processes.</p> <p>The consultation process provides opportunity and encouragement for all interested and affected parties to be involved, and facilitates their effective engagement. SG60, and SG80 are met but not SG100.</p>		
References		<p>NORMAC, http://www.afma.gov.au/fisheries/committees/northern-prawn-management-advisory-committee/</p> <p>AFMA (2003), Guide to How MACs Work. Available at http://www.afma.gov.au/wp-content/uploads/2010/07/macs.pdf</p> <p>AFMA (2015a) Fisheries Management Paper (FMP) No.1 - Management Advisory Committees. Available at http://www.afma.gov.au/wp-content/uploads/2014/09/FMP-1-30-Oct-15.pdf</p> <p>AFMA (2011), Fisheries Administration Paper Series No. 12 Resource Assessment Groups - Roles, Responsibilities and Relationship with Management Advisory Committees. Available at http://www.afma.gov.au/wp-content/uploads/2011/09/Resource-Assessment-Groups-Roles-Responsibilities-and-Relationship-with-Management-Advisory-Committees.pdf</p>		

PI 3.1.2	<p>The management system has effective consultation processes that are open to interested and affected parties.</p> <p>The roles and responsibilities of organisations and individuals who are involved in the management process are clear and understood by all relevant parties</p>	
	<p>AFMA (2016d). Northern Prawn Fishery Management Advisory Committee (NORMAC) Meeting 79. Available at http://www.afma.gov.au/wp-content/uploads/2014/08/NORMAC-Meeting-Minutes-1-March-2016.pdf</p> <p>Smith, A. D. M. Sainsbury, K. J., and Stevens, R. A. (1999), Implementing effective fisheries-management systems – management strategy evaluation and the Australian partnership approach, ICES Journal of Marine Science, 56: 967–979. 1999. Available at http://icesjms.oxfordjournals.org/content/56/6/967.abstract</p> <p>AFMA (2015b), Fisheries Administration Paper Series No. 12 Resource Assessment Groups - Roles, Responsibilities and Relationship with Management Advisory Committees. Available at http://www.afma.gov.au/wp-content/uploads/2014/09/FAP-12-Oct-15.pdf</p> <p>Jarrett & Barwick (2010). FRDC (2010/320) Tactical Research Fund: Developing a model for enhanced consultation and collaboration between indigenous communities and the fishing industry: A case study between the NPF Industry and Carpentaria Land Council Aboriginal Corporation and Wellesley Island elders</p> <p>AFMA (2017), Directions and Closures, 2017, Available at http://www.afma.gov.au/wp-content/uploads/2017/03/Final-NPF-Directions-and-Closures-2017.pdf</p> <p>DAFF (2013). Final Report of the Review of the Commonwealth Fisheries Harvest Strategy Policy and Guidelines. Available at http://www.agriculture.gov.au/SiteCollectionDocuments/fisheries/environment/bycatch/report-harvest-strategy.pdf</p>	
OVERALL PERFORMANCE INDICATOR SCORE:		100

Evaluation Table for PI 3.1.3

PI 3.1.3		<p>The management policy has clear long-term objectives to guide decision-making that are consistent with MSC Principles and Criteria, and incorporates the precautionary approach</p>		
Scoring Issue		SG 60	SG 80	SG 100
a	Guide post	Long-term objectives to guide decision-making, consistent with the MSC Principles and Criteria and the precautionary approach, are implicit within management policy	Clear long-term objectives that guide decision-making, consistent with MSC Principles and Criteria and the precautionary approach are explicit within management policy.	Clear long-term objectives that guide decision-making, consistent with MSC Principles and Criteria and the precautionary approach, are explicit within and required by management policy.
	Met?	Y	Y	Y
	Justification	The long-term objectives of the management system are specified in the FMA and the EPBC Act, and further defined in the Commonwealth Fisheries Harvest Strategy Policy and Guidelines. The objectives and policy guidance are consistent with MSC's Principles and		

PI 3.1.3		The management policy has clear long-term objectives to guide decision-making that are consistent with MSC Principles and Criteria, and incorporates the precautionary approach	
		Criteria and explicitly require application of the precautionary principle. The fishery is also subject to the Commonwealth EPBC Act which requires periodic assessment against the <i>Guidelines for the Ecologically Sustainable Management of Fisheries</i> . These Guidelines are consistent with the MSC Principles and Criteria and encourage practical application of the ecosystem approach to fisheries management.	
References		<p>Australian Government, Australian Fisheries Management Act of 1991. Available at http://www.austlii.edu.au/au/legis/cth/consol_act/fma1991193/</p> <p>Australian Government, Environment Protection and Biodiversity Conservation Act 1999. Available at http://www.comlaw.gov.au/Details/C2011C00751</p> <p>Australian Government, The National Strategy for Ecologically Sustainable Development, 1992; available at http://www.environment.gov.au/about-us/esd/publications/national-esd-strategy.</p> <p>DAFF (2003). Looking to the Future: A review of Commonwealth Fisheries Policy.</p> <p>DAFF (2007). Commonwealth Fisheries Harvest Strategy Policy and Guidelines. Available at http://www.daff.gov.au/__data/assets/pdf_file/0004/397264/HSP-and-Guidelines.pdf</p> <p>DAFF (1999), The National Policy on Fisheries By-Catch; available at http://www.agriculture.gov.au/fisheries/environment/bycatch/nat_by_policy_1999</p> <p>DoE (1992), The Intergovernmental Agreement on the Environment; available at http://www.environment.gov.au/about-us/esd/publications/intergovernmental-agreement</p> <p>DoE (2007). Guidelines for Ecologically Sustainable Management of Fisheries. Available at http://www.environment.gov.au/coasts/fisheries/publications/pubs/guidelines.pdf</p> <p>Kompas T and Grafton Q., (2011) Target Path: Maximum Economic Yield in Fisheries Management, ABARES. Available at http://adl.brs.gov.au/data/warehouse/pe_abares99010704/TR11.03MEYfish_hr.pdf</p>	
OVERALL PERFORMANCE INDICATOR SCORE:			100
CONDITION NUMBER (if relevant):			

Evaluation Table for PI 3.1.4

PI 3.1.4		The management system provides economic and social incentives for sustainable fishing and does not operate with subsidies that contribute to unsustainable fishing		
Scoring Issue		SG 60	SG 80	SG 100
a	Guide post	The management system provides for incentives that are consistent with achieving the outcomes	The management system provides for incentives that are consistent with achieving the outcomes expressed by MSC	The management system provides for incentives that are consistent with achieving the outcomes expressed by MSC Principles 1 and 2, and explicitly considers

PI 3.1.4		The management system provides economic and social incentives for sustainable fishing and does not operate with subsidies that contribute to unsustainable fishing		
		expressed by MSC Principles 1 and 2.	Principles 1 and 2, and seeks to ensure that perverse incentives do not arise.	incentives in a regular review of management policy or procedures to ensure they do not contribute to unsustainable fishing practices.
	Met?	Y	Y	Y
	Justification	<p>The fishery has set the achievement of maximum economic yield (MEY) as its management target, consistent with the FMA objective to maximise net economic returns to the Australian community (Kompas <i>et al.</i>, 2010; Kompas and Grafton, 2011). The allocation of SFRs in the form of individual transferable Gear and B (boat) SFRs is the primary mechanism by which the management system seeks to provide long-term incentives for sustainable fishing in the prawn fishery (AFMA, 2016a). Three structural adjustment programs have been undertaken in order to address significant overcapacity issues and to ensure that such overcapacity does not pose a risk to the sustainability of stocks. Management measures (for example seasonal closures and tradable SFRs) also seek to optimize economic benefits. This system is constantly under review as part of the Harvest Strategy.</p> <p>Management costs are recovered from fishers in line with the Government's cost recovery policy as articulated in the Cost Recovery Impact Statement (AFMA, 2016b) and levy income and expenditure summaries provided in AFMA (2016). Research (including stock assessment), data collection and AFMA management costs are funded predominantly by industry and government. AFMA is responsible for compliance costs. The total of levies contributed by the NPF is around AUD 2 million.</p> <p>ABARES has also explicitly evaluated the impact of subsidies (Gooday, 2002). The report concluded that the major subsidies, 'buy back' or decommissioning and licence buy back, were seen as positive incentives since they explicitly supported changes to fisheries management, effectively limiting harvest and effort.</p> <p>Regular economic status assessments are undertaken by ABARES of indicators including the gross value of production, cost of management, financial performance (indicators including profit at full equity, cash operating surplus and return on investment), determination of major cost increases, regional economic impacts and economic rent. Since there are no incentive schemes in operation and because the fishery operates on a cost recovery process, a score of SG100 is reached.</p>		
References		<p>Kompas T, Dichmont C.E, Punt, A.E, Deng A, Tuong Nhu Che, Bishop, J., Gooday, P., Yemin, Y., Zhou, S., (2010) Maximizing profits and conserving stocks in the Australian Northern Prawn Fishery, Australian Journal of Agricultural Economics, Vol 54, Issue 3.</p> <p>Kompas T and Grafton Q., (2011) Target Path: Maximum Economic Yield in Fisheries Management, ABARES. Available at http://adl.brs.gov.au/data/warehouse/pe_abares99010704/TR11.03MEYfish_hr.pdf</p> <p>AFMA (2016a). NPF Directions and Closures, 2016. Available at http://www.afma.gov.au/wp-content/uploads/2014/02/NPF-Directions-and-Closures-2016.pdf</p> <p>AFMA (2016b). 2016 Cost Recovery Impact Statement (CRIS). Available at http://www.comfish.com.au/uploads/3/9/1/7/39171797/attachment-c-cris-2016-process.pdf</p> <p>AFMA (2016c). Levy Arrangements Guide for 2014-15, Available at http://www.afma.gov.au/wp-content/uploads/2015/01/Levy-Guide-2014-15.pdf</p> <p>Gooday, P., Fisheries subsidies (2002), ABARES, Available at http://adl.brs.gov.au/data/warehouse/pe_abarebrs99000765/PC12289.pdf</p>		

PI 3.1.4	The management system provides economic and social incentives for sustainable fishing and does not operate with subsidies that contribute to unsustainable fishing	
	Bath A and Green R, Australian Fisheries Economic Indicators Report (2015), Financial and Economic Performance of the Northern Prawn Fishery, Available t Australian Bureau of Agricultural and Resource Economics (ABARE). Available at http://data.daff.gov.au/data/warehouse/9aam/9aame/2016/FinEconPerfNPF/FinEconPerfNPF2015_v1.0.0.pdf	
OVERALL PERFORMANCE INDICTOR SCORE:		100
CONDITION NUMBER (if relevant):		

Evaluation Table for PI 3.2.1

PI 3.2.1		The fishery has clear, specific objectives designed to achieve the outcomes expressed by MSC's Principles 1 and 2		
Scoring Issue		SG 60	SG 80	SG 100
a	Guide post	Objectives, which are broadly consistent with achieving the outcomes expressed by MSC's Principles 1 and 2, are implicit within the fishery's management system	Short and long-term objectives, which are consistent with achieving the outcomes expressed by MSC's Principles 1 and 2, are explicit within the fishery's management system.	Well-defined and measurable short and long-term objectives, which are demonstrably consistent with <i>achieving</i> the outcomes expressed by MSC's Principles 1 and 2, are explicit within the fishery's management system.
	Met?	Y	Y	Y
	Justification	<p>The <i>Northern Prawn Fishery Management Plan</i> 1995 reinforces the objectives of the FMA as the objectives of the Plan. Fishery specific objectives for each sub fishery can be identified in the Northern Prawn Fishery Harvest Strategy (Dichmont <i>et al.</i>, 2014), and these are reviewed on a regular basis (the previous strategy set out in 2011). The Strategy contains references to use of measurable indicators such as target and limit reference points. Each subfishery has an operational objective. The operational objective of this Harvest Strategy is to attain long term MEY from the tiger prawn fishery. The objective of MEY can be considered equivalent to the objective of maximising the net present value of the flow of profits in the fishery over an indefinite period. For the NPF, MEY is assumed to be achieved over a seven-year period. The dynamic path to MEY is calculated as the effort level and associated catch in each year over a seven-year projection period that leads to a long run sustainable yield that maximises profits over time. Achievement of this objective is underlined by Target and Limit Reference Point, $EY/EMEY = 1$, and $0.5SMSY$. These are underlined by a strong catch monitoring system.</p> <p>The Bycatch Management Strategy (MRAG, 2012) applies to each subfishery and has historically relied on the use of Environmental Risk Assessments to assess the potential impact of the fishery, and underlined by a series of technological gear mitigation measures, as well as spatial and temporal approaches. For the Tiger prawn fishery, these measures achieved more than a 50% reduction of bycatch since 1998. The revised Bycatch Action Plan specifies the outcomes. A separate NPFI Bycatch Management Strategy (NPFI, 2015) seeks to achieve a 30% reduction. P2 outcomes include a reduction on small fish and sea snake bycatch, strengthening data, the application of effective bycatch reduction devices, addressing ETP interactions. Actions include Industry engagement to develop innovative options and/or gear modifications for testing, trialing robust, light- weight and crew-safe BRDs and/or gear modifications, investigating the feasibility of spatial and temporal approach to reducing bycatch, reviewing data collection requirements and observer protocols in the NPF, streamlining the gear directions, continuing to develop and implement training for Crew Member Observers (CMO) in the collecting and recording of valuable scientific data; Compiling and reporting CMO, TEP and bycatch data to NORMAC, and CSIRO to completing sustainability assessment of bycatch species. Each of these management actions and outcomes contains performance indicators.</p> <p>The operationalization of these strategies is supported by an NPF Industry Code of Practice for Responsible Fishing (AFMA, 2004), formerly Northern Prawn Fishing Industry Organisation and a Northern Prawn Fishery Operational Information Booklet (AFMA, 2016a), and the Bycatch and Discarding Workplan (AFMA, 2014-2016).</p> <p>AFMA assesses the sustainability of the NPF bycatch, published in CSIRO reports. AFMA also submits quarterly ETP monitoring reports to DoEE.</p>		

PI 3.2.1		The fishery has clear, specific objectives designed to achieve the outcomes expressed by MSC’s Principles 1 and 2	
		<p>The effectiveness of the Plan and supporting strategies are summarised by:</p> <ul style="list-style-type: none">(a) The status of economic efficiency of the Northern Prawn Fishery (Bath and Green (2015); and(b) The status of the biological resources and environmental conditions in the Northern Prawn Fishery area (Patterson <i>et al.</i>, 2016); and(c) The cost effectiveness of the management arrangements for the Northern Prawn Fishery (AFMA, 2016b). <p>Well-defined and measurable short and long-term objectives, which are demonstrably consistent with achieving the outcomes expressed by MSC’s Principles 1 and 2, are explicit within the fishery’s management system achieving SG60, SG80 and SG100.</p>	
References		<p>Australia Government, Northern Prawn Fishery Management Plan, 1995. Available at https://www.legislation.gov.au/Details/F2012C00160</p> <p>Dichmont, C.M, Jarrett, A., Hill, F., Brown, M. (2014) Harvest Strategy for the Northern Prawn Fishery under Input Controls. AFMA. Available at http://www.afma.gov.au/wp-content/uploads/2014/11/Harvest-Strategy-NPF-April-2014.pdf</p> <p>AFMA (2015), Northern Prawn Fishery Bycatch Management strategy, 2015-2018. Available at http://www.afma.gov.au/wp-content/uploads/2014/02/NPF-Bycatch-Strategy-2015-18-FINAL-VERSION.pdf</p> <p>NPF Industry Ltd (2004), Industry Code of Practice for Responsible Fishing (formerly Northern Prawn Fishing Industry Organisation). Available at http://www.afma.gov.au/wp-content/uploads/2010/06/npf_code.pdf</p> <p>AFMA (2016a). NPF Directions and Closures, 2016. Available at http://www.afma.gov.au/wp-content/uploads/2014/02/NPF-Directions-and-Closures-2016.pdf</p> <p>AFMA, 2014, Bycatch and Discarding Work Plan. Available at http://www.afma.gov.au/wp-content/uploads/2014/11/NPF-Bycatch-and-Discard-Workplan-Nov2014.pdf</p> <p>Bath A and Green R (2015), Australian Fisheries Economic Indicators Report, Financial and Economic Performance of the Northern Prawn Fishery, Available t Australian Bureau of Agricultural and Resource Economics (ABARE). Available at http://data.daff.gov.au/data/warehouse/9aam/9aame/2016/FinEconPerfNPF/FinEconPerfNPF2015_v1.0.0.pdf</p> <p>Patterson, H., Noriega, R., Georgeson, L., Stobutzki, I. & Curtotti, R. (2016), Fishery status reports 2016, Australian Bureau of Agricultural and Resource Economics and Sciences, Canberra. Available at http://www.agriculture.gov.au/abares/display?url=http://143.188.17.20/anrdl/DAFFService/display.php?fid=pb_fsr16d9abm_20160930.xml.</p> <p>AFMA (2016b). Cost Recovery Impact Statement (CRIS). Available at http://www.comfish.com.au/uploads/3/9/1/7/39171797/attachment-c-cris-2016-process.pdf.</p>	
	OVERALL PERFORMANCE INDICATOR SCORE:		100
	CONDITION NUMBER (if relevant):		

Evaluation Table for PI 3.2.2

PI 3.2.2		The fishery-specific management system includes effective decision-making processes that result in measures and strategies to achieve the objectives, and has an appropriate approach to actual disputes in the fishery under assessment.		
Scoring Issue		SG 60	SG 80	SG 100
a	Guide post	There are some decision-making processes in place that result in measures and strategies to achieve the fishery-specific objectives.	There are established decision-making processes that result in measures and strategies to achieve the fishery-specific objectives.	
	Met?	Y	Y	
	Justification	<p>DAFF has delegated the management of specific fisheries to AFMA (Australia Government, 1991), DAFF having overarching responsibility for the development of laws and policy.</p> <p>The decision-making processes by AFMA is based on advice from NORMAC (working with NPF RAG and the NPF Research and Environment Committee (NPF REC)) (AFMA, 2015). The workings of these groups include evaluation and assessment of each sub fishery and are transparent with feedback provided by the Commission directly from NORMAC and to stakeholders through media such as the regular <i>AFMA Update</i> and through the Annual public meeting of both the MAC and AFMA.</p> <p>The decision-making process for the NPF is consistent with those for the broader management system and responds to the defined harvest and bycatch management strategies, which respond to research, outcomes evaluations and monitoring programmes. The AFMA website contains an extensive list of evaluations, research reports and assessments, and evidence exists within the NORMAC and the NPF RAG that decisions respond to these findings (http://www.afma.gov.au/fisheries/northern-prawn-fishery/). Therefore, both SG60 and SG80 have been met.</p>		
b	Guide post	Decision-making processes respond to serious issues identified in relevant research, monitoring, evaluation and consultation, in a transparent, timely and adaptive manner and take some account of the wider implications of decisions.	Decision-making processes respond to serious and other important issues identified in relevant research, monitoring, evaluation and consultation, in a transparent, timely and adaptive manner and take account of the wider implications of decisions.	Decision-making processes respond to all issues identified in relevant research, monitoring, evaluation and consultation, in a transparent, timely and adaptive manner and take account of the wider implications of decisions.
	Met?	Y	Y	Y
	Justification	The decision making process for the NPF is consistent with those for the broader commonwealth management system and responds to the defined harvest and bycatch management strategies, which respond to research, outcome evaluations and monitoring programmes. Specific and relevant issues are evaluated through the MAC and NPF RAG and mechanisms are in place that take account of the wider implications of decisions, including		

PI 3.2.2		The fishery-specific management system includes effective decision-making processes that result in measures and strategies to achieve the objectives, and has an appropriate approach to actual disputes in the fishery under assessment.		
		reference to the AFMA commissioners. Important decisions relating to harvest strategy development, and bycatch management are all encompassed through these groups. Therefore, SG 60, SG 80 and SG 100 have been met.		
c	Guide post		Decision-making processes use the precautionary approach and are based on best available information.	
	Met?		Y	
	Justification	<p>The harvest strategies and control rules applied to each sub fishery incorporate a precautionary approach to the decision-making process by requiring a review when the target reference level is not met. This ensures that any warning signs are recognised and investigated / addressed in their early stages. The frequency of evaluation (both annually and in-season) and review means that management action to investigate and, where required, alleviate adverse impacts on stocks is always taken before the performance indicators reach the limit reference level.</p> <p>The application of the research, monitoring and evaluation within the NPF Management Plan, Harvest Strategy and Bycatch Management Strategy provides a good tool to assess the relative risks to target species, bycatch, ETP species and habitats in each sub fishery, initiating when appropriate, actions to deal with at risk species and assemblages. Examples of precautionary actions include controlling the trawl footprint, regulating fishing to take account of real time variations in prawn size, temporal and spatial closures; and the voluntary code. Since there is strong evidence of precautionary actions covering both P1 and P2 management issues, the SG80 has been met.</p>		
d	Guide post	Some information on fishery performance and management action is generally available on request to stakeholders.	Information on fishery performance and management action is available on request, and explanations are provided for any actions or lack of action associated with findings and relevant recommendations emerging from research, monitoring, evaluation and review activity.	Formal reporting to all interested stakeholders provides comprehensive information on fishery performance and management actions and describes how the management system responded to findings and relevant recommendations emerging from research, monitoring, evaluation and review activity.
	Met?		Y	Y
	Justification	<p>AFMA, CSIRO and the NPF Pty Ltd provide a comprehensive range of reports which confirm fishery performance and how management has responded to findings from recommendations emerging from research, monitoring, evaluation and review activity. (http://www.afma.gov.au/fisheries/northern-prawn-fishery/ and http://npfindustry.com.au/publications/). These include stock status reports; catch data including target species, by-product (retained species), bycatch and ETP species; benthic impact assessments; BRD Assessments; Ecological Risk Assessments; Sustainability assessment reports, Observer reports and risk assessment and mitigation of sea snakes.</p>		

PI 3.2.2		The fishery-specific management system includes effective decision-making processes that result in measures and strategies to achieve the objectives, and has an appropriate approach to actual disputes in the fishery under assessment.		
		<p>Explanations are provided for actions or lack of actions by the organisations tasked with implementation. Failure to achieve the management reference levels is discussed at NORMAC and advice provided to AFMA. AFMA provide responses through the MAC how information is reviewed and the management decisions made (See Northern Prawn Management Advisory Committee past meetings (http://www.afma.gov.au/fisheries/committees/northern-prawn-management-advisory-committee/normac-past-meetings/)). It then becomes the responsibility of AFMA to rectify failure to achieve specific management outcomes. As part of comanagement functions, NPFI is responsible for implementing supporting activities such as ensuring the accuracy, timeliness and dissemination of the fishery catch and effort, gear and economic data; managing the CMO program; coordinating pre-season briefing of fishers to ensure operators are aware of all the rules regulating the fishery and that they are following best practice and undertaking essential reporting and advising AFMA on operational matters in the fishery, including the timing of fishing seasons, the setting of fishing gear limits and research priorities.</p> <p>The Harvest Strategy, Bycatch and Discards Workplan and Bycatch Strategy 2015 contain monitoring and performance indicators and provided the basis for incorporating relevant recommendations emerging from research, monitoring, evaluation and review activity</p> <p>Therefore, both SG80 and SG100 have been met.</p>		
e	Guide post	Although the management authority or fishery may be subject to continuing court challenges, it is not indicating a disrespect or defiance of the law by repeatedly violating the same law or regulation necessary for the sustainability for the fishery.	The management system or fishery is attempting to comply in a timely fashion with judicial decisions arising from any legal challenges.	The management system or fishery acts proactively to avoid legal disputes or rapidly implements judicial decisions arising from legal challenges.
	Met?	Y	Y	Y
	Justifi cation	The consultation and advisory processes ensure that the management system in each sub fishery acts proactively to avoid legal disputes. The co-management system allows for some delegation of responsibilities and the partnership approach between AFMA and the NPFI actively works towards avoiding disputes. In addition, licence conditions provide for a system of dispute resolution in the event that the prescribed licence holder is not satisfied with the conditions (Part 8 161-162 of the Fisheries Management Act). No legal challenges or judicial decisions have taken place in the NPF. An appeals procedure exists to the Federal Court for Statutory Fishing Rights Allocations, but has not been tested.		
		The scoring guidance outcomes SG60, SG80 and SG100 are met.		
References		Australian Government, Fisheries Administration Act, 1991. Available at https://www.google.com.au/search?client=safari&rls=en&q=fisheries+administration+act+1991&ie=UTF-8&oe=UTF-8&gfe_rd=cr&ei=10J8WJe-As7u8wfTroXwBg		

PI 3.2.2	The fishery-specific management system includes effective decision-making processes that result in measures and strategies to achieve the objectives, and has an appropriate approach to actual disputes in the fishery under assessment.		
	<p>AFMA (2015a) Fisheries Management Paper (FMP) No.1 - Management Advisory Committees. Available at http://www.afma.gov.au/wp-content/uploads/2014/09/FMP-1-30-Oct-15.pdf</p> <p>Dichmont, C.M, Jarrett, A., Hill, F., Brown, M. (2014) Harvest Strategy for the Northern Prawn Fishery under Input Controls. AFMA. Available at http://www.afma.gov.au/wp-content/uploads/2014/11/Harvest-Strategy-NPF-April-2014.pdf</p> <p>AFMA Publications are available on http://www.afma.gov.au/fisheries/northern-prawn-fishery/ and http://npfindustry.com.au/publications/</p> <p>NPF publications are available on http://npfindustry.com.au/publications/</p> <p>Australian High Court Judgement. Available at http://www.hcourt.gov.au/assets/publications/judgment-summaries/2013/hca47-2013-11-06.pdf</p>		
OVERALL PERFORMANCE INDICATOR SCORE:			100
CONDITION NUMBER (if relevant):			

Evaluation Table for PI 3.2.3

PI 3.2.3		Monitoring, control and surveillance mechanisms ensure the fishery's management measures are enforced and complied with		
Scoring Issue		SG 60	SG 80	SG 100
a	Guide post	Monitoring, control and surveillance mechanisms exist, are implemented in the fishery under assessment and there is a reasonable expectation that they are effective.	A monitoring, control and surveillance system has been implemented in the fishery under assessment and has demonstrated an ability to enforce relevant management measures, strategies and/or rules.	A comprehensive monitoring, control and surveillance system has been implemented in the fishery under assessment and has demonstrated a consistent ability to enforce relevant management measures, strategies and/or rules.
	Met?	Y	Y	Y
	Justification	AFMA deploys a comprehensive enforcement system, including at sea patrols and boardings, pre-inspection checks and inspections on offloading (AFMA (2016-2017)). The effectiveness of the inspection system is underlined by a system of risk assessment (AFMA 2015c), where systematic offenders are likely to be singled out. Specific non-compliance areas have been prioritised, notably failure to have a Vessel Monitoring System (VMS) system operating at all times, closure monitoring, effective application of BRDs and TEDs and reporting ETP interactions (AFMA (2016-2017)). Therefore, SG60, SG 80 and SG100 have been met.		

PI 3.2.3		Monitoring, control and surveillance mechanisms ensure the fishery's management measures are enforced and complied with		
b	Guide post	Sanctions to deal with non-compliance exist and there is some evidence that they are applied.	Sanctions to deal with non-compliance exist, are consistently applied and thought to provide effective deterrence.	Sanctions to deal with non-compliance exist, are consistently applied and demonstrably provide effective deterrence.
	Met?	Y	Y	Y
	Justification	<p>AFMA operates an effective compliance system, but focuses primarily of awareness raising prior to the start of the fishing seasons in each sub fishery. When infringements are detected the penalty process implemented equates to the seriousness of offence, culminating in a sequence of warnings, expedited offences and prosecutions, leading to license confiscation for serious offences. The main tool applied is AFMA Commonwealth Fisheries Infringement Notices (CFINs), which are on the spot fines.</p> <p>The schedule of fines is based on a penalty unit system defined in Section 95 of the FMA, 1991, with fines offences specified on the Fisheries Management regulations (1992) with defined Index to offences.</p> <p>The combination of substantial enforcement and the small number of offences taking place is evidence that sanctions are a demonstrably effective deterrent. Company enforcement action adds another level of deterrent. Therefore SG60, SG80 and SG100 have been met.</p>		
c	Guide post	Fishers are generally thought to comply with the management system for the fishery under assessment, including, when required, providing information of importance to the effective management of the fishery.	Some evidence exists to demonstrate fishers comply with the management system under assessment, including, when required, providing information of importance to the effective management of the fishery.	There is a high degree of confidence that fishers comply with the management system under assessment, including, providing information of importance to the effective management of the fishery.
	Met?	Y	Y	Y
	Justification	<p>The Division measures compliance outcomes by estimating compliance and non-compliance rates. The record of offences (2013-2016) (Clementz, AFMA compliance, 2017) indicates a small number of minor offences (Fava, AFMA, 2017). These relate to some non-conformity with the TED regulations, failure to appropriately mark the length of gear, and effective application of BRDs. AFMA's response has been to issue CFIRs, or place good behaviour bonds in infringing vessels.</p> <p>As part of comanagement functions, NPFI is responsible for implementing supporting activities such as ensuring the accuracy, timeliness and dissemination of the fishery data program; coordinating pre-season briefing of fishers to ensure operators are aware of all the rules regulating the fishery and that they are following best practice and undertaking essential reporting and advising AFMA on operational matters in the fishery, including the timing of fishing seasons and the setting of fishing gear limits.</p> <p>Industry companies have their own disciplinary management systems in place. Any detected irregularity is acted upon, and reported to AFMA. Any evidence of systematic noncompliance by individual skippers, or one off clear abuses result in dismissal (Austral/Raptis, NPFI stakeholder meeting, 14 February 2017).</p> <p>Therefore SG60, SG80 and SG100 have been met.</p>		

PI 3.2.3		Monitoring, control and surveillance mechanisms ensure the fishery's management measures are enforced and complied with		
d	Guide post		There is no evidence of systematic non-compliance.	
	Met?		Y	
	Justification	There is no evidence of systematic non-compliance by the licensees and skippers in the NPF, nor is there evidence that the existing (negligible) level of non-compliance in the past five years is a risk to target prawn stocks or ecosystem components. SG80 has been met.		
References		<p>AFMA (2015d). AFMA National Compliance and Enforcement Policy. Available at http://www.afma.gov.au/wp-content/uploads/2014/08/2015-National-Compliance-and-Enforcement-Policy.pdf</p> <p>Administration of the Domestic Fishing Compliance Program. The Auditor-General Audit Report No.20 2012-2013, Performance Audit. Available at https://www.anao.gov.au/sites/g/files/net2446/f/201213%20Audit%20Report%20No%2020.pdf</p> <p>AFMA (2016-2017). National Compliance and Enforcement Programme (2016-2017). Available at http://www.afma.gov.au/wp-content/uploads/2016/08/National-Compliance-and-Enforcement-Program-2016-17.pdf</p> <p>AFMA (2015c) National Compliance (2015-2016) Risk Assessment Methodology. Available at http://www.afma.gov.au/wp-content/uploads/2014/08/Compliance-risk-methodology-Final-2015-17.pdf</p> <p>Australian Government, Fisheries Management Act (FMA) of 1991. Available at http://www.austlii.edu.au/au/legis/cth/consol_act/fma1991193/</p> <p>Australian Government, Fisheries Management Regulations, 1992. Available at https://www.legislation.gov.au/Details/F2016C00617</p> <p>Australia Government (1992). Fisheries Management Regulations, Index to offences.</p> <p>Shane Fava, AFMA, pers com, 18 January, 2017.</p> <p>Shane Clementz, AFMA Compliance, pers com, 19 January, 2017</p>		
OVERALL PERFORMANCE INDICATOR SCORE:				100
CONDITION NUMBER (if relevant):				

Evaluation Table for PI 3.2.4

PI 3.2.4		The fishery has a research plan that addresses the information needs of management		
Scoring Issue		SG 60	SG 80	SG 100
a	Guide post	Research is undertaken, as required, to achieve the objectives consistent with	A research plan provides the management system with a strategic approach	A comprehensive research plan provides the management system with a coherent and strategic

PI 3.2.4		The fishery has a research plan that addresses the information needs of management		
		MSC's Principles 1 and 2.	to research and reliable and timely information sufficient to achieve the objectives consistent with MSC's Principles 1 and 2.	approach to research across P1, P2 and P3, and reliable and timely information sufficient to achieve the objectives consistent with MSC's Principles 1 and 2.
	Met?	Y	Y	Y
	Justification	<p>A five-year Research Plan (2014-2018) has been published (NPFIP, 2014) and was implemented from the start of 2014. Key strategic research priorities include:</p> <ul style="list-style-type: none"> • Collect information to inform annual RAG assessment to set the Total Allowable Effort (TAE) for tiger, common and red-legged banana prawns in accordance with NPF harvest strategies • Provide key data used to set TAE through at-sea monitoring projects (i.e. recruitment and spawning surveys) • Undertake annual analysis of CMO and Scientific Observer data to confirm it meets criteria for use in monitoring populations of Endangered, Threatened, and Protected (ETP) and at-risk species • Undertake a Sustainability Assessment of Fishing Effects (SAFE) assessment for the Joseph Bonaparte Gulf subfishery. <p>The research priorities for the NPF are reviewed annually by the Research Advisory Group (NPRAG) and the Management Advisory Committee (NORMAC) and included in an Annual Research Statement.</p> <p>The NPF and NORMAC need to ensure that the research plan includes prioritised, cost effective research and information required to support management the application of the harvest strategy and Bycatch Action Plan.</p> <p>Research priorities are then pursued by research providers, often in partnership with industry and/or fisheries managers with the help of the below research advisory bodies: The AFMA Research Committee (ARC) which considers essential stock assessment type research for funding by AFMA in the following financial year; and the Commonwealth Fisheries Research Advisory Body (ComFRAB) which considers Commonwealth fisheries research priorities for potential Fisheries Research and Development Corporation (FRDC) funding two years hence) - the FRDC research cycle is an 18 months' cycle compared to the ARC which is a 12 months' cycle. Therefore SG60, SG80 and SG100 have been met.</p>		
b	Guide post	Research results are available to interested parties.	Research results are disseminated to all interested parties in a timely fashion.	Research plan and results are disseminated to all interested parties in a timely fashion and are widely and publicly available.
	Met?	Y	Y	Y
	Justification	<p>The Research Plan is available on the website and disseminated to interested parties (http://www.afma.gov.au/wp-content/uploads/2014/12/NPF_Five_Year_Strategic_Research_Plan_FINAL1.pdf). The Results of the Plan are disseminated through research papers published on the AFMA Website and the NPFI http://npfindustry.com.au/publications/</p>		
References		AFMA (2014b) NPF Strategic Research Plan, 2014-2018, http://www.afma.gov.au/wp-content/uploads/2010/06/NPF_Five_Year_Strategic_Research_Plan_FINAL1.pdf		

PI 3.2.4	The fishery has a research plan that addresses the information needs of management	
	AFMA (Northern Prawn Research and data publications) http://www.afma.gov.au/fisheries/northern-prawn-fishery/ NPF Industry Pty Ltd http://npfindustry.com.au/publications/	
OVERALL PERFORMANCE INDICATOR SCORE:		100
CONDITION NUMBER (if relevant):		

PI 3.2.5		There is a system of monitoring and evaluating the performance of the fishery-specific management system against its objectives There is effective and timely review of the fishery-specific management system		
Scoring Issue				
a	Guide post	The fishery has in place mechanisms to evaluate some parts of the management system.	The fishery has in place mechanisms to evaluate key parts of the management system	The fishery has in place mechanisms to evaluate all parts of the management system.
	Met?	Y	Y	Y
	Justification	<p>The Australia Government commissioned two independent reviews of the core Acts (EPBC Act and FMA) governing the environment and fisheries (Hawke, 2009, and Borthwick, 2012). The Borthwick review also included reviews of policy settings, recasting AFMA's objectives, fisheries management plans, the Minister's powers to vary fisheries management plans, integrating fisheries and environmental assessments, Research, fisheries management and industry levies, Offshore Constitutional Settlements (OCS), Recreational Fishing, Aquaculture, Compliance and enforcement and Co-management. The Government response to the Borthwick Review was announced in March 2013. DAFF thereafter initiated a public consultation process DAFF (2012/2013), followed by specific Reports on Harvest Strategy and Bycatch management strategy (DAFF 2013a, DAFF 2013b). Thereafter, this prompted NPF to revise their fishery specific harvest (Dichmont <i>et al.</i>, 2014), and bycatch management strategies (NPFI, 2015)</p> <p>The fishery has in place mechanisms to evaluate all parts of the management system. Therefore SG60, SG80 and SG100 have been met.</p>		
b	Guide post	The fishery-specific management system is subject to occasional internal review.	The fishery-specific management system is subject to regular internal and occasional external review.	The fishery-specific management system is subject to regular internal and external review.
	Met?	Y	Y	Y
	Justification	<p>In addition, AFMA's management system is subject to internal and external performance evaluation including (Nick Rayns, AFMA, January 2017, pers. com):</p> <p>Internal peer reviews, which include:</p> <ul style="list-style-type: none"> • The requirement to report in AFMA's Annual Report on overall performance against the legislative objectives, statutory requirements and financial reporting, the effectiveness of internal controls and adequacy of systems; and the Authority's risk management processes; • AFMA and the MAC to periodically assess the effectiveness of the management measures taken to achieve the objectives of this Management Plan by reference to the performance criteria specified in the Plan • An AFMA MAC/RAG Workshop focusing on managing conflicts of interest, the Productivity Commission review of commercial fisheries management, the regulatory outlook etc. • AFMA and NORMAC developing performance measures and responses to avoid overcapitalisation and encourage autonomous structural adjustment in the NPF • NPF research proposals reviewed by the AFMA Research Committee and those for FRDC funding by the Commonwealth Research Advisory Committee 		

PI 3.2.5	<p>There is a system of monitoring and evaluating the performance of the fishery-specific management system against its objectives</p> <p>There is effective and timely review of the fishery-specific management system</p>
	<ul style="list-style-type: none"> • The NPF harvest strategy remains consistent with the Australian government's Harvest Strategy Policy • Review of AFMA's ERA-ERM Framework – new Guidelines for fisheries have been drafted and will be finalised by 30 June 2017; and • AFMA also has an internal quality assurance program to determine whether Compliance best practice has been followed <p>External reviews, which include:</p> <ul style="list-style-type: none"> • Questioning by the Senate Standing Committee on Rural and Regional Affairs and Transport in Senate Estimates hearings (three times/year); • Annual reporting of NPF performance against protected species and export approval requirements under the EPBC Act consistent with the Guidelines for the Ecologically Sustainable Management of Fisheries (See below); • The Australian Bureau of Agricultural and Resource Economics and Sciences (ABARES) annual status reports (last published late 2016) on the ecological and economic sustainability of fisheries managed by AFMA; • US biennial review and accreditation of fishing gear to meet Turtle Excluder Device requirements; • The draft Productivity Commission review of commercial fisheries regulation in Australia which has made a number of draft recommendations relevant to AFMA (the final report is due to be completed shortly); • The Australian National Audit Office periodic reviews of aspects of AFMA's performance. This includes an audit of AFMA's risk management procedures which is currently underway. <p>These reviews constitute a review on NPF's fishery-specific management system including its subfisheries.</p> <p>DAWR with responsibility for oversight DAF undertake a regular framework evaluations of the Commonwealth harvest strategy (http://www.agriculture.gov.au/fisheries/domestic/harvest_strategy_policy/review), with a framework currently to be published. AFMA also produces a statement of the performance of the NPF against its objectives, performance indicators and performance measures which is made annually in AFMA's annual report – whilst the report is prepared internally, it does have to be tabled in Parliament. Example http://www.afma.gov.au/wp-content/uploads/2014/04/2013-14-AFMA-Annual-Report.pdf</p> <p>CSIRO's internal and external review procedures (Buckworth and Hutton, pers com 14th February, 2017) comprise the following:</p> <ul style="list-style-type: none"> • Internal sensitivity test procedures of research paper outputs • paper reviews by 2 scientists and principal scientific officer to sign off • A 5 yearly CSIRO Science Review of research methodologies, using independent experts • External review of journal papers • RAG member response to papers <p>All FRDC funded research papers are also subject to external review.</p> <p>The ANAO regularly reviews the AFMA Compliance Programme (ANAO, 2013), and these recommendations are adopted into the AFMA Compliance Programme (AFMA 2016-2017).</p>

PI 3.2.5	<p>There is a system of monitoring and evaluating the performance of the fishery-specific management system against its objectives</p> <p>There is effective and timely review of the fishery-specific management system</p>
	<p>The implementation of the <i>Environment Protection and Biodiversity Conservation Act 1999</i> (EPBC Act) allows the Australian Government to assess the environmental performance of fisheries and promote ecologically sustainable management.</p> <p>An independent assessment of all export and all Australian Government managed fisheries is required. These assessments ensure that, over time, fisheries are managed in an ecologically sustainable way. The Assessment (DoE, 2013) is available at DoEE website, Assessment of the Northern Prawn Fishery. Available at http://www.environment.gov.au/marine/fisheries/commonwealth/northern-prawn;</p> <p>The Accreditation of the NPF (Government of Australia, 2013) is available at http://www.environment.gov.au/system/files/pages/d13c64f2-0564-49b6-9abd-c06aed4f3fc8/files/part13-2013.pdf</p> <p>The assessors conclusion is that SG 3.25a and 3.2.5b are met for 60, 80 and 100. This is consistent with the Australian blue grenadier fishery, an Australian domestic fishery also managed by AFMA (https://fisheries.msc.org/en/fisheries/australia-blue-grenadier/@@assessments) and therefore harmonised with this score.</p>
References	<p>Hawke, A. (2009) Report of the Independent Review of the Environment Protection and Biodiversity Conservation Act, 1999., October, 2009, Available at https://www.environment.gov.au/system/files/resources/5f3fdad6-30ba-48f7-ab17-c99e8bcc8d78/files/final-report.pdf</p> <p>Borthwick, D (2012). Review of Commonwealth Fisheries: Policy, Legislation and Management, DAFF, https://www.google.com.au/search?client=safari&rls=en&q=Review+of+the+operation+of+the+Fisheries+Act&ie=UTF-8&oe=UTF-8&gfe_rd=cr&ei=d7J-WI6LNsr8Af_37PACw</p> <p>Australia Government, Government Response to the Commonwealth Fisheries Review, Statement by the Minister for Agriculture, Fisheries and Forestry Senator the Hon Joe Ludwig, 21 March 2013. Available on http://www.tarfish.org/documents/Borthwick%20Review%20Report%20Govt%20Response%2020130321.pdf</p> <p>DAFF (2012/2013), Summary of stakeholder consultation for the review of the Commonwealth Fisheries Harvest Strategy Policy and Guidelines. Available at http://www.agriculture.gov.au/SiteCollectionDocuments/fisheries/domestic/harvest-strategy-policy/hspsummary.pdf</p> <p>DAFF (2013a). Final Report of the Review of the Commonwealth Fisheries Harvest Strategy Policy and Guidelines. Available at http://www.agriculture.gov.au/SiteCollectionDocuments/fisheries/environment/bycatch/report-harvest-strategy.pdf</p> <p>DAFF (2013b), Report on the review of the Commonwealth Policy on Fisheries Bycatch. Available at http://www.agriculture.gov.au/SiteCollectionDocuments/fisheries/environment/bycatch/submissions/fisheries-bycatch.pdf</p> <p>Dichmont <i>et al.</i> (2014). Harvest Strategy for the Northern Prawn Fishery under Input Controls. Available at http://www.afma.gov.au/wp-content/uploads/2014/11/Harvest-Strategy-NPF-April-2014.pdf</p> <p>NPFI, 2015. Northern Prawn Fishery Bycatch Strategy, 2015-2018. Available at http://www.afma.gov.au/wp-content/uploads/2014/02/NPF-Bycatch-Strategy-2015-18-FINAL-VERSION.pdf</p>

PI 3.2.5	<p>There is a system of monitoring and evaluating the performance of the fishery-specific management system against its objectives</p> <p>There is effective and timely review of the fishery-specific management system</p>
	<p>Australian National Audit Office (2013), Administration of Australian Government, Public Governance, Performance and Accountability Act 2013, Available at https://www.legislation.gov.au/Details/C2016C00414</p> <p>ANAO Administration of the Domestic Fishing Compliance Program (2013). The Auditor-General Audit Report No.20 2012-2013, Performance Audit. Available at https://www.anao.gov.au/sites/g/files/net2446/f/201213%20Audit%20Report%20No%2020.pdf</p> <p>AFMA (2016-2017). National Compliance and Enforcement Programme (2016-2017). Available at http://www.afma.gov.au/wp-content/uploads/2016/08/National-Compliance-and-Enforcement-Program-2016-17.pdf</p> <p>DoE (2013), Assessment of the Northern Prawn Fishery. Available at http://www.environment.gov.au/marine/fisheries/commonwealth/northern-prawn</p> <p>Government of Australia (2013). Revocation of Accreditation of a Plan, Regime or Policy for the Purposes of Part 3 / Accreditation of a Plan, Regime or Policy for the Purposes of Part 3. Available at http://www.environment.gov.au/system/files/pages/d13c64f2-0564-49b6-9abd-c06aed4f3fc8/files/part13-2013.pdf</p> <p>SCS, Australian Blue Grenadier Fishery MSC Full Assessment Report, https://fisheries.msc.org/en/fisheries/australia-blue-grenadier/@_assessments</p>
OVERALL PERFORMANCE INDICATOR SCORE:	
100	

7.2 Appendix 2: Risk-Based Framework for Red Endeavour Prawn

7.2.1 Scale Intensity Consequence Analysis

The following steps were followed in applying the RBF:

- The form “Use of the Risk-Based framework” was published on the MSC website on 22 December 2016, however, given knowledge of the original MSC assessment it was expected that the RBF would not be required. Consequently, the RBF was not pursued at the site visit (13-14 February 2017).
- During the site visit it became apparent that available information was inadequate to apply the standard assessment methodology, as prescribed in the FCR v2.0, for red endeavour prawn Principle 1 assessment. As a result, a “Notice of Remote Risk-Based Framework Process” was published on the MSC website on 2 May 2017.
- The assessment team developed a questionnaire (see below) designed to obtain the necessary information for the SICA. This questionnaire was included with the Notice.
- 30 days was allowed for comment, closing 2 June 2017.
- The Northern Prawn Fishery Assessment Group met in Brisbane on 11 May 2017 for one of its regular meetings. During that meeting a workshop was conducted to discuss the SICA questionnaire. Participants are indicated below. A consolidated response to the questionnaire was provided by the participants and is attached at 10.2.3. No responses on the questionnaire were received from other parties.
- The consolidated response from NPRAG was used to inform the SICA scoring at Table 40.

NPF MSC SICA Workshop Attendance May 2017

Name	Membership (type i.e. chair etc.)
Ian Knuckey	Chair
Phil Robson	Industry Member
Ian Boot	Industry Member
Malcolm Haddon	Scientific Member - CSIRO
Tom Kompas	Economic Member - ANU
Rik Buckworth	Scientific Member
David Brewer	Scientific Member
Shane Fava	AFMA Member
Stephen Eves	Executive Officer - AFMA
Gabrielle Miller	Observer - AFMA
Annie Jarrett	Observer - NPFI
Eva Plaganyi-Lloyd	Observer - CSIRO
Trevor Hutton	Observer - CSIRO
Roy Deng	Observer - CSIRO
Sean Pascoe	Observer - CSIRO
Rob Kenyon	Observer - CSIRO
Robert Curtotti	Observer - ABARES
Andrea Bath	Observer - ABARES
David Mobsby	Observer - ABARES

Table 40: Principle 1 SICA scoring – Red Endeavour Prawns (based on Griffith *et al.*, (2007) and the SICA questionnaire below).

(Reference: MSC CR v1.3 Table CC3)

Performance Indicator	Risk-causing activities	Spatial scale of activity	Temporal scale of activity	Intensity of activity	Relevant sub-components	Consequence score	MSC Score
Target species outcome	Fishing activities from all fisheries including: <ul style="list-style-type: none">• Direct capture• Unobserved mortality (e.g. gear loss)• Capture as bycatch in other fisheries• Other identified risk-causing activities	2	4	3	Population size	2	80
					Reproductive capacity		
					Age/size/sex structure		
					Geographic range		
Rationale for selecting worst plausible case scenario	Lack of information on stock status.						
Rationale for Spatial scale of activity	The species has a wide Indo-Pacific distribution. There are permanently closed areas and only a small percentage of the total NPF management area is fished (1.6% trawled with a swept area of 2.7%; Pitcher <i>et al.</i> , 2015). Red endeavour prawns spend much of the year in waters deeper than those typically fished. The score is supported by the findings of the SICA questionnaire at 10.2.3.						
Rationale for Temporal scale of activity	Red endeavour prawns are predominantly a byproduct of the tiger prawn sub-fishery which operates for approximately 120 days per year. Also see SICA questionnaire at 10.2.3.						
Rationale for Intensity of activity	The reduced number of vessels now operating in the fishery, the small percentage of the NPF management area fished and the seasonal closures. The SICA questionnaire indicates a minor level of intensity in all except one of the fishing areas. A moderate level is indicated for area 14.						
Rationale for choosing most vulnerable sub-component	Population size most likely component affected by fishing and there is currently no stock assessment to monitor this.						
Rationale for Consequence score	Annual surveys indicate low abundance with high CVs. Nevertheless, the surveys suggest minimal impact on population size over time. The SICA questionnaire responses also support a consequence score of 2 given the spatial scale of fishing activity and the minor intensity of fishing in most areas.						

7.2.2 Productivity Susceptibility Analysis – worksheet for PI 1.1.1 for Red Endeavour Prawns

		Productivity Scores [1-3]*								Susceptibility Scores [1-3]**					1.1.1 only					PSA scores (automatic)			
COMMON_NAME	GEAR_TYPE(1.1.1)	Average age at maturity	Average max age	Fecundity	Average max size	Average size at Maturity	Reproductive strategy	Trophic level (fishbase)	Total Productivity (average)	Availability	Encounterability	Selectivity	Post-capture mortality	Total (multiplicative)	Catch (tons) (1.1.1)	Weighting (1.1.1)	Weighted Total	Weighted average	Color on PSA plot	PSA Score	MSC Score	Risk Category Name	MSC scoring guidepos
Red endeavour prawn	Otter trawl	1	1	1	1	1	1	1	1.00	1	3	3	3	1.65	100	1.00	1.65	1.65		1.93	96.0	Low	>80

* Productivity scores are as per the 2007 ecological risk assessment of the fishery (Griffiths *et al.*, 2007) using the ERAEF methodology described in Section 3.4.4 of this report. The ERAEF was a scientific risk assessment process developed by CSIRO over several years for application to Australia's Commonwealth-Government managed fisheries. The methodology (Hobday *et al.*, 2007) has been used widely in many fisheries around the world and is similar to the MSC RBF. The ERAEF PSA undertaken in Griffiths *et al.* (2007) derived the total productivity score for red endeavour prawns to be 1. Information for the scoring of the components for the PSA above (average age at maturity, average maximum age, fecundity, average maximum size, average size at maturity, reproductive strategy and trophic level) were checked in available literature (e.g. Crocos *et al.*, 2001) for consistency with the Griffiths *et al.* (2007) findings.

** The ERAEF described above also undertook a SICA analysis for the NPF. Given the time since the Griffiths *et al.* work and changes to the fishery since then, an updated SICA was undertaken based on the questionnaire below. Susceptibility scores are as per the 2007 ecological risk assessment of the fishery (Griffiths *et al.*, 2007), with consideration of the updated SICA results.

7.2.3 SICA Questionnaire for Northern Prawn Fishery

Red endeavour prawns (*Metapenaeus ensis*)
April 2017

As part of the MSC assessment for the NPF, the Assessment Team requests further information from various stakeholders (e.g. managers, fishermen, NGOs) on red endeavour prawns to inform a revised Scale, Intensity and Consequence Analysis (SICA).

The lack of a formal stock assessment undertaken for red endeavour prawns requires that the MSC RBF be used in assessing the species against the MSC criteria. A SICA analysis was undertaken for the fishery in 2007 as part of the AFMA/CSIRO Ecological Risk Assessment project. However, the time that has passed since that analysis requires that the SICA be updated. The 2007 analysis focussed on brown tiger prawns as the most vulnerable component of the fishery given their history of being overfished around that time. The following questions are intended to assess the relevance of that analysis to red endeavour prawns and whether or not circumstances have changed since the 2007 analysis.

To aid your judgement, the map from Pitcher et al., 2015 shows predicted species assemblages within the NPF managed areas based on historical survey datasets and the table shows what percentage of each area (each colour on the map) is currently fished and what percentage of each area is closed to fishing.

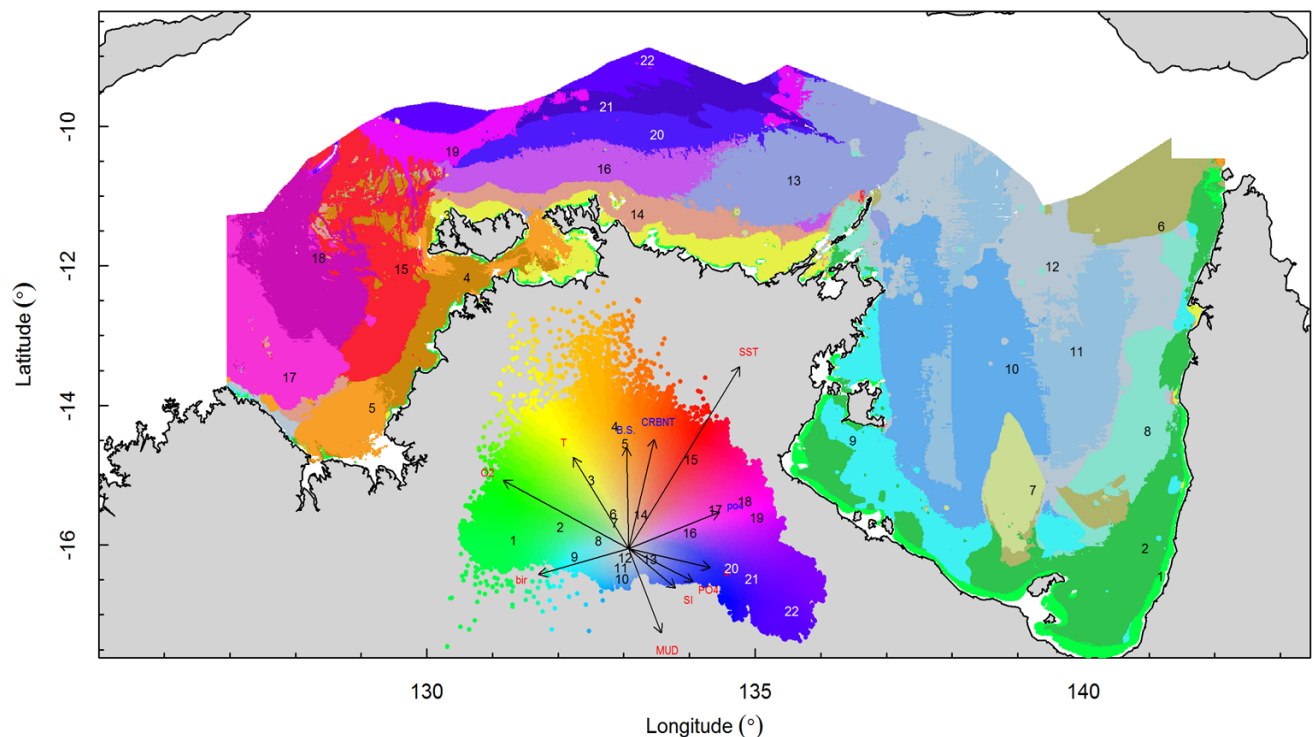


Figure: Map of the NPF region showing clustered patterns of species composition change predicted by relationships with multiple environmental gradients.

Table: Intersection of species assemblages by area, in the NPF region with closed areas and with trawl effort.

Assemblage	Area(km ²)	Total% Closed	%_Trawled	%_Swept
1	16,306	22.6	1.0	1.2
2	59,520	29.2	5.7	7.9
3	21,421	13.3	3.0	4.1
4	19,572	24.1	1.7	2.8
5	20,402	37.1	0.5	0.7
6	30,760	55.6	0.1	0.1
7	13,934	14.2	0.0	0.1
8	33,338	15.0	1.5	2.0
9	33,846	7.1	13.0	24.7
10	77,804	2.7	1.0	1.9
11	59,536	0.2	0.0	0.0
12	66,193	5.3	0.6	0.9
13	49,670	3.4	0.0	0.0
14	23,942	25.0	4.0	5.6
15	38,150	45.3	0.0	0.0
16	28,415	10.1	0.0	0.0
17	27,622	25.7	1.4	2.3
18	36,978	57.1	0.0	0.0
19	18,015	28.5	0.0	0.0
20	25,289	13.5	0.0	0.0
21	18,144	53.0	0.0	0.0
22	14,060	52.9	0.0	0.0
	732,919	20.5	1.6	2.7

Source: Pitcher *et al.*, 2015

Spatial Scale Overlap

Question 1. Where do you think commercial size red endeavour prawns (*M. ensis*) are distributed, i.e. not just where they are caught. Please answer the question by indicating with an x in column Q1 of the table. Note: colours and numbers correspond to areas on the map.

Question 2. According to your knowledge, in which area/s on the map are red endeavour prawn caught in the NPF. Please answer with an x in column Q2.

Question 3. In areas where red endeavour prawns are caught, for each area, approximately what is the percentage contribution of red endeavor to the total prawn commercial catch? Please write the percentage in the column Q3 for each area identified at Q2.

Area	Q1	Q2	Q3
1	X		
2	X	X	<1%
3	X	X	10%
4	X		
5	X	X	<5%
6			
7			
8			
9	X	X	10%
10	X	X	<1%
11			
12	X	X	<1%
13			
14	X	X	40%
15	X	X	<5%
16	X	X	<5%
17	X	X	<5%
18			
19			
20			
21			
22			

Question 4. From your experience and knowledge, is there a certain depth where most red endeavour prawns are caught, or are they caught uniformly over the fished areas? Please tick which applies.

<10m	10-14m	15-19m	20-24m	25-29m	30-34m	35-39m	>40m
				X	X	X	X

Temporal Scale Overlap

Question 5. Are there certain times during the tiger fishing operation when most of the red endeavour prawns are caught or are they caught evenly for the whole fishing period? Please tick which applies.

June	July	August	September	November
10%			30%	30%

Question 6. Thinking of your answer to the Q5, how often would you say red endeavour prawns are caught in the NPF tiger prawn fishery in each fished area? Please tick a box in the following table.

AREA	1	2	3	4	5	6	7	8	9	10	12	14	17
1 day every 10 years or so													
1 day every few years													
1-100 days per year													
100-200 days per year	X	X	X	X	X	X	X	X	X	X	X	X	X
200-300 days per year													
300-365 days per year													

Intensity

Question 7. Based on the spatial and temporal overlap between the NPF tiger prawn fishery and the distribution of the red endeavour prawns identified at previous questions, how discernible is the effect of the overall level of fishing activity on the stock of the red endeavour prawns in Northern Australia? Please tick one box for each area.

Level/ AREA	1	2	3	4	5	6	7	8	9	10	12	14	17
Negligible													
Minor	X	X	X	X	X	X	X	X	X	X	X		X
Moderate												X	
Major													
Severe													
Catastrophic													

Negligible = remote likelihood of detection of activity at any spatial or temporal scale

Minor = activity occurs rarely or in few restricted locations and evidence of activity even at these scales is rare

Moderate = moderate detection of activity at broader spatial scale, or obvious but local detection

Major = detectable evidence of activity occurs reasonably often at broad spatial scale

Severe = easily detectable localised evidence of activity or widespread and frequent evidence of activity

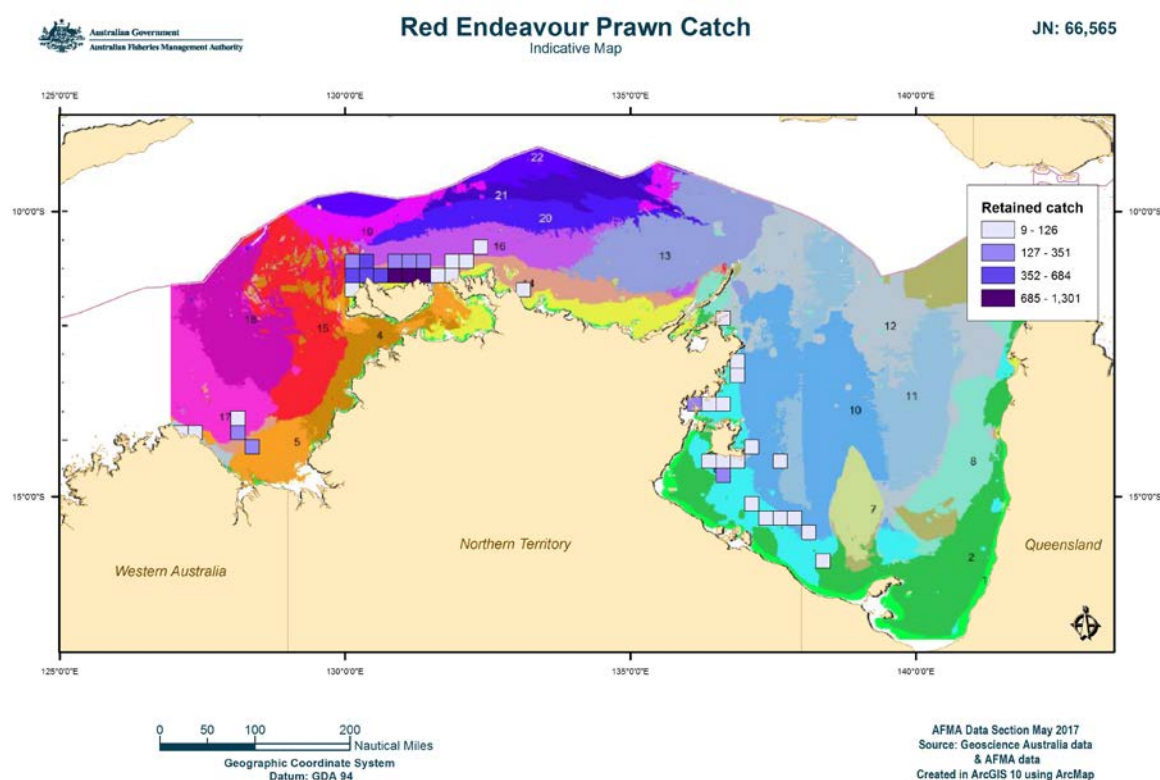
Catastrophic = local to regional evidence of activity or continual and widespread evidence

Comments (Please add any information you have to support your answers to the questions):

NPFI members/stakeholders noted that no fishery data was provided on the distribution or catch of red endeavours at the SICA workshop. As such, views put forward on percentages of catch and distribution were estimates by those in attendance at the workshop. The estimates correlate reasonably well with some of the data contained in the attached Indicative Map which was prepared by AFMA following the workshop. However, it should be noted the data set covers the last 10 years and that the catch distribution changes from year to year.

NPFI members noted that the large majority (approximately 90%) of the catch of red endeavours in the Northern Prawn Fishery is taken in Melville/Essington areas. Of this approximately 55% is taken around Melville and 45% is caught around Port Essington.

Industry members noted that the data provided in the Indicative Map incorporates 10 years of data (2006 -2016). NPFI members confirmed that there had been limited catch of red endeavours in Joseph Bonaparte Gulf due to the lower fishing effort in that area in the past 5 years (since the initial MSC assessment).



7.3 Appendix 3: Client Action Plan: Northern Prawn Conditions

Three conditions are set for the NPF at reassessment.

Condition 1: Red endeavour prawn, PI 1.2.1, scoring issue (a). There is a need to demonstrate that the harvest strategy is responsive to the state of the red endeavour prawn stock.

Condition 2: Red endeavour prawn, PI 1.2.2, scoring issue (a). Harvest control rules are lacking for red endeavour prawns. Well defined harvest rules are required for the stock.

Condition 3: Red-legged banana prawn, PI 1.2.2, scoring issues (b) and (c). There is a need to demonstrate that harvest control rules adequately take uncertainty into account and that the tools in place are appropriate.

Condition 1

UoA	Red Endeavour Prawn
Target Species	Red Endeavour Prawn
Performance Indicator	PI 1.2.1
Scoring Issue	(a)
Score	60
Rationale	See evaluation table for PI 1.2.1 Red Endeavour. There is a formal harvest strategy in place for the Northern Prawn Fishery. Whilst the harvest strategy is expected to achieve stock management objectives for red endeavour prawns (SG60), the elements of the harvest strategy are not as well developed as for the two tiger prawns and blue endeavour prawns. It is not evident that the elements of the HS are working together towards achieving management objectives reflected in target and limit reference points as required to meet SG80.
Condition	By the fourth surveillance audit, demonstrate that the harvest strategy for red endeavour prawn is responsive to the state of the stock and the elements of the harvest strategy work together towards achieving stock management objectives reflected in PI 1.1.1 SG80.
Milestones	<u>Years 1, 2 and 3:</u> (Resulting score 70) The client will need to provide evidence that it is actively working to ensure that the harvest strategy for red endeavour prawns is responsive to the state of the stock and that the elements of the harvest strategy work together towards achieving the management objectives. This evidence will include a summary of the actions taken by the client and other relevant parties to achieve this outcome. <u>Year 4:</u> (Resulting score ≥ 80) The client will need to provide evidence that the harvest strategy is responsive to the state of the stock and that the elements of the harvest strategy work together towards achieving management objectives reflected in PI 1.1.1.
Client action plan	
By 1 st Audit (Nov 2018):	The NPRAG, in consultation with AFMA and NPFI, will:

	<p>initiate a review of all available data (eg catch and effort, species split, survey data) on red endeavours;</p> <p>discuss and consider the option of running a single ‘higher level sensitivity test’ for the next full Tiger Prawn assessment in 2018 which includes red endeavours as incidental catch using either a Deriso or Bayesian production model; <i>and</i></p> <p>discuss and consider alternative approaches (eg ‘data poor’ harvest strategy approaches) for managing red endeavours.</p> <p>CSIRO, on advice from the NPRAG, will:</p> <p>Run a single ‘higher level sensitivity test’ for the next full 2018 Tiger Prawn assessment which includes red endeavours as incidental catch using either a Deriso or Bayesian production model</p> <p>Present the findings to the NPRAG for consideration</p>
By 2 rd Audit: Nov 2019	<p>the NPRAG will:</p> <p>Subject to the results of the sensitivity test and a cost/benefit (risk-catch-cost) analysis, determine whether to:</p> <p>re-include red endeavour prawns in the tiger prawn assessment; or,</p> <p>to develop independent empirically -based harvest control rules for red endeavour prawns.</p> <p>If the latter, develop an independent empirical-based set of harvest control rules for red endeavours for testing.</p>
By 3 rd Audit: Nov 2020	<p>AFMA will:</p> <p>Apply either the multi-species model to management of red endeavour prawns or</p> <p>Apply independent empirical-based harvest control rules to red endeavours as a trial to determine the effectiveness of the management approach (tiger seasons 2018/2019)</p>
By 4 th Audit (Nov 2021):	<p>The NPRAG will:</p> <p>Review the success of the management approach using either the stock assessment outputs or other appropriate methodologies (eg a Management Strategy Evaluation (MSE) of independent empirically-based harvest control rules).</p> <p>recommend to NORMAC and AFMA the preferred management option for red endeavour prawns.</p> <p>AFMA, in consultation with NORMAC and NPFI, will:</p> <p>amend the NPF Harvest Strategy such that it demonstrates responsiveness to the state of the red endeavour prawn stock and includes well-defined harvest control rules, meeting the requirements of Condition 1.</p>
Consultation on condition	Client Action Plan

Condition 2

UoA	Red Endeavour Prawn
Target Species	Red Endeavour Prawn
Performance Indicator	PI 1.2.2
Scoring Issue	(a)
Score	60
Rationale	<p>See evaluation table for PI 1.2.2 Red Endeavour.</p> <p>The NPF harvest strategy contains a comprehensive set of control rules for the tiger prawn subfishery that feed into management actions. As currently written, the control rules in the harvest strategy for the tiger prawn subfishery apply to brown tiger prawn, grooved tiger prawn and blue endeavour prawn. Well-defined control rules are not in place for red endeavour prawns.</p>
Condition	SI a) By the fourth surveillance audit, demonstrate that well defined HCRs are in place that ensure that the exploitation rate is reduced as the

	PRI is approached, are expected to keep the stock fluctuating around a target level consistent with (or above) MSY.
Milestones	<p><u>Years 1, 2 and 3:</u> (Resulting score 60) The client will need to provide evidence that it is actively working to ensure that well defined harvest control rules taking into account the main uncertainties are in place for red endeavour prawns that are consistent with the harvest strategy and ensure that the exploitation rate is reduced as limit reference points are approached. This evidence will include a summary of the actions taken by the client and other relevant parties to achieve this outcome.</p> <p><u>Year 4:</u> (Resulting score ≥ 80) The client will need to provide evidence that well defined harvest control rules taking into account the main uncertainties are in place for red endeavour prawns that are consistent with the harvest strategy and ensure that the exploitation rate is reduced as limit reference points are approached.</p>
Client action plan	
By 1 st Audit (Nov 2018):	<p>The NPRAG, in consultation with AFMA and NPFI, will: initiate a review of all available data (eg catch and effort, species split, survey data) on red endeavours; discuss and consider the option of running a single ‘higher level sensitivity test’ for the next full Tiger Prawn assessment in 2018 which includes red endeavours as incidental catch using either a Deriso or Bayesian production model; <i>and</i> discuss and consider alternative approaches (eg ‘data poor’ harvest strategy approaches) for managing red endeavours.</p> <p>CSIRO, on advice from the NPRAG, will: Run a single ‘higher level sensitivity test’ for the next full 2018 Tiger Prawn assessment which includes red endeavours as incidental catch using either a Deriso or Bayesian production model Present the findings to the NPRAG for consideration.</p>
By 2 nd Audit: Nov 2019	<p>the NPRAG will: Subject to the results of the sensitivity test and a cost/benefit (risk-catch-cost) analysis, determine whether to: re-include red endeavour prawns in the tiger prawn assessment; or, to develop independent empirically -based harvest control rules for red endeavour prawns. If the latter, develop an independent empirical-based set of harvest control rules for red endeavours for testing.</p>
By 3 rd Audit: Nov 2020	<p>AFMA will: Apply either the multi-species model to management of red endeavour prawns <i>or</i> Apply independent empirical-based harvest control rules to red endeavours as a trial to determine the effectiveness of the management approach (tiger seasons 2018/2019)</p>
By 4 th Audit (Nov 2021):	<p>The NPRAG will: Review the success of the management approach using either the stock assessment outputs or other appropriate methodologies (eg a Management Strategy Evaluation (MSE) of independent empirically-based harvest control rules). recommend to NORMAC and AFMA the preferred management option for red endeavour prawns.</p> <p>AFMA, in consultation with NORMAC and NPFI, will: amend the NPF Harvest Strategy as required to include well defined harvest control rules to manage red endeavour prawns to meet the requirements of Condition 2.</p>

Consultation on condition	Client Action Plan
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Condition 3

UoA	Red-legged Banana Prawn
Target Species	Red-legged Banana Prawn
Performance Indicator	PI 1.2.2
Scoring Issues	(b) and (c)
Score	(b) 60 and (c) 60
Rationale	See evaluation table for PI 1.2.2 Red-legged Banana. The control rules were part of the MSE reported in PI 1.2.1 for the red-legged banana prawns which includes testing of the design of the rules. However, there is a higher level of uncertainty in the red-legged banana prawn assessment than for tiger prawns. NPRAG (2016a) has indicated that further consideration of the appropriateness of the harvest strategy in years of low fishing effort is needed. Recent assessment has indicated improving levels of spawning biomass. However, the implication of the low catches and catch rates of red-legged prawns in JBG in 2015 and 2016 for the harvest control rules requires further investigation to ensure that SG80 requirements are met for SI (b) and SI (c).
Condition	SI b) By the fourth surveillance audit, provide evidence that the HCRs take into account the main uncertainties. SI c) By the fourth surveillance audit, demonstrate that available evidence indicates that the tools in use are appropriate and effective in achieving the exploitation levels required under the HCRs.
Milestones	<u>Years 1, 2 and 3: (Resulting score 60)</u> The client will need to provide evidence that it is actively working to ensure that well defined harvest control rules taking into account the main uncertainties are in place for red-legged banana prawns that are consistent with the harvest strategy and ensure that the exploitation rate is reduced as limit reference points are approached. This evidence will include a summary of the actions taken by the client and other relevant parties to achieve this outcome. <u>Year 4: (Resulting score ≥ 80)</u> The client will need to provide evidence that well defined harvest control rules taking into account the main uncertainties are in place for red-legged banana prawns that are consistent with the harvest strategy and ensure that the exploitation rate is reduced as limit reference points are approached.
Client action plan	
By 1 st Audit (Nov 2018):	CSIRO will: Present a report to the NPRAG on investigations into the impacts of the Southern Oscillation Index (SOI) and economic impacts of fishing effort in other areas of the NPF (eg the Gulf of Carpentaria) on the red legged banana prawn assessment Propose additional harvest control rules for inclusion in the NPF red legged banana prawn Harvest Strategy to address the current uncertainties Subject to data availability, run and present the Red-legged Banana Prawn Assessment.

	<p>The NPRAG will:</p> <p>Consider and discuss the proposed additional harvest control rules to address the uncertainties for the Red-legged Banana Prawn assessment;</p> <p>Consider mechanisms for testing the proposed HCRs if required (eg a management strategy evaluation).</p>
By 3 rd Audit: Nov 2019	<p>The NPRAG will:</p> <p>Initiate mechanisms for testing the proposed HCRs if required</p> <p>Review HCR tests;</p> <p>Make recommendations to NORMAC and AFMA on the additional HCRs to address the current uncertainties for the Red-legged Banana Prawn assessment</p> <p>AFMA, in consultation with NPFI and NORMAC, will:</p> <p>revise and incorporate the new Harvest Control rules into the NPF Stock Assessment (by Nov 2019) to meet Condition 3</p>
Consultation on condition	Client Action Plan

Appendix 3: Report support documents

Client Action Plan: Northern Prawn Fishery 2017

The NPF Industry Pty Ltd (NPFI) is committed to taking the following actions to address the three conditions arising from the MSC re-assessment of the Northern Prawn Fishery (NPF). Following the 2017 re-assessment, there are three fishery specific conditions that apply to this fishery including:

Red Endeavour PI 1.2.1 (scoring issue a),
Red Endeavour PI 1.2.2 (scoring issue a), and
Red legged banana PI 1.2.2 (scoring issues b and c)

PI	Red Endeavour Prawn 1.2.1 scoring issue a
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Condition 1: By the fourth surveillance audit, demonstrate that the harvest strategy for red endeavour prawn is responsive to the state of the stock and the elements of the harvest strategy work together towards achieving stock management objectives reflected in PI 1.1.1 SG80.

Action

By 1st Audit (Nov 2018):

The NPRAG, in consultation with AFMA and NPFI, will:

initiate a review of all available data (eg catch and effort, species split, survey data) on red endeavours;

discuss and consider the option of running a single 'higher level sensitivity test' for the next full Tiger Prawn assessment in 2018 which includes red endeavours as incidental catch using either a Deriso or Bayesian production model; *and*

discuss and consider alternative approaches (eg 'data poor' harvest strategy approaches) for managing red endeavours.

CSIRO, on advice from the NPRAG, will:

Run a single 'higher level sensitivity test' for the next full 2018 Tiger Prawn assessment which includes red endeavours as incidental catch using either a Deriso or Bayesian production model

Present the findings to the NPRAG for consideration

By 2nd Audit: (Nov 2019):

the NPRAG will:

Subject to the results of the sensitivity test and a cost/benefit (risk-catch-cost) analysis, determine whether to:

re-include red endeavour prawns in the tiger prawn assessment; or,

to develop independent empirically -based harvest control rules for red endeavour prawns.

If the latter, develop an independent empirical-based set of harvest control rules for red endeavours for testing.

By 3rd Audit: Nov 2020

AFMA will:

Apply either the multi-species model to management of red endeavour prawns *or*

Apply independent empirical-based harvest control rules to red endeavours as a trial to determine the effectiveness of the management approach (tiger seasons 2018/2019)

By 4th Audit (Nov 2021):

The NPRAG will:

Review the success of the management approach using either the stock assessment outputs or other appropriate methodologies (eg a Management Strategy Evaluation (MSE) of independent empirically-based harvest control rules).

recommend to NORMAC and AFMA the preferred management option for red endeavour prawns.

AFMA, in consultation with NORMAC and NPFI, will:

amend the NPF Harvest Strategy such that it demonstrates responsiveness to the state of the red endeavour prawn stock and includes well-defined harvest control rules, meeting the requirements of Condition 1.

PI	Red Endeavour Prawn 1.2.2 scoring issue a
----	---

Condition 2: By the fourth surveillance audit, demonstrate that well defined HCRs are in place that ensure that the exploitation rate is reduced as the PRI is approached, are expected to keep the stock fluctuating around a target level consistent with (or above) MSY.

Action

By 1st Audit (Nov 2018):

the NPRAG, in consultation with AFMA and NPFI, will:

initiate a review of all available data (eg catch and effort, species split, survey data) on red endeavours;

discuss and consider the option of running a single ‘higher level sensitivity test’ for the next full Tiger Prawn assessment in 2018 which includes red endeavours as incidental catch using either a Deriso or Bayesian production model; *and*

discuss and consider alternative approaches (eg ‘data poor’ harvest strategy approaches) for managing red endeavours.

CSIRO, on advice from the NPRAG, will:

Run a single ‘higher level sensitivity test’ for the next full 2018 Tiger Prawn assessment which includes red endeavours as incidental catch using either a Deriso or Bayesian production model

Present the findings to the NPFRAG for consideration.

By 2nd Audit: (Nov 2019):

the NPRAG will:

Subject to the results of the sensitivity tests and cost/benefits, determine whether to re-include red endeavour prawns in the tiger prawn assessment or to develop independent empirical-based harvest control rules for red endeavour prawns

If the latter, develop an independent empirical-based set of harvest control rules for red endeavours for testing.

By 3rd Audit: Nov 2020

AFMA will:

Apply either the multi-species model to management of red endeavour prawns *or*

Apply independent empirical-based harvest control rules to red endeavours as a trial to determine the effectiveness of the management approach (tiger seasons 2018 /2019).

By 4th Audit (Nov 2021):

The NPRAG will:

Subject to the above, review the success of the management approach using either the stock assessment outputs or other appropriate methodologies (eg a Management Strategy Evaluation (MSE) of independent empirical-based harvest control rules) recommend to NORMAC and AFMA the preferred management option for red endeavour prawns.

AFMA, in consultation with NORMAC and NPFI, will:

amend the NPF Harvest Strategy as required to include well defined harvest control rules to manage red endeavour prawns to meet the requirements of Condition 2.

PI	Red Legged Banana Prawn 1.2.2 scoring issues b and c
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Condition 3:

SIa: By the fourth surveillance audit, provide evidence that the HCRs take into account the main uncertainties.

SIb: By the fourth surveillance audit, demonstrate that available evidence indicates that the tools in use are appropriate and effective in achieving the exploitation levels required under the HCRs

Action:

By 1st Audit:

CSIRO will:

Present a report to the NPRAG on investigations into the impacts of the Southern Oscillation Index (SOI) and economic impacts of fishing effort in other areas of the NPF (eg the Gulf of Carpentaria) on the red-legged banana prawn assessment

Propose additional harvest control rules for inclusion in the NPF red legged banana prawn Harvest Strategy to address the current uncertainties

Subject to data availability, run and present the Red-legged Banana Prawn Assessment.

The NPRAG will:

Consider and discuss the proposed additional harvest control rules to address the uncertainties for the Red-legged Banana Prawn assessment;

Consider mechanisms for testing the proposed HCRs if required (eg a management strategy evaluation).

By 2nd Audit (Nov 2019)

The NPRAG will:

Initiate mechanisms for testing the proposed HCRs if required

Review HCR tests;

Make recommendations to NORMAC and AFMA on the additional HCRs to address the current uncertainties for the Red-legged Banana Prawn assessment

AFMA, in consultation with NPFI and NORMAC, will:

revise and incorporate the new Harvest Control rules into the NPF Stock Assessment (by Nov 2019) to meet Condition 3

Supporting letters from management organisations



22 August 2017

Mr Richard Banks
Lead Assessor
MRAG Americas
13 Ribbon Avenue
PORT DOUGLAS QLD 4877

Dear Mr Banks

I write to confirm the support of the Australian Fisheries Management Authority (AFMA) for the Marine Stewardship Council's re-certification process being pursued for the Northern Prawn Fishery by the NPF Industry Pty Ltd (NPFi).

In response to the MSC's re-assessment of the NPF and the conditions which need to be addressed for the NPF to maintain its certification, the NPFi has developed a Client Action Plan. In developing the Client Action Plan, NPFi has worked with AFMA (and CSIRO) to ensure that the actions proposed are achievable, cost-effective and can be delivered in a timely manner for annual auditing by MSC.

AFMA supports the action plan noting that there will need to be an adequate budget available to put actions into effect and that other issues may, from time to time, take priority over those stated in the action plan. I also note that some decisions associated with the action plan may need to be made by the AFMA Commission, the CEO or their delegates and that this is done independently of the MSC process.

I would like to take this opportunity to congratulate the NPF Industry Pty Ltd on its efforts in the re-assessment process and wish the company all the best in attaining MSC re-certification. I have no doubt that AFMA will continue to have a close and effective working relationship with NPFi throughout this process.

Yours Sincerely

Dr Nick Rayns
Executive Manager Fisheries

Canberra
PO Box 7051
Canberra Business Centre ACT 2610
P 02 6225 5555 F 02 6225 5500

Darwin
PO Box 131
Darwin NT 0801
P 08 8943 0333 F 08 8942 2897

Thursday Island
PO Box 376
Thursday Island QLD 4875
P 07 4069 1990 F 07 4069 1277



Castray Esplanade, Hobart TAS 7000
GPO Box 1538, Hobart TAS 7001, Australia
T (03) 6232 5222 • ABN 41 687 119 230

Mr. Richard Banks
Lead Assessor, MRAG Americas
13 Ribbon Avenue
Port Douglas

Re: Letter of Support for Marine Stewardship Council Certification of the Northern Prawn Fishery.

Dear Sir

I write to confirm that CSIRO are supportive of the endeavours of the NPF Industry Pty Ltd (NPI) for Marine Stewardship Council re-certification, being pursued for the Northern Prawn Fishery.

In response to the MSC's re-assessment of the NPF and the conditions which need to be addressed for the NPF to maintain its certification, the NPF Industry Pty Ltd has developed a Client Action Plan. In developing the Client Action Plan, we note that the NPF Industry has worked closely with AFMA (as well as CSIRO) to ensure that the actions proposed are achievable, cost effective and can be deliverable in a timely manner for annual auditing by MSC.

I would like to take this opportunity to congratulate the NPF Industry Pty Ltd on their efforts in the assessment process and wish them all the best in attaining MSC re-certification. I have no doubt that CSIRO will continue to have a close and effective working relationship with the NPF Industry Pty Ltd throughout this process.

Yours Sincerely

A handwritten signature in black ink, appearing to read "DSM", enclosed in a rectangular box.

David Smith
Research Director
CSIRO Oceans and Atmosphere
29 August 2017

7.4 Appendix 4: Harmonisation

The Northern Prawn fishery is a Commonwealth Managed fishery and as such should be harmonised for P3 with the Australian Blue Grenadier Fishery, assessed in 2015 ([SCS, Australian Blue Grenadier](https://fisheries.msc.org/en/fisheries/australia-blue-grenadier/@@assessments) Fishery Msc Full Assessment Report, <https://fisheries.msc.org/en/fisheries/australia-blue-grenadier/@@assessments>), with matching scores shown between the two fisheries for 3.1 and 3.2.

7.5 Appendix 5. Peer Review Reports

Peer Reviewer A

Overall Opinion

<i>Has the assessment team arrived at an appropriate conclusion based on the evidence presented in the assessment report?</i>	Yes – but see below	Conformity Assessment Body Response
<p><u>Justification:</u> It is considered that the assessment team has (almost certainly) reached an appropriate conclusion, based on the whole body of evidence presented in the report. However, most of this evidence is contained in the background section of the report. In several places in the scoring tables, notably throughout Principle 1 but also some parts of Principle 3, the scoring commentary does not present the evidence (even in a summary form) to justify the scoring in relation to the specific requirements of the Scoring Guideposts. This means the reader has to continuously cross-reference the scoring table with lengthy background sections elsewhere in the report. This does not appear to be compliant with FCR v2.0 7.10.6, 7.10.6.1 and 7.10.6.2.</p>		<p>Some adjustments have been made to the scoring text to improve the scoring justification made. MSC FCR 7.10.6 refers to the rational and the need to reference every scoring issue which has been done. This includes some cross referencing. However, the FCR does not state that all the details must be contained in the scoring tables, which would be quite impractical, and the MSC report template requires proper attention is paid to both the reporting template and the scoring table. We also note that Peer Reviewer B states '<i>the report is a very well written with comprehensive explanations given for scoring</i>'. It is also noteworthy that this report was reviewed by ASI who are responsible for evaluating standards, and no comment was made about any irregularities in the standard applied to scoring justification. It is also evident from the contents of some of the Peer Reviewer A's comments, that some areas were sufficiently explained in the text, for example, the selection of primary species, compliance and the comprehensive structure of reviews, risk assessment and research, and these were not fully grasped by the peer reviewer, suggesting a less rigorous look at the report contents and only focussing on the scoring template in detail. It is important to understand in this context that Public scrutiny places as much weight in the report content as it does on the scoring documentation.</p>

<i>Do you think the condition(s) raised are appropriately written to achieve the SG80 outcome within the specified timeframe?</i>	No	Conformity Assessment Body Response
<p><u>Justification:</u> Condition 1, 2 and 3 – milestones must set out 'measurable improvements and outcomes... expected each year'; this is important in terms of determining whether actions are 'on target'. Annual milestones should therefore be determined. The Action Plan requires actions by (at least) CSIRO and AFMA. It should be confirmed that relevant bodies have committed resources to these actions (Ref FCR 7.11.4)?</p>		<p>All conditions are written so that SG 80 can be met within the specified timeframe. The Action Plan spells out steps against which progress can be judged. Support letters have since been submitted by CSIRO and AFMA (Section 7.4).</p>

If included:

<i>Do you think the client action plan is sufficient to close the conditions raised?</i>	Yes	Conformity Assessment Body Response
<i>Justification:</i> The client action plan seems well considered and effective, But it is noted that Condition 3 has neither specific milestone nor client action specified in Year 2. This may need to be reviewed as and when annual milestones are specified. The commitment of CSIRO, AFMA (etc?) may also need to be confirmed.		See above

General Comments on the Assessment Report (optional)

Table 31 – would not the P1 species will be main?

Corrected

Table 31 and Section 5 – the prawn species appear as a bycatch in other UoAs. It makes sense that these are then sold as certified product, but this should be clarified, particularly in the UoA descriptions, that these would enter CoC.

Clarified in the Traceability text.

Section 5. There appear some areas in the traceability of product that present a risk of mixing – notably purchase of product from other vessels and contract processing in another country (of ‘soft and broken’ product). Presumably these activities take place in the vertically integrated companies. This should be clarified. Would these companies need separate CoC under such circumstances?

The carriers do not source from other prawn fisheries.

The risk for 'soft and broken' is identified in the text - *Chain of Custody (CoC) will begin at the point of first sale or shipment and therefore this, or any other custom processor, shall obtain MSC CoC certification prior to handling these products as certified.*

Performance Indicator Review

Please complete the table below for each Performance Indicator which are listed in the Conformity Assessment Body's Public Certification Draft Report.

Performance Indicator	Has all the relevant information available been used to score this Indicator? (Yes/No)	Does the information and/or rationale used to score this Indicator support the given score? (Yes/No)	Will the condition(s) raised improve the fishery's performance to the SG80 level? (Yes/No/NA)	Justification Please support your answers by referring to specific scoring issues and any relevant documentation where possible. Please attach additional pages if necessary.	Conformity Assessment Body Response
Brown Tiger Prawn P1					
1.1.1	Y	Y	NA		
1.1.2	Y	N	NA	Sic: It should be confirmed that meY will always be higher than msy, or if not, under what conditions. It is also not clear here how the ecological role of the stock gives rise to greater precaution in setting MEY?	It is beyond the scope of this report to present a detailed discussion of MEY vs MSY. It is widely reported in the literature that in most cases an MEY objective results in yields and effort levels that are less than at MSY, and in stock biomass levels greater than at MSY. It is the higher stock biomass levels that gives rise to greater precaution in adopting an MEY objective.
1.1.3	-	-	-		
1.2.1	Y	N	NA	SId: While a lot of information is presented in the report, it is necessary to include the key evidence in the scoring commentary – in this case, how often is the harvest strategy reviewed?	Additional information on review of the harvest strategy has been included in the justification. There is detailed information on review processes in response to Peer Reviewer B PI 3.2.5 comments.

Performance Indicator	Has all the relevant information available been used to score this Indicator? (Yes/No)	Does the information and/or rationale used to score this Indicator support the given score? (Yes/No)	Will the condition(s) raised improve the fishery's performance to the SG80 level? (Yes/No/NA)	Justification Please support your answers by referring to specific scoring issues and any relevant documentation where possible. Please attach additional pages if necessary.	Conformity Assessment Body Response
1.2.2	Y	N	NA	SIb: As above, the reviewer welcomes concise commentary, but some indication of the uncertainties considered would be valuable evidence here.	Additional information has been included in the justifications for these SIs.
1.2.3	Y	Y	NA		
1.2.4	Y	N	NA	SIc: For SG100 some information on the probabilistic assessment should be provided, for completeness. Sid: have alternative hypotheses and assessment approaches been rigorously explored? This requires presentation of evidence.	Additional information has been included in the justifications for these SIs.
Grooved Tiger Prawn P1					
1.1.1	Y	Y	NA		

Performance Indicator	Has all the relevant information available been used to score this Indicator? (Yes/No)	Does the information and/or rationale used to score this Indicator support the given score? (Yes/No)	Will the condition(s) raised improve the fishery's performance to the SG80 level? (Yes/No/NA)	Justification Please support your answers by referring to specific scoring issues and any relevant documentation where possible. Please attach additional pages if necessary.	Conformity Assessment Body Response
1.1.2	Y	N	NA	SIc: It should be confirmed that mey will always be higher than msy, or if not, under what conditions. it is also not clear here how the ecological role of the stock gives rise to greater precaution in setting MEY?	It is beyond the scope of this report to present a detailed discussion of MEY vs MEY. It is widely reported in the literature that in most cases an MEY objective results in yields and effort levels that are less than at MSY, and in stock biomass levels greater than at MSY. It is the higher stock biomass levels that gives rise to greater precaution in adopting an MEY objective.
1.1.3	-	-	-		
1.2.1	Y	N	NA	SId: While a lot of information is presented in the report, it would be helpful to include some key evidence in the scoring commentary – in this case, how often is the harvest strategy reviewed?	Additional information on review of the harvest strategy has been included in the justification. There is detailed information on review processes in response to Peer Reviewer B PI 3.2.5 comments.
1.2.2	Y	N	NA	Sib: MSE was not reported in 1.2.1. Same comments apply as for brown tiger prawn above.	MSE is referred to in 1.2.1b. Additional information on uncertainties has been included in the justification.
1.2.3	Y	Y	NA		

Performance Indicator	Has all the relevant information available been used to score this Indicator? (Yes/No)	Does the information and/or rationale used to score this Indicator support the given score? (Yes/No)	Will the condition(s) raised improve the fishery's performance to the SG80 level? (Yes/No/NA)	Justification Please support your answers by referring to specific scoring issues and any relevant documentation where possible. Please attach additional pages if necessary.	Conformity Assessment Body Response
1.2.4	Y	N	NA	Sic: For SG100 some information on the probabilistic assessment should be provided, for completeness. SG100 has a Y? Sid as for brown TP.	Additional information has been included in the justifications for these SIs.
Blue Endeavour Prawn P1					
1.1.1	Y	Y	NA		
1.1.2	Y	N	NA	Sic: SG80 can be considered to be met on the evidence presented. For SG100 it is not clear that there is sufficient precaution that the stock would be maintained at or above Bmsy (e.g. it is not there now).	The scoring issue requires that the target reference point maintains the stock at B _{MSY} or surrogate. S _{MSY} is marginally below the target level in some of the sensitivities examined but well above in others. The current healthy stock levels follow a period of depletion prior to the implementation of the harvest strategy. The management strategy evaluation provides confidence that the harvest strategy will maintain the stock at appropriate levels into the future.
1.1.3	-	-	-		

Performance Indicator	Has all the relevant information available been used to score this Indicator? (Yes/No)	Does the information and/or rationale used to score this Indicator support the given score? (Yes/No)	Will the condition(s) raised improve the fishery's performance to the SG80 level? (Yes/No/NA)	Justification Please support your answers by referring to specific scoring issues and any relevant documentation where possible. Please attach additional pages if necessary.	Conformity Assessment Body Response
1.2.1	Y	N	NA	Sib: For SG100, is the stock being clearly maintained at target levels? SId: While a lot of information is presented in the report, it would be helpful to include some key evidence in the scoring commentary – in this case, how often is the harvest strategy reviewed?	Sib: The assessors conclude that although the stock was depleted prior to the implementation of the harvest strategy, the management changes reducing effort in the fishery and the introduction of the harvest strategy have led to stock recovery and the stock is being maintained at the target level. SId: Additional information on review of the harvest strategy has been included in the justification. There is detailed information on review processes in response to Peer Reviewer B PI 3.2.5 comments.
1.2.2	Y	N	NA	Sib: MSE was not reported in 1.2.1. Same comment as for brown tiger prawn above.	The MSE is referred to in 1.2.1b. Additional information on uncertainties has been included in the justification.
1.2.3	Y	Y	NA		
1.2.4	Y	N	NA	Sic: Probabilistic assessments are considered under SIa but for completeness, should also be considered here. Sid: usual comment as above.	Additional comments have been provided against these SIs to address the issues raised.

Performance Indicator	Has all the relevant information available been used to score this Indicator? (Yes/No)	Does the information and/or rationale used to score this Indicator support the given score? (Yes/No)	Will the condition(s) raised improve the fishery's performance to the SG80 level? (Yes/No/NA)	Justification Please support your answers by referring to specific scoring issues and any relevant documentation where possible. Please attach additional pages if necessary.	Conformity Assessment Body Response
Red Endeavour Prawn P1					
1.1.1	NA	NA	NA	RBF Used	
1.1.2	NA	NA	NA	Default 80 as RBF	
1.1.3	-	-	-		
1.2.1	Y	Y	Y	Minor Point on Sid – this should be 'N' rather than 'Not scored' – all Sis should be scored unless in parentheses. See comments above on condition milestones.	A change has been made to 'N' rather than 'Not scores'. However, it is not evident from Section 27.10 of FCR v1.3 that this is the approach that should be taken. Many assessment assign 'Not scored' at SG100 when an SG80 element has not been met.
1.2.2	Y	Y	Y	See comments above on condition milestones.	

Performance Indicator	Has all the relevant information available been used to score this Indicator? (Yes/No)	Does the information and/or rationale used to score this Indicator support the given score? (Yes/No)	Will the condition(s) raised improve the fishery's performance to the SG80 level? (Yes/No/NA)	Justification Please support your answers by referring to specific scoring issues and any relevant documentation where possible. Please attach additional pages if necessary.	Conformity Assessment Body Response
1.2.3	Y	N	NA	<p>SIa: again, the information presented is not sufficient to justify the SG80 score – how is this sufficient to support the HS?</p> <p>Sib: The scoring comments do not seem to relate to the SG – presumably the survey provides information on stock abundance and catches are accurately reported to provide data on fishery removals. The relationship to the HCR could be made clear. SG80 is probably justified, but this is not supported by the evidence presented.</p>	<p>SIa: There are conditions at 1.2.1 and 1.2.2 due to the shortcomings of the current harvest strategy for the species. However, there has been and continues to be a thorough program of information gathering from the fishery, including for red endeavour prawns. This information is adequate to support an improved harvest strategy.</p> <p>SIb: the justification has been amended to address the comments.</p>
1.2.4	NA	NA	NA	Default 80 as RBF used.	
White Banana Prawn P1					
1.1.1	Y	N	NA	<p>SIb would benefit from a clearer justification of how proxy TRP relates to Bmsy, especially as catches were below minimum trigger in 2016 (which was presumably environmentally-driven).</p>	<p>The SI requires that the stock has been fluctuating around or has been above the TRP. The justification has been edited to provide additional information.</p>

Performance Indicator	Has all the relevant information available been used to score this Indicator? (Yes/No)	Does the information and/or rationale used to score this Indicator support the given score? (Yes/No)	Will the condition(s) raised improve the fishery's performance to the SG80 level? (Yes/No/NA)	Justification Please support your answers by referring to specific scoring issues and any relevant documentation where possible. Please attach additional pages if necessary.	Conformity Assessment Body Response
1.1.2	Y	N	NA	Slc: It is not clear from the commentary as to how the TRP has a similar intent or outcome as Bmsy – i.e. evidence for selection of appropriate triggers.	There is currently no formal stock assessment for banana prawns nor evaluation of stock status in relation to MSY levels. The harvest strategy for the stock has, inter alia, an objective to allow sufficient escapement to ensure an adequate spawning biomass and to allow subsequent recruitment. Historical records indicate that the banana prawn fishery is sustainable with the current short fishing season. The season closes when catch rates fall below a trigger level associated with permitting sufficient prawns to escape to ensure an adequate spawning biomass for subsequent recruitment. In addition, the trigger is designed to achieve an economic outcome by closing fishing when catch rates fall below uneconomic levels. The MEY point for the banana prawn fishery is the point such that weekly marginal revenue equals weekly marginal cost i.e. when catch rates fall to the point where revenue generated by the catch is equal to the daily costs of fishing, so that marginal profit falls to zero: the “break even” catch rate.

Performance Indicator	Has all the relevant information available been used to score this Indicator? (Yes/No)	Does the information and/or rationale used to score this Indicator support the given score? (Yes/No)	Will the condition(s) raised improve the fishery's performance to the SG80 level? (Yes/No/NA)	Justification Please support your answers by referring to specific scoring issues and any relevant documentation where possible. Please attach additional pages if necessary.	Conformity Assessment Body Response
1.1.3	-	-	-		
1.2.1	Y	Y	NA		
1.2.2	Y	N	NA	<p>SIa: Whilst the HCRs have been explained earlier in the report, there needs to be more information included in the scoring commentary, particularly how the exploitation rate is reduced as the LRP is approached.</p> <p>Sib: As above, the commentary should provide clarification of what are the main uncertainties and how these are taken into account.</p>	SIa and SIb: The justifications have been edited to provide additional information.
1.2.3	Y	N	NA	<p>SIa: For SG100, which is the information collected which may not be directly related to the HS?</p> <p>Sib: SG100 does not require a stock assessment and so SG100 may be met, but again there is not sufficient information in the commentary to confirm this.</p>	<p>SIa: the assessors conclude that the justification for this SI covers the requirements.</p> <p>Sib: The assessors agree that the 100 requirements are potentially met in terms of the current assessment and harvest strategy. However, a score of 80 is given in view of the lack of a formal assessment to examine uncertainty.</p>

Performance Indicator	Has all the relevant information available been used to score this Indicator? (Yes/No)	Does the information and/or rationale used to score this Indicator support the given score? (Yes/No)	Will the condition(s) raised improve the fishery's performance to the SG80 level? (Yes/No/NA)	Justification Please support your answers by referring to specific scoring issues and any relevant documentation where possible. Please attach additional pages if necessary.	Conformity Assessment Body Response
1.2.4	Y	N	NA	<p>SIa: It is not clear why SG100 is not met</p> <p>Sib: the commentary does not mention reference points</p> <p>Sie: Would not CSIRO represent an external review?</p>	<p>SIa: as for SI 1.2.3, the assessors agree that the 100 requirements are potentially met in terms of the current assessment approach and its suitability for this stock. However, a score of 80 is given in view of the lack of a formal stock assessment modelling approach.</p> <p>SIb: The justification has been edited to provide additional information.</p> <p>SIc: CSIRO are contracted to undertake research for the fishery, including stock assessment, hence are not seen as external. Review processes are detailed at PI 3.2.5.</p>
Red-legged Banana Prawn P1					

Performance Indicator	Has all the relevant information available been used to score this Indicator? (Yes/No)	Does the information and/or rationale used to score this Indicator support the given score? (Yes/No)	Will the condition(s) raised improve the fishery's performance to the SG80 level? (Yes/No/NA)	Justification Please support your answers by referring to specific scoring issues and any relevant documentation where possible. Please attach additional pages if necessary.	Conformity Assessment Body Response
1.1.1	Y	N	NA	SIa: it is not clear from the commentary why it is 'highly likely' that the stock is above PRI. From the comments in Sib some discussion on confidence intervals and probabilities seems appropriate. Sib: Some reference to historical variability would provide confidence of stock status fluctuating around the TRP.	SIa: additional comments have been made in relation to confidence intervals. Sib: Additional comments have been made in relation to historical stock estimates.
1.1.2	Y	N	NA	Sib and c: the comments relate more to stock status than the appropriateness of the RP.	Agreed. The justifications have been edited to address the comments.
1.1.3	-	-	-		
1.2.1	Y	N	NA	SI c and d: both contain very little evidence to support the scoring.	Additional justification has been provided.
1.2.2	Y	Y	Y	See comments above on condition milestones.	
1.2.3	Y	Y	NA		

Performance Indicator	Has all the relevant information available been used to score this Indicator? (Yes/No)	Does the information and/or rationale used to score this Indicator support the given score? (Yes/No)	Will the condition(s) raised improve the fishery's performance to the SG80 level? (Yes/No/NA)	Justification Please support your answers by referring to specific scoring issues and any relevant documentation where possible. Please attach additional pages if necessary.	Conformity Assessment Body Response
1.2.4				<p>SIa: It is not clear from the commentary why SG100 is not met. Of note, the standard has absolute requirements, not relative to other prawn fisheries.</p> <p>SI b and c: these contain insufficient information to justify the scores awarded, e.g. what is the probabilistic assessment in SIc.</p> <p>SIe: the comments relating to external review do not seem to correspond to those in SIa.</p>	<p>SIa: As indicated at PI 1.1.1 for this species, low catches and effort in 2015 resulted in the 2016 update of the assessment not being able to provide reliable estimates of stock status. The assessors concluded that on this basis SG100 is not met.</p> <p>SIb and SIc: Additional comments have been made against these scoring issues to address the issues raised.</p> <p>SIe: Although SIa refers to an expert reviewer, this process is part of CSIRO's role as research provider for the fishery. As such, it is considered as part of the internal review process.</p>

2.1.1	Y	N	NA	<p>It is noted that the prawn species are covered in P1 (see CB3.5.1).</p> <p>SIa: The SG100 requirement applies to all retained catch, there is not an exemption in the standard for catches <0.5% (although CB3.5.4 may apply, but this needs some ‘strong justification’ – presumably relating to long-term stock status and catches).</p> <p>Sid is certainly met, but as there are other retained species, presumably with little information, these would need to be addressed here.</p>	<p>RE: CB3.5.1. Please note that each unit of certification (UoC) has been assessed individually and for each UoC, prawn species that are target in the fishery but not in the respective UoC, were assessed as retained. The paragraph referred to was correctly applied and no changes have been made in the report.</p> <p>The exemption of the catches under 0.5% is based on CB3.5.4 which states: “SG100 should usually require quantitative evidence and exceptions would need strong justification of very low risk over the period of proposed certification”.</p> <p>Justification: All species have been risk assessed. Bugs, squid, cuttlefish and scallops were subject of a byproduct study and their MSY consistent ABCs were estimated. The retained teleosts were SAFE assessed, using quantitative data specific for the species and the fishery. The risk assessments will be repeated in the following certification period and the effort and trawl footprint are not expected to increase, meeting the conditions in CB3.5.4. Quantitative data exists for most of the species under 0.5% but target reference points for these species would be impossible to set, which is the reason for the exemption.</p> <p>For the retained species where less quantitative data exists, the catches are extremely low (few kg/year) and CB3.5.3 applies: SG100 is met by default where the retention is extremely low and the</p>
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Performance Indicator	Has all the relevant information available been used to score this Indicator? (Yes/No)	Does the information and/or rationale used to score this Indicator support the given score? (Yes/No)	Will the condition(s) raised improve the fishery's performance to the SG80 level? (Yes/No/NA)	Justification Please support your answers by referring to specific scoring issues and any relevant documentation where possible. Please attach additional pages if necessary.	Conformity Assessment Body Response
					<p>impact negligible. The text in the scoring table was changed to clarify this as follows: The exemption from scoring species with catches under 0.5% was based on CB3.5.4 and CB3.5.3 because of evidence of very low or negligible risk over the period of proposed certification (MSC, 2012, p. C167).</p> <p>Si 2.1.1d does not apply because there is enough quantitative information to assess that these species are very low risk.</p>
2.1.2	Y	Y	NA		
2.1.3	Y	Y	NA		

Performance Indicator	Has all the relevant information available been used to score this Indicator? (Yes/No)	Does the information and/or rationale used to score this Indicator support the given score? (Yes/No)	Will the condition(s) raised improve the fishery's performance to the SG80 level? (Yes/No/NA)	Justification Please support your answers by referring to specific scoring issues and any relevant documentation where possible. Please attach additional pages if necessary.	Conformity Assessment Body Response
2.2.1	Y	N	NA	Sic: this is certainly met at SG60, but as there are species for which status is 'poorly known' this SI may need to be scored?	As for PI 2.1.1 all bycatch species have been risk assessed. Most bycatch are non-ETP teleosts and elasmobranch which have been assessed at SAFE, based on quantitative measures. Species where there is more uncertainty because they are caught in very low quantities are monitored on the NPF priority list, thus this SI would be certainly met. The score of 100 for the species with poorly known status is by default based on their very low stock overlap with the fishery. SI 2.1.1.c doesn't need to be scored. No changes were made in response of this comment.
2.2.2	Y	Y	NA		
2.2.3	Y	Y	NA		

2.3.1	Y	Y	NA	<p>Notes:</p> <p>Sib – mammals – 2nd para: This is a little confused and needs editing; the nature of the interaction with mammals would be good to know, given the ‘downgrade’ described in the next paragraph.</p> <p>Seabirds: The risk assessment supports a score of 80, but the lack of data may question a score of 100 for these?</p>	<p>Text for mammals was edited to be more clear:” During 2011-2015 period, two common dolphin interactions were reported from the tiger prawn subfishery and one from the red-legged banana subfishery (NPFI, 2016, unpublished data. All marine mammal species have been risk assessed at Level 2 PSA within the ERAEF framework, in 2007. The common dolphin, scored “low risk” despite of the few interactions recorded since 2011. All the other mammal species scored as "medium risk" which was downgraded by expert override by the NPFRAG. The reason for downgrade was that some of these species are too large to be caught in a prawn trawl and for the smaller species, TEDs allow escape (Griffiths <i>et al.</i>, 2007). The remaining interactions with dolphins, occur at the cod’s drawstrings or in try nets (small nets that can be used when searching for prawns) which do not have TEDs.”</p> <p>In our opinion the score for seabirds is correct for the following reasons: No recent interactions with birds occurred (fact validated by CMOs and AFMA SOs). Some interactions were recorded in the first MSC assessment. These interactions were recorded in 2006 in only one year, which seems to be rather an exception. No interactions were recorded in the last 10 years.</p> <p>This comment was included in the justification text:”In the risk assessment</p>
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Performance Indicator	Has all the relevant information available been used to score this Indicator? (Yes/No)	Does the information and/or rationale used to score this Indicator support the given score? (Yes/No)	Will the condition(s) raised improve the fishery's performance to the SG80 level? (Yes/No/NA)	Justification Please support your answers by referring to specific scoring issues and any relevant documentation where possible. Please attach additional pages if necessary.	Conformity Assessment Body Response
					report, the authors noted that there have been no historical bird interactions in the NPF (Griffiths <i>et al.</i> , 2007). 5 gull-billed tern interactions have been reported in the tiger prawn subfishery in 2006, year not included in the risk assessment. Since 2007, however ¹ , no bird interactions have occurred (MRAG, 2012, NPFI, 2016, unpublished data). This fact was validated by fishery independent and dependent observers." Evidence of no interactions in the last 10 years and dependent and independent monitoring justify a score of 100.
2.3.2	Y	Y	NA	To avoid confusion, a partial score should be recorded in SId	We are not sure what is required here because each UoC was scored individually, including for SId
2.3.3	Y	Y	NA		
2.4.1	Y	Y	NA		

2.4.2	Y	N	NA	Sib: the strategy relates to restricting the footprint of the fishery (for each UoA) while the comments talk about food web effects; testing should be related to the specific strategy (this may be included within a wider study and if so should be specifically stated). This is also related to Sid.	Agreed, a better justification was provided in the scoring table as follows:” Evidence that this strategy works and achieving its objective can be drawn from studies of trawl impact on biodiversity. Moreover, only a very small percentage of the NPF managed area is trawled, in areas with high natural variability and disturbance thus, impact from sources other than prawn fishing are likely to be more significant for the changes in the structure and function of the habitats in the NPF managed area. Haywood et al (2005) found that the state of the habitats impacted by trawling in the NPF is not a steady state that favours the fast growing or ‘weedy’ species over the slow growing ones but a highly dynamic one in which the seabed biota is changing in response to factors other than trawling. Moreover, simulation of the food web processes demonstrated that the reduction of fishing (from 286 vessels in 1981 to 52 vessels in 2009) has resulted in clear reductions of the overall impacts on biomass (bycatch) and trophic levels, this including the reduction of overall impacts on the structure and function of the habitat.”
2.4.3	Y	Y	NA		
2.5.1	Y	Y	NA	Note: The report makes passing reference to tiger prawns having a keystone role in the ecosystem. This may deserve more attention here?	The justification was changed to strengthen the argument that the removal of this keystone species does

Performance Indicator	Has all the relevant information available been used to score this Indicator? (Yes/No)	Does the information and/or rationale used to score this Indicator support the given score? (Yes/No)	Will the condition(s) raised improve the fishery's performance to the SG80 level? (Yes/No/NA)	Justification Please support your answers by referring to specific scoring issues and any relevant documentation where possible. Please attach additional pages if necessary.	Conformity Assessment Body Response
					not cause serious and irreversible harm to the ecosystem. This paragraph was added: It was found that tiger prawns could presumably play a keystone function in the ecosystem –i.e. they have a disproportionate + and - trophic effects despite their relative low biomass (Bustamante <i>et al.</i> , 2010). Due to this fact, it is conceivable that if historical level of high fishing intensity would have continued, the removal of tiger prawns would have resulted in serious negative consequences for the ecosystem's structure and function. However, according to the same study, the important reductions in the fishing effort, thus reduction in the tiger prawn removals, allowed recovery, as presented next."
2.5.2	Y	Y	NA	Note: Presumably the Management Plan is the 'plan' within which measures are contained?	The text was edited to reflect this: "These strategies combined together constitute a management plan to mitigate impacts from each subfishery on the ecosystem overall."
2.5.3	Y	Y	NA		

Performance Indicator	Has all the relevant information available been used to score this Indicator? (Yes/No)	Does the information and/or rationale used to score this Indicator support the given score? (Yes/No)	Will the condition(s) raised improve the fishery's performance to the SG80 level? (Yes/No/NA)	Justification Please support your answers by referring to specific scoring issues and any relevant documentation where possible. Please attach additional pages if necessary.	Conformity Assessment Body Response
3.1.1	Y	Y	NA	Note: Sib contains some incomplete sentences.	Corrected

Performance Indicator	Has all the relevant information available been used to score this Indicator? (Yes/No)	Does the information and/or rationale used to score this Indicator support the given score? (Yes/No)	Will the condition(s) raised improve the fishery's performance to the SG80 level? (Yes/No/NA)	Justification Please support your answers by referring to specific scoring issues and any relevant documentation where possible. Please attach additional pages if necessary.	Conformity Assessment Body Response
3.1.2	Y	N	NA	<p>SIa: does not CSIRO have functions beyond being part of NORMAC? Where do NPF RAG and NPF REC feed into the process and what are relative responsibilities?</p> <p>Sib: There is little explanation at SG100 of how the management system demonstrates consideration of the information and explains how it is used or not used?</p> <p>Sic: here is little explanation at SG100 of how the system facilitates effective engagement of all stakeholders.</p>	<p>Reference is made on several occasions to CSIRO as the science provider to all RAGs including within SIa. These include providing science based reports described throughout the report relating to stock assessment and the impact of the harvest strategy. The relative responsibilities of MACs and RAGs are described. The text IN THE SCORING TABLE has been adjusted slightly to reflect the points raised by the Peer Reviewer.</p> <p>NORMAC considers the wide range of information including the report of the NFPRAG, and local knowledge as part of its advisory processes. NORMAC is not only made up of relevant stakeholders, but is also required to consult all interested parties and bodies, including those not represented on the Committee, for example, Native Title holders. The minutes of NORMAC meeting are publicly available (AFMA, 2016d). These include rationale on how research and local knowledge has, or has not, been incorporated into management advice to the AFMA Commission.</p>

Performance Indicator	Has all the relevant information available been used to score this Indicator? (Yes/No)	Does the information and/or rationale used to score this Indicator support the given score? (Yes/No)	Will the condition(s) raised improve the fishery's performance to the SG80 level? (Yes/No/NA)	Justification Please support your answers by referring to specific scoring issues and any relevant documentation where possible. Please attach additional pages if necessary.	Conformity Assessment Body Response
3.1.3	Y	Y	NA	Note: it would be useful to reiterate here what the objectives are.	
3.1.4	Y	Y	NA		
3.2.1	Y	Y	NA		
3.2.2	Y	Y	NA		

Performance Indicator	Has all the relevant information available been used to score this Indicator? (Yes/No)	Does the information and/or rationale used to score this Indicator support the given score? (Yes/No)	Will the condition(s) raised improve the fishery's performance to the SG80 level? (Yes/No/NA)	Justification Please support your answers by referring to specific scoring issues and any relevant documentation where possible. Please attach additional pages if necessary.	Conformity Assessment Body Response
3.2.3	Y	N	NA	<p>SIa: Little evidence is presented here of the systems ability to enforce relevant management measures, strategies and/or rules: are systematic offenders singled out, has prioritisation of non-compliance areas led to increased monitoring?</p> <p>Sic: areas of non-confirmity identified are different to SIa (VMS)?</p>	<p>We do not agree. The report presents a suite of management tools, allied to an effective strategy of dealing with the risks. The report also specifically identifies priority actions taken and the ability to identify offences. The report also clarifies (SIc) that there are no systematic offenders. This is further clarified in SIc 'a small number of minor offences were identified (Fava, 2017). The risk assessment is used to support targeted planning of inspection activity. VMS monitoring is a priority for the NPF, not specifically because there are systematic offences, but because were it to occur, it would be a high risk offence. The fact that no VMS offences are detected demonstrates that the risk of fishing in closed areas is mitigated. This has been added to the text.</p>

Performance Indicator	Has all the relevant information available been used to score this Indicator? (Yes/No)	Does the information and/or rationale used to score this Indicator support the given score? (Yes/No)	Will the condition(s) raised improve the fishery's performance to the SG80 level? (Yes/No/NA)	Justification Please support your answers by referring to specific scoring issues and any relevant documentation where possible. Please attach additional pages if necessary.	Conformity Assessment Body Response
3.2.4	Y	N	NA	SLa: It is not clear that research is undertaken in respect to P3.	CB4.10.3 refers to the need to address issues in a research plan which are relative to the scale and intensity of the issues. The PI scores 100 in all SG's suggesting that there is a limited requirement for research relating to P3. In many cases the analytical tool required to address P3 issues is either a Review or a Risk Assessment, which does not qualify as research, but more as a supporting planning tool. The economics of the fishery is assessed in in the Annual Status Reports, and this area forms part of the evidence used to support 3.1.4 (incentives). No changes are made to the text.
3.2.5	Y	Y	NA		

For reports using the Risk-Based Framework:

Performance Indicator	Does the report clearly explain how the process used to determine risk using the RBF led to the stated outcome? Yes/No	Are the RBF risk scores well-referenced? Yes/No	Justification: Please support your answers by referring to specific scoring issues and any relevant documentation where possible. Please attach additional pages if necessary.	Conformity Assessment Body Response:
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1.1.1	Y	N	<p>SICA: The most relevant risk-causing activity should be identified – presumably direct capture? This should be justified in Table 40.</p> <p>The justification for the consequence score could usefully expand on the statement “the surveys suggest minimal impact on population size over time” – given the low abundance and relatively high temporal and intensity scores.</p>	Additional comments to address the points raised have been made in Table 40.
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Peer Reviewer B
Overall Opinion

<i>Has the assessment team arrived at an appropriate conclusion based on the evidence presented in the assessment report?</i>	Yes/No	Conformity Assessment Body Response
<u>Justification:</u> This report is a very well written with comprehensive explanations given for scoring. Some suggestions ,to review several of scores or enhance the justifications, have been made.		This suggestions have been well noted and adjustments largely incorporated into the scoring tables.

<i>Do you think the condition(s) raised are appropriately written to achieve the SG80 outcome within the specified timeframe?</i>	Yes/No	Conformity Assessment Body Response
<u>Justification:</u> Three conditions are raised. Two of these conditions relate to red endeavour prawn and result from changes in the Northern Prawn Fishery harvest strategy since the original assessment. The third condition relates to red-legged banana prawn and results from uncertainty in recent stock assessment. All conditions are written so that SG 80 can be met within the specified timeframe.		

If included:

<i>Do you think the client action plan is sufficient to close the conditions raised?</i>	Yes/No	Conformity Assessment Body Response
<u>Justification:</u> The client action plan is good. There is a commitment from the NPF industry to action the plan. However other organizations are relied on to carry out the actions required eg CSIRO, AFMA NPRAG – is there a commitment from them???		AFMA and CSIRO have provided written confirmation of support. The letters arrived during the PR stage and are now included in the PCR (Section 7.4)

General Comments on the Assessment Report (optional)

This is a well written report assessing a complicated set of prawn species.

In this assessment report the assessors provide the rationales for all scores proposed. Detailed rationales are presented for all Performance Indicators (PIs) under Principle 1 (Stock status and Harvest strategy), Principle 2 (Ecosystem Impact) and Principles 3 (Governance, Policy and Management system) of the MSC Standard.

There are three subfisheries covered in this assessment, the banana prawn subfishery, operating from 1 April to mid-June), the tiger prawn subfishery operating from 1 August until the end of November, and the seph Bonaparte Gulf (JBG) subfishery, with two seasons, coinciding with the banana and tiger prawn fishery, respectively

Six target species across the subfisheries are considered in this assessment: brown tiger prawn (*Penaeus esculentus*), grooved tiger prawn (*P. semisulcatus*), blue endeavour prawn (*Metapenaeus endeavouri*), red endeavour prawn (*M. ensis*), white banana prawn (*Fenneropenaeus merguensis*) and red-legged banana prawn (*F. indicus*). These six species are fished with the same fishing gear across the Northern Prawn Fishery Management Area by

all fishers operating in the fishery, the client group. Hence these six species represent six Units of Certification (UoC) and are equivalent to the Units of Assessment (UoA).

Principle 1 scoring separates the UoAs and although there is some repetition it is very clear and easy to follow.

Principle 2 is very well researched but more difficult to follow especially for 2.1 retained species (and bycatch species). The overall box of Y /N / and partial do not seem to be relevant. All the UoAs are given a score and this is appropriate – the matrix tables provided are excellent. However the justifications were sometimes difficult to follow as there was a mix of subfisheries combined, single species and elements of each.

Principle 3 was very thorough and well written

Performance Indicator Review

Please complete the table below for each Performance Indicator which are listed in the Conformity Assessment Body's Public Certification Draft Report.

Performance Indicator	Has all the relevant information available been used to score this Indicator? (Yes/No)	Does the information and/or rationale used to score this Indicator support the given score? (Yes/No)	Will the condition(s) raised improve the fishery's performance to the SG80 level? (Yes/No/NA)	Justification Please support your answers by referring to specific scoring issues and any relevant documentation where possible. Please attach additional pages if necessary.	Conformity Assessment Body Response
Brown tiger prawn (<i>Penaeus esculentus</i>) and Grooved tiger prawn (<i>Penaeus semisulcatus</i>) Comments same for both species					
1.1.1	Yes	Yes	NA	The score is justified and evidence provided in s 3.3.2 Although stocks were previously depleted the rebuilding strategy from 2002 to 2006 has been effective	
1.1.2	Yes	Yes	NA	The score is justified. Limit and target reference points are appropriate.	
1.1.3		NA			
1.2.1	Yes	Yes	NA	The HS is evaluated and tested	

Performance Indicator	Has all the relevant information available been used to score this Indicator? (Yes/No)	Does the information and/or rationale used to score this Indicator support the given score? (Yes/No)	Will the condition(s) raised improve the fishery's performance to the SG80 level? (Yes/No/NA)	Justification Please support your answers by referring to specific scoring issues and any relevant documentation where possible. Please attach additional pages if necessary.	Conformity Assessment Body Response
1.2.2	Yes	Yes	NA	Yes and HC rules are working. It might be worthwhile saying how the trigger is determined ie at breakeven point where costs equal revenue trigger of 350kg/day (not a biological trigger). The control rules appear to only relate to the average catch of the fleet being above 350kg/day. Some areas of the fishery can therefore potentially be well underneath this and still be able to continue to operate as long as the average is above it.	The 350 kg/day is only one aspect of the overall harvest strategy which is described in the report. Whilst there could be the potential for localised depletion with individual vessel catch rates below this level it is unlikely to be an important consideration for economic reasons.
1.2.3	Yes	Yes	NA	Agreed	
1.2.4	Yes	Yes	NA	Yes there is an adequate assessment of the stock status	
Blue endeavour prawn (<i>Metapenaeus endeavouri</i>)					
1.1.1	Yes	Yes	NA	The score is justified Although stocks were previously depleted the rebuilding strategy from 2002 to 2006 has been effective. However there is not a high degree of certainty that the stock has been fluctuating around its TRP or above and SIb scores 80.	
1.1.2	Yes	Yes		The score is justified.	

Performance Indicator	Has all the relevant information available been used to score this Indicator? (Yes/No)	Does the information and/or rationale used to score this Indicator support the given score? (Yes/No)	Will the condition(s) raised improve the fishery's performance to the SG80 level? (Yes/No/NA)	Justification Please support your answers by referring to specific scoring issues and any relevant documentation where possible. Please attach additional pages if necessary.	Conformity Assessment Body Response
1.1.3		NA			
1.2.1	Yes	Yes		Evidence is provided for a robust and precautionary HS	
1.2.2	Yes	Yes		SI c . The rebuilding strategy was directed at tiger prawns however it appears that the tools have been effective as controls for this fishery	
1.2.3	Yes	Yes		The score is justified	
1.2.4	Yes	Yes		The score is justified	
Red endeavour prawn (<i>Metapenaeus ensis</i>)					
1.1.1	Yes	Yes		No stock assessment is available for red endeavour prawns. However there is information on catches and other similar information as the for blue endeavour prawn. The assessors concluded that there was insufficient information to apply the standard assessment methodology, as prescribed in the FAM V2, to assess the stock status to score PI 1.1.1 for red endeavour prawns. For this reason, the RBF was applied.	

Performance Indicator	Has all the relevant information available been used to score this Indicator? (Yes/No)	Does the information and/or rationale used to score this Indicator support the given score? (Yes/No)	Will the condition(s) raised improve the fishery's performance to the SG80 level? (Yes/No/NA)	Justification Please support your answers by referring to specific scoring issues and any relevant documentation where possible. Please attach additional pages if necessary.	Conformity Assessment Body Response
1.1.2	Yes	Yes		The default score for this PI is 80 when RBF is used to score PI 1.1.1., in accordance with MSC CR v1.3.	
1.1.3		NA			
1.2.1	Yes	Yes	Yes	The condition raised here is appropriate. The HS for the does not include a separate component for the red endeavour prawn.	
1.2.2	Yes	No	Yes	At Sla there are no well defined HC rules for this species. Agreed SG80 is not met and a condition raised At Slc. The rebuilding strategy was directed at tiger prawns however this species did benefit and shows tools were effective. Maybe it scores 100 as per the blue endeavour prawn. As scored currently Sla 60, Slb 80, Slc 60. The overall score should be 70 not 75	Re Slc, whilst the rebuilding strategy has had benefits for endeavour prawns, the lack of a stock assessment for the species prevents a score of 100. The reviewer appears to have misread the score. Slc is scored at 80.
1.2.3	Yes	No		Sla. The justification just repeats the guidepost and does not state what is the sufficient relevant information eg on stock structure stock and productivity to support the HS.	Additional comments have been made to strengthen the justification.
1.2.4	Yes	Yes		RBF used. Default score is 80.	
White banana prawn (<i>Fenneropenaeus merguensis</i>)					

Performance Indicator	Has all the relevant information available been used to score this Indicator? (Yes/No)	Does the information and/or rationale used to score this Indicator support the given score? (Yes/No)	Will the condition(s) raised improve the fishery's performance to the SG80 level? (Yes/No/NA)	Justification Please support your answers by referring to specific scoring issues and any relevant documentation where possible. Please attach additional pages if necessary.	Conformity Assessment Body Response
1.1.1	Yes	Yes/No		There is no stock assessment model. And no formal biomass reference points Was RBF considered for this PI? ie can the biologically-based limits for sustainability be estimated such that serious of irreversible harm could be identified? If not then RBF can be used.	Although a typical stock assessment model is not used for the fishery, the approach taken is based on an extensive historical research program and close monitoring of the fishery. The assessors consider that the available information is sufficient to use the default assessment tree.
1.1.2	Yes	No		Analytical RPs are missing for either LRP or TRP, the CAB has determined that The surrogate LRP and TRP measures are (i) that there will be a sufficient escapement from the subfishery to not jeopardize subsequent recruitment and (ii) that the economic yield is maximized each year within this constraint, thus achieving the maximum average return.. However implicit RPs must be consistent with MSC default values. $TRP = B_{MSY} = 40\% B_0$; $LRP = B_{LIM} = 20\% B_0 = 1/2 B_{MSY}$ and this is not clear.	The management strategy for the fishery has been tested using management strategy evaluation. The white banana stock is managed under a Maximum Economic Yield strategy which is consistent with the MSC default values. Additional commentary on the MEY approach has been incorporated into the justification.
1.1.3		NA			
1.2.1	Yes	Yes		Score is justified	
1.2.2	Yes	Yes		A reference to section in report would be helpful	A reference has been added.

Performance Indicator	Has all the relevant information available been used to score this Indicator? (Yes/No)	Does the information and/or rationale used to score this Indicator support the given score? (Yes/No)	Will the condition(s) raised improve the fishery's performance to the SG80 level? (Yes/No/NA)	Justification Please support your answers by referring to specific scoring issues and any relevant documentation where possible. Please attach additional pages if necessary.	Conformity Assessment Body Response
1.2.3	Yes	Yes		Agreed	
1.2.4	Yes	Yes		Agreed	
Red-legged banana prawn (<i>Fenneropenaeus indicus</i>)					
1.1.1	Yes	Yes		Agreed	
1.1.2	Yes	Yes		Agreed	
1.1.3	NA				
1.2.1	Yes	Yes		Sl d. Examples of improvements for this particular fishery would be useful.	This is best addressed by the condition at 1.2.2.
1.2.2	Yes	Yes	Yes	The implication of low catches and catch rates requires further investigation. A condition covering Slb and Slc is appropriate	
1.2.3	Yes	Yes		Agreed	
1.2.4	Yes	No		Slc from the justification only SG80 is met	Additional justification has been provided to support the score.

Performance Indicator	Has all the relevant information available been used to score this Indicator? (Yes/No)	Does the information and/or rationale used to score this Indicator support the given score? (Yes/No)	Will the condition(s) raised improve the fishery's performance to the SG80 level? (Yes/No/NA)	Justification Please support your answers by referring to specific scoring issues and any relevant documentation where possible. Please attach additional pages if necessary.	Conformity Assessment Body Response
2.1.1	Yes	Yes		<p>My preference would not to give a Yes/No/Partial in the Met? Box. It is irrelevant as each UoA is given a score in the matrix table which is appropriate</p> <p>Blue endeavour prawn. The most recent stock assessment (Buckworth <i>et al.</i>, 2016) shows that blue endeavour prawn was below the target reference point ($S_{2015}/S_{MEY}=80\%$, $TRP = S_{MEY}$). But the final sentence in the justification says. There is a high degree of certainty that blue endeavour prawn is within its biologically based limits and above target reference points. Contradiction?</p>	<p>Yes/No Box is part of the MSC scoring table.</p> <p>The text was changed for blue endeavour prawn from "above target reference points" to "around its target reference point"</p>
2.1.2	Yes	Yes		As above the Met? Box is misleading	Same as above.
2.1.3	Yes	Yes		Agreed	
2.2.1	Yes	Yes		Agreed	

Performance Indicator	Has all the relevant information available been used to score this Indicator? (Yes/No)	Does the information and/or rationale used to score this Indicator support the given score? (Yes/No)	Will the condition(s) raised improve the fishery's performance to the SG80 level? (Yes/No/NA)	Justification Please support your answers by referring to specific scoring issues and any relevant documentation where possible. Please attach additional pages if necessary.	Conformity Assessment Body Response
2.2.2	Yes	Yes		SI c Justification states that compliance monitoring ensures that the strategy is implemented successfully is the "clear evidence just gear monitoring and VMS?	A more complete justification has been provided for this SI as follows: Compliance monitoring ensures that the strategy is implemented successfully in all three NPF subfisheries. A gear monitoring program is in place to monitor vessel fishing power and TED/BRD configurations. VMS data covers the whole fleet throughout the seasons to monitor position of vessels especially with respect to spatial and temporal closures (Dichmont <i>et al.</i> , 2014). Crew Observer training and coverage improved in recent years ensuring that best practices are employed in handling, measuring and recording the catch. Logbook recording is complied with, the logbook reports being compulsorily submitted to AFMA for validation (AFMA, 2016).
2.2.3	Yes	Yes		Agreed	
2.3.1	Yes	Yes		Agreed scores are justified Again the Met? Box is irrelevant. The matrix summary tables are very helpful in summarising infor for each UoA..	Same as above

Performance Indicator	Has all the relevant information available been used to score this Indicator? (Yes/No)	Does the information and/or rationale used to score this Indicator support the given score? (Yes/No)	Will the condition(s) raised improve the fishery's performance to the SG80 level? (Yes/No/NA)	Justification Please support your answers by referring to specific scoring issues and any relevant documentation where possible. Please attach additional pages if necessary.	Conformity Assessment Body Response
2.3.2	Yes	Yes		As above	
2.3.3	Yes	Yes		Agreed	
2.4.1	Yes	Yes		Good evidence provided to meet the awarded scores.	

2.4.2	No	No		Slb. This justification about food webs is not relevant to habitat strategy being tested	The justification was changed to reflect the strategy for habitat specifically: "Evidence that this strategy works and achieving its objective can be drawn from studies of trawl impact on biodiversity. Moreover, only a very small percentage of the NPF managed area is trawled, in areas with high natural variability and disturbance thus, impact from sources other than prawn fishing are likely to be more significant for the changes in the structure and function of the habitats in the NPF managed area. Haywood et al (2005) found that the state of the habitats impacted by trawling in the NPF is not a steady state that favours the fast growing or 'weedy' species over the slow growing ones but a highly dynamic one in which the seabed biota is changing in response to factors other than trawling. Moreover, simulation of the food web processes demonstrated that the reduction of fishing (from 286 vessels in 1981 to 52 vessels in 2009) has resulted in clear reductions of the overall impacts on biomass (bycatch) and trophic levels, this including the reduction of overall impacts on the structure and function of the habitat."
2.4.3	Yes	Yes		Agreed	
2.5.1	Yes	Yes		Agreed	

Performance Indicator	Has all the relevant information available been used to score this Indicator? (Yes/No)	Does the information and/or rationale used to score this Indicator support the given score? (Yes/No)	Will the condition(s) raised improve the fishery's performance to the SG80 level? (Yes/No/NA)	Justification Please support your answers by referring to specific scoring issues and any relevant documentation where possible. Please attach additional pages if necessary.	Conformity Assessment Body Response
2.5.2	Yes	Yes		Agreed	
2.5.3	Yes	Yes		Agreed	
All species					
3.1.1	Yes	Yes		Agreed	
3.1.2	Yes	No		SI b shows that the management system includes consultation process that seeks and accepts relevant information and explains how it is used however the rationale presented does not provide evidence of the regularity of management seeking relevant information. This is required at the SG80 level for this PI.	The text clearly lays out the consultative process that information is provided from science providers and other stakeholders in seeking information. AFMA, and NPF Industry Pty Ltd undertake management actions, and where appropriate provide information on the effectiveness of these management actions through the NORMAC meeting process. This process is inclusive of incorporating local knowledge, including industry and NGO inputs, as well as wider stakeholder views.

Performance Indicator	Has all the relevant information available been used to score this Indicator? (Yes/No)	Does the information and/or rationale used to score this Indicator support the given score? (Yes/No)	Will the condition(s) raised improve the fishery's performance to the SG80 level? (Yes/No/NA)	Justification Please support your answers by referring to specific scoring issues and any relevant documentation where possible. Please attach additional pages if necessary.	Conformity Assessment Body Response
3.1.3	Yes	Yes		The justification could refer back to Sect 3.5.3 of the report where the long term objectives are described	Reference is made to Section 3.5.3. Evidence there shows that the number of objectives contained in Commonwealth Legislation are extensive, but explicitly are consistent with MSC principles 1 and 2.
3.1.4	Yes	Yes		Agreed	
3.2.1	Yes	Yes		Agreed	
3.2.2	Yes	Yes		SI b. Information is certainly provided to show that decision making responds to serious and other important issues identified but to ALL issues?	The defined harvest and bycatch management strategies respond to all issues. This has been added to the text, as well as the source references used (Dichmont et al, and regular AFMA and NPF publications).

Performance Indicator	Has all the relevant information available been used to score this Indicator? (Yes/No)	Does the information and/or rationale used to score this Indicator support the given score? (Yes/No)	Will the condition(s) raised improve the fishery's performance to the SG80 level? (Yes/No/NA)	Justification Please support your answers by referring to specific scoring issues and any relevant documentation where possible. Please attach additional pages if necessary.	Conformity Assessment Body Response
3.2.3	Yes	Yes		The report Sect 3.5.8 identifies a prioritised risk that are the focus of the 2016-17 program as a failure to have VMS monitoring at all times but it doesn't say whether or not this is a "risk" for the prawn fisheries	The risk assessment is used to support targeted planning of inspection activity. VMS monitoring is a priority for the NPF, not specifically because there are systematic offences, but because were it not to occur, it would be a high risk offence. The fact that no VMS offences are detected demonstrates that the risk of fishing in closed areas is mitigated. This has been added to the text.
3.2.4	Yes	Yes		Agreed	

3.2.5	Yes	Yes/No		<p>SIb. Fishery specific relates to the northern prawn fisheries The justification for internal reviews includes some fishery specific bullet points eg “the NPF harvest strategy remains consistent with the Australian government’s Harvest Strategy Policy” but there is no comment as to how regular this is.</p> <p>Although parts of the management system, specifically science, enforcement, and ETP undergo external review there is no explicit separate external review reported for the management system of the prawn specific fishery.</p>	<p>The scoring table identifies eight internal review processes. The word periodically has been changed to regularly, which reflects the pattern of the respective harvest strategy and annual management plans. This has been qualified by NPFI (Jarrett, September, 2017). There is no specific schedule for reviewing the HS however this frequently occurs as the need arises and is undertaken initially by the NPRAG, which makes recommendations to NORMAC. Any changes to HS recommended by the MAC must be approved by the AFMA Commission before they can be implemented, and is footnoted..</p> <p>The fishery specific harvest strategy was internally reviewed by NPFRAG in 2013/2014 (White banana), and in 2014 (Tiger prawn). The Red legged harvest strategy is currently under review. Evidence of these reviews are available in NPFRAG papers and minutes. Whilst there are extensive external reviews undertaken for this fishery, including external reviews of fisheries specific management strategies and actions taken.</p> <p>Commonwealth managed Heard Island Toothfish fishery.</p>
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Any Other Comments

Comments	Conformity Assessment Body Response
Was a reduced reassessment considered? This fishery was probably eligible Refer FCR v2 7.24.6?	Yes, but the client opted for the full assessment process, preferring total transparency throughout the stages.

For reports using the Risk-Based Framework:

Performance Indicator	Does the report clearly explain how the process used to determine risk using the RBF led to the stated outcome? Yes/No	Are the RBF risk scores well-referenced? Yes/No	Justification: Please support your answers by referring to specific scoring issues and any relevant documentation where possible. Please attach additional pages if necessary.	Conformity Assessment Body Response:
Red endeavour prawn (<i>Metapenaeus ensis</i>)				
1.1.1	<i>Yes</i>	<i>Yes</i>	There was insufficient information to apply the standard assessment methodology, to assess the stock status to score PI 1.1.1 for red endeavour prawns. For this reason, the RBF was applied. A Scale Intensity Consequence Analysis (SICA) and a Productivity Susceptibility Analysis (PSA) were undertaken. The results are well described and justified.	
2.1.1	<i>NA</i>	<i>NA</i>		

2.2.1	<u>NA</u>	NA		
2.4.1	<u>NA</u>	NA		
2.5.1				

For reports assessing enhanced fisheries:

<i>Does the report clearly evaluate any additional impacts that might arise from enhancement activities?</i>	Yes/No	Conformity Assessment Body Response:
<u>Justification:</u>		

Peer Reviewer A's Outstanding Issues

List any outstanding issues you have with the CAB's responses to your comments on PI scoring.

Performance Indicator	Outstanding Issue (provide clear justification)	Certifier Response
1.2.3 Information and monitoring	<p>Most issues raised in the PR related to insufficient evidence being presented in the scoring commentary to justify the score awarded. It is acknowledged that the information is present in the text of the report but the comments made requested at least a <u>summary</u> to show that '<i>each scoring issue is fully and unambiguously met</i>' (FCR 7.10.6)</p> <p>This has been mostly provided now, which makes the rationale behind the scoring much more transparent. However:</p> <p>Red endeavor prawn. SIa simply restates the SG 80 requirement with no evidence <i>in the scoring commentary</i>.</p>	The justification for this scoring issue for red endeavour prawn has been revised to add further information..
2.3.2 ETP species management strategy	SG100 is met for some elements but not for others	The error has been rectified in the scoring table: Y was replaced with Partially for SI 2.3.2d

List any outstanding issues you have with the CAB's responses to your comments on Conditions.

Performance Indicator	Outstanding Issue (provide clear justification)	Certifier Response

List any other issues you feel haven't been adequately addressed and would make a material difference to the scoring of the fishery.

Outstanding Issue	Certifier Response

Appendix 7. ASI Summary of Findings. MSC Accreditation Program



ASI SUMMARY OF FINDINGS MSC ACCREDITATION PROGRAM

MRAG Americas, Inc - Desk review Assessment

Ref.	66211	Date detected	24/7/2017
Grade	Minor Nonconformity	Deadline for implementation	23/7/2018
Subject			
Detected by	Antonio Hervas		
Normative Reference and Requirement	<p>MSC-CR-V1.3-CB-2.2.2</p> <p>CB2.2.2 The team shall consider the biology of the species and the scale and intensity of both the fishery and management system and other relevant issues in determining relevant time periods over which to judge fluctuations. ■</p> <p>CB2.2.2.1 At SG80, there shall be evidence that the stock is at the target reference point now or has fluctuated around the target reference point for the past few years.</p>		
Description	No evidence was provided by the CAB that the stock is at the target reference point now or has fluctuated around the target reference point for the past few years.		

Evidence observed	<p>Unit of Assessment for blue endeavour prawn (<i>Metapenaeus endeavour</i>):</p> <p>PI 1.1.1 Stock Status was scored at SG80 for scoring issue b "The stock is at or fluctuating around its target reference point". However the rationale provided by the CAB stated the following: "The most recent assessment of the status of blue endeavour (Buckworth et al., 2016) shows that stock status is approaching the TRP (S2015/SMEY=80%; 77-84% over the range of sensitivities) (Table 5)..." The background information provided in the report also states the following regarding blue endeavour stock status</p> <p>"Blue endeavour prawns are considered a byproduct of the tiger prawn subfishery. The species is not considered to be over-fished relative to the target reference point of 0.5 SMSY (based on a 5-year moving average). In all the scenarios tested, the stock abundance was close to SMSY at the end of 2015 (77% to 97 %). The five-year average abundance estimate ranged from 75% to 94% of SMSY (Table 1 and Figure 1)."</p> <p>It is noted also that PI 1.1.1 Issue b also states "The stock has reached the TRP in recent assessments but has not been above the TRP". However no evidence of this was provided in the report.</p>
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	This finding is graded as a minor non conformity as this was identified as one single failure to confer to the standard requirements.
Additional evidence	

Ref.	66212	Date detected	24/7/2017
Grade	Minor Nonconformity	Deadline for implementation	23/7/2018
Subject	Process Requirements / Scoring the fishery		
Detected by	Antonio Hervas		
Normative Reference and Requirement	MSC-FCR-V2.0-7.10.6.1 7.10.6.1 A rationale shall be presented to support the team's conclusion.		
Description	In one instances a rationale was not provided to support the team conclusion.		
Evidence observed	<p>Unit of Assessment for Blue Endeavour:</p> <p>-For PI 1.1.2 Issue c SG 100 "The target reference point is such that the stock is maintained at a level consistent with BMSY or some measure or surrogate with similar intent or outcome, or a higher level, and takes into account relevant precautionary issues such as the ecological role of the stock with a high degree of certainty" the CAB did not provide a rationale to support the team conclusion. The rationale does not provide evidence to support that relevant precautionary issues (such as the ecological role of the stock) have been accounted for with a high degree of certainty.</p> <p>Unit of Assessment for Red Endeavour:</p> <p>-For PI 1.1.1 the RBF was used. The SICA assessment and scoring process is well described. However no rationale is provided to support the team conclusion regarding the PSA's productivity and susceptibility scores.</p> <p>This finding is graded as a minor NC as it was not considered to meet any of the criteria, as defined by ASI's finding procedure, to grade it as a major NC.</p>		
Additional evidence			

Ref.	66214	Date detected	24/7/2017
Grade	Opportunity for Improvement	Deadline for implementation	23/7/2018
Subject	Process Requirements / Scoring the fishery		
Detected by	Antonio Hervas		
Normative Reference and Requirement	<p>MSC-FCR-V2.0-7.10.7.4</p> <p>7.10.7.4 Table 4 shall be used to determine the overall score for the PI from the scores of the different scoring elements.</p>		
Description	generally table 4 was used in conformity to the requirements. However for one PI the CAB did not applied table 4 correctly.		
Evidence observed	<p>Unit of Assessment for Brown Tiger Prawns:</p> <p>PI 2.2.1 "Bycatch outcome": For PI 2.2.1 five species (elements) were scored. Two of them scored at SG 80 and three of them scored at 100. The team allocated an score of 90. However following Table 4 a score of 95 shall be scored.</p> <p>The above evidence was a single error. Generally the team demonstrated to apply Table 4 correctly. Therefore this finding is graded as a Opportunity of Improvement; The score was precautionary and it is not considered that the CAB overall applied incorrectly table 4.</p>		
Additional evidence			

Assessor's response

The team further considered the scoring of Blue endeavour prawns and acknowledge that although the stock has been on a trajectory towards the stated target reference point the latest assessment indicates that it has not yet reached that level. However, the assessment team consider that there is justification to maintain a score of 80 for 1.1.1b (noting the MSC interpretation on target reference points for short-lived species). The justification has been amended to reflect this. Similarly, the team has strengthened the justification given for the score of 100 given for 1.1.2 for blue endeavours.

For Red endeavours, the Productivity scores used are as per the 2007 ecological risk assessment of the fishery (Griffiths *et al.*, 2007) using the ERAEF methodology described in Section 3.4.4 of this report. The ERAEF was a scientific risk assessment process developed by CSIRO over several years for application to Australia's Commonwealth-Government managed fisheries. The methodology (Hobday *et al.*, 2007) has been used widely in many fisheries around the world and is similar to the MSC RBF. The ERAEF PSA undertaken in Griffiths *et al.* (2007) derived the total productivity score for red endeavour prawns to be 1. Information for the scoring of the components for the PSA above (average age at maturity, average maximum age, fecundity, average maximum size, average size at maturity, reproductive strategy and trophic level) were also checked in available literature (e.g. Crocos *et al.*, 2001) for consistency with the Griffiths *et al.* (2007) findings.

The ERAEF described above also undertook a SICA analysis for the NPF. Given the time since the Griffiths *et al.* work and changes to the fishery since then, an updated SICA was undertaken based on the questionnaire below. Susceptibility scores are as per the 2007 ecological risk assessment of the fishery (Griffiths *et al.*, 2007), with consideration of the updated SICA results.

Richard Banks, Team leader

Emily McGregor, PhD
Fishery Assessment Manager

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Technical Oversight Response.

SubID	PageReference	Grade	RequirementVersion	OversightDescription	CAB comment
27373+F3F3A2:F4A2:F4	192	Minor	CR-27.6.1 v1.3	The report does not provide an eligibility date. Although this is a reassessment, this date should still be clear, for example to identify and account for potential lapses in the certificate if the re-certification is delayed.	Eligibility date has now been added under the eligibility subheading in the traceability section of the report.
27374	194	Minor	CR-27.12.2.1a v1.3	There are vessels, client group members (including on-land handlers), transport and storage facilities included in the fishery certificate. Although the latter two may be too many to name, the report must indicate the names of the fishery client group mem	The fishery client is NPF Industry Pty. Group members comprise 18 company owners and 52 associated vessels (Table 2). This sentence now precedes Table 2.

27375	193	Guidance	CR-27.12.1.4 v1.3	<p>The report indicates that “soft and broken” shrimp are sent to parts of Asia for processing. Please indicate who owns and is responsible for the product until it reaches the processing facility. Is the transport from Australia to Asia intended to be cover</p>	<p>Ownership of product during transit to the factory is the product owners (either vessel owners or 3rd party marketing agents who have purchased the product from vessel owners). MSC Certification covers the product until it reaches Asia provided it stays in the same format as packed on the vessel. The MSC logo or MSC claim can only be used from this point onwards if the processing plant also holds MSC Chain of Custody. The product may be sold within Asia under the clients trade name or returned back to Australia, agaon under the clients trade name. This change has been inserted into the text for clarification</p>
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27376	193	Guidance	CR-27.12.2 v1.3	The following sentences are confusing: “It is difficult to generalise the transfer of ownership within the fleet. There are a portion of the fleet for whom the ownership of the product is transferred on unloading” and “The transfer of ownership happens ea	Product is stacked into pallets, loaded onto freezer trucks for transport and delivered to the wholesaler’s freezers. Product is either sold and processed by the vessel owners or on-sold at point of unload to 3rd parties (these 3rd parties include wholesalers, retailers, processors or marketing & sales agencies). Transfer of ownership is confirmed via a sales invoice. The owners maintain a record of all product inventories until sold on. This change has been inserted into the text for clarification
27377	194	Guidance	CR-27.12.1.5 v1.3	The report refers to ‘and then... to secondary processors.’ Does the fishery certificate include any processing activities, either at sea or at landing? If so, the report should describe these activities and how	The report states that the product is snap frozen, onboard, ready-for-distribution, MSC Certification should only covers packing and freezing at sea to point of sale in the same packing format. Further down chain partners who change the product packing format will require their own CoC if they

				traceability is maintained.	intend on using the MSC logo. Any packing or further processing on land by vessel owners requires them to have their own CoC. These issues are already highlighted in the text.
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7.6 Appendix 7. Surveillance Frequency

Table A4: Fishery Surveillance Plan

Score from CR Table C3	Surveillance Category	Year 1	Year 2	Year 3	Year 4
7.23.4.2	Reduced surveillance	On-site surveillance audit	On-site surveillance audit	On-site surveillance audit	On-site surveillance audit & re-certification site visit
	In the second and subsequent certification periods a reduced team of 1 auditor may be used if the fishery has conditions associated with Principle 1, or no conditions.				

7.7 Appendix 8. Client Agreement





PO Box 756
Caloundra Qld 4551
AUSTRALIA

12th January 2018

Amanda Stern-Pirlot
Director - Fisheries Certification
MRAG Americas--Seattle
1631 15th Ave W, Suite 201
Seattle, WA 98119Ms

Dear Ms. Stern-Pirlot,

This letter is to confirm that the NPF Industry Pty Ltd (NPF) accepts the public comment report (PRC) and certification decision, to show that the Northern Prawn Fishery conforms to the MSC standard.

Please do not hesitate to contact me if you have any questions.

Yours Sincerely,

A handwritten signature in black ink, which appears to read 'A. E. Jarrett'. The signature is written in a cursive style with a large, looping 'J' at the end.

Annie Jarrett CEO