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Ecological Risk Assessment for the Effects of Fishing

Report for the Northern Prawn Fishery: Banana Prawn sub-fishery 2013-2017

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Important disclaimer

Notes to this document:

This fishery ERA Report document contains figures and tables with numbers that correspond to the full methodology document for the ERAEF method:

> Hobday, A. J., A. Smith, H. Webb, R. Daley, S. Wayte, C. Bulman, J. Dowdney, A. Williams, M. Sporcic, J. Dambacher, M. Fuller, T. Walker. (2007). Ecological Risk Assessment for the Effects of Fishing: Methodology. Report R04/1072 for the Australian Fisheries Management Authority, Canberra

Thus, table and figure numbers within the fishery ERA Report document are not sequential as not all are relevant to the fishery ERA Report results.

Additional details on the rationale and the background to the methods development are contained in the ERAEF Final Report:

> Smith, A., A. Hobday, H. Webb, R. Daley, S. Wayte, C. Bulman, J. Dowdney, A. Williams, M. Sporcic, J. Dambacher, M. Fuller, D. Furlani, T. Walker. (2007). Ecological Risk Assessment for the Effects of Fishing: Final Report R04/1072 for the Australian Fisheries Management Authority, Canberra.

This document also reflects some changes in methods that are detailed in AFMA's ERA guide (2017).

> Australian Fisheries Management Authority (2017). Guide to AFMA's Ecological Risk Management. 130 pp. (Commonwealth of Australia, Canberra).

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Executive summary

The “Ecological Risk Assessment for Effect of Fishing” ERAEF was developed jointly by CSIRO Marine and Atmospheric Research and the Australian Fisheries Management Authority (Hobday et al. 2007, 2011b). This assessment of the ecological impacts of the Northern Prawn Banana Prawn sub-fishery was undertaken using the ERAEF method version 9.2, with some additional modifications currently in final stages of development with AFMA (Australian Fisheries Management Authority 2017). This revised ERAEF provides a hierarchical framework for a comprehensive assessment of the ecological risks arising from fishing, with impacts assessed against five new ecological components –key commercial and secondary commercial species; byproduct and bycatch species; protected species; habitats; and (ecological) communities (ERM Guide; AFMA, 2017).

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.

Application of the ERAEF methods to a fishery represents 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 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 specific fishery. Level 1 screens out activities that are judged to have low impact, and potentially screens out components with all low impact scores. Level 2 is a screening or prioritization process for individual species, habitats, and communities at risk from direct impacts of fishing, using either PSA or SAFE. 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 – the term used at Level 2 is 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.

This 2013-2017 assessment of the Northern Prawn Fishery: Banana Prawn sub-fishery consists of the following:

- Scoping
- Level 1 results for all components
- Level 2 results for two components
- Residual risk analysis

Fishery Description

Gear:	Otter board trawl
Area:	The management area of the NPF covers over 77,1000 square kilometres off Australia's northern coast, from Cape Londonderry in Western Australia to Cape York in Queensland.
Depth range:	1 - 320 m (mean: 31.7 m; median: 18 m; 95th percentile: 62 m)
Fleet size:	52 vessels
Effort:	1980-3160 boat days p.a.
Landings:	~ 4241 t p.a (2904 -6330 t)
Discard rate:	fishery wide discard rate not available
Commercial species (ERA classification):	White banana prawn (*Penaeus merguiensis*)
Management:	Quota management system across species/stocks.
Observer program (2013-2017):	AFMA Observer program. Coverage: 1.04-2.12% [average: 1.69%]. Crew Member Observer program. Coverage: 11.08-15.76% [average: 12.9%].

Ecological Units Assessed

Table ES1.1. Ecological units assessed in 2019 and 2006.

ECOLOGICAL COMPONENT	2019#	2006+
Key/secondary commercial species	1 key; 0 secondary	9^
Byproduct and bycatch species	14 byproduct; 335 bycatch	135 byproduct; 516 bycatch
Protected species	42	128
Habitats	demersal: 19' (region 1); 15' (region 2); 22 demersal**, 1 pelagic	156 demersal*, 1 pelagic
Communities	6 demersal, 1 pelagic	6 demersal, 1 pelagic

based on assessment period: 2013-2017; + combined list of Banana and Tiger Prawn sub-fisheries
^ corresponds to target species; * these habitats are not comparable with current assessment
' based on Pitcher et al. (2018); ** based on Pitcher et al. (2016)

A total of 391 species across the three ecological components were assessed in this ERAEF (Table ES1.1). By contrast, the greater number of species assessed in 2006 (i.e., 788) can be partly attributed to the fact that there were two sub-fisheries combined (i.e., Tiger Prawn and Banana Prawn). Also, the difference in the number of protected species between assessments is mainly due to the inclusion of species that interacted in this sub-fishery (apart from any expansion of species groups identified from AFMA logbook and/or Observer data).

Level 1 Results and Summary

Two ecological components were eliminated at Level 1 (i.e., no components with risk scores of 3 – moderate – or above).

Most hazards (fishing activities) were eliminated at Level 1 (i.e., no components with risk scores of 3 – moderate – or above). Those that remained were:

- Fishing (capture impacts on three ecological components)
- Fishing (non-capture impacts on two ecological components)
- External hazards from other fisheries (on three components)

As a result of direct capture by fishing, the most vulnerable bycatch species Australian blacktip shark (Carcharhinus tilstoni) was assessed at moderate risk largely due to the fact that they make up most of shark species caught in the NPF and sharks typically have low fecundity, slow growth rate and low trawl survivability.

As a result of direct capture by fishing, the most vulnerable protected species, the green and freshwater sawfish (*Pristis zijsron* and *Pristis pristis*) as they appear to have a high entanglement rate in trawl nets and escapement rates of sawfish from trawl nets through TED openings are currently unknown.

As a result of direct impact of non-capture by fishing, the most vulnerable protected species, the Olive Ridley turtle (*Lepidochelys olivacea*) as they have the greatest risk of extinction for marine turtle stocks in the Gulf of Carpentaria region (C. Limpus pers. comm.).

The impact of fishing represented a major risk to habitats (region 2: assemblage 5) largely due to the concentration of effort at depths where highly vulnerable fauna occur i.e., encounter with heavier demersal trawl gears will result in removal and damage of erect, rugose and inflexible octocorals associated with soft, muddy substrata.

Significant external hazards included other fisheries in the region on three components (byproduct/bycatch; protected; habitats). External fisheries and aquaculture were rated at major risk (score 4) on protected species.

A Level 2 analysis for habitats was not possible at this time (Table ES1.2).

Table ES1.2. Outcomes of assessments for ecological components conducted in 2019 and 2006.

ECOLOGICAL COMPONENT	2019 (CURRENT)	2006 (PREVIOUS)
Key/secondary commercial species	Level 1	Level 2
Byproduct and bycatch species	Level 2	Level 2^
Protected species	Level 2	Level 2^
Habitats	Level 2-	Level 2
Communities	Level 1	Level 2*

- no Level 2 assessment was conducted in 2019
*triggered but due to lack of methodology available in 2006 and ecosystem modelling projects underway in 2016 this component was not assessed at L2 in the ERA process.
^SAFE analysis was also performed on species 2007-2009 (Zhou 2011).

Table ES1.3. Key and secondary commercial species stock status, assessment and tier status, and ERA classification for NPF Banana prawn sub-fishery. NSTOF: Not subject to overfishing; NOF: Not overfished; OF: Overfished; UNC: uncertain. Primary: C1; Secondary: C2. ^: based on ABARES classification. ^^ based on stock assessment. MEY: Maximum Economic Yield.

COMMON NAME	SPECIES NAME	ERA CLASSIFICATION	FISHING MORTALITY^	BIOMASS^	STATUS^^	REFERENCE^^	YEAR LAST ASSESSED	TIER	COMMENTS
White banana prawn	*Penaeus merguiensis*	C1	NSTOF	NOF	No formal assessment; MEY trigger employed	-	-	-	-

Level 2 Results and Summary

PSA

Byproduct species: There were 14 byproduct invertebrate species considered in a PSA. Of these 14 species, none were high risk, four were medium risk and 10 were low risk.

Bycatch species: Of 67 invertebrate BC species, 49 were high risk, six medium risk and 12 low risk. A residual risk analysis was conducted on the 49 high risk species resulting in 44 species reduced to low risk and five species reduced to medium risk.

Of the 30 un-assessable SAFE species, 17 were high risk and 13 were medium risk. A residual risk analysis was performed on these 17 high risk species, resulting in all 17 species reduced to low risk. Therefore, there were no bycatch species classified as high risk.

Protected species: Of the 39 species, nine were high risk (one marine bird, six marine reptiles, two chondrichthyans), 29 medium risk (12 marine birds, 15 marine reptiles, two chondrichthyans) and one species low risk (one marine bird). Two of the nine high risk species remained high risk (narrow sawfish *Anoxypristis cuspidata*; dwarf sawfish *Pristis clavata*) and one species was reduced to low risk (Crested tern *Thalasseus bergii*), following a residual risk analysis (Table ES1.4). In addition, the two medium risk sawfish species increased their risk score to a precautionary high following a residual risk analysis: green sawfish (*Pristis zijsron*) and freshwater sawfish (*Pristis pristis*) (Table ES1.4).

bSAFE

Byproduct species: There was no SAFE performed for these species. Instead as a PSA was conducted.

Bycatch species: Of the 234 assessable SAFE species, none were extreme, high or medium risk and all 234 species were low risk.

Protected species: All three species were low risk.

Summary

A total of four chondrichthyans (protected sawfishes) species were evaluated at high risk following a residual risk analysis (Table ES1.4). These four protected species of sawfishes, i.e., green, narrow, freshwater and dwarf sawfishes, were classified at high risk, partly due to life history and vulnerability parameters, and small overlap of effort in this fishery. It should be noted that 55% of all sawfish interactions were reported under the family taxonomic classification, i.e., Pristidae – unidentified (308 alive plus 184 dead).

The six protected species of sea snakes were medium risk following a residual risk analysis partly due to (i) these being reported under the family taxonomic classification, i.e., Hydrophiidae – unidentified (5270 alive plus 1434 dead), (ii) relatively high post capture survival rates at the individual species level, (iii) low overlap with fishery operations, (iv) breeding occurring in shallower waters than trawl grounds and (v) flat standardized trends within the assessment period.

Table ES1.4. Extreme or high-risk PSA or bSAFE species following a preliminary residual risk (RR) analysis in the NPF Banana Prawn sub-fishery. x: preliminary risk score following RR analysis. #: un-assessable in bSAFE. CH: chondrichthyan; INV: invertebrate; MM: marine mammal; MB: marine bird. No. Missing: Number of missing attributes in PSA analysis. Grey shading: expanded species from group code. BC: bycatch; BP: byproduct; PS: Protected.

LEVEL 2 ANALYSIS	ERA CLASSIFICATION	TAXA	No. MISSING	SCIENTIFIC NAME	COMMON NAME	HIGH RISK
PSA	PS	CH	0	*Anoxypristis cuspidata*	Narrow sawfish	x
		CH	0	*Pristis clavata*	Dwarf sawfish	x
		CH	0	*Pristis zijsron*	Green sawfish	x
		CH	0	*Pristis pristis*	Freshwater sawfish	x

1 Overview

1.1 Ecological Risk Assessment for the Effects of Fishing (ERAEF) Framework

1.1.1 The Hierarchical Approach

The Ecological Risk Assessment for the Effects of Fishing (ERAEF) framework involves a hierarchical approach that moves from a comprehensive but largely qualitative analysis of risk at Level 1, through a more focused and semi-quantitative approach at Level 2, to a highly focused and fully quantitative "model-based" approach at Level 3 (Figure 1.1). This approach is efficient because many potential risks are screened out at Level 1, so that the more intensive and quantitative analyses at Level 2 (and ultimately at Level 3) are limited to a subset of the higher risk activities associated with fishing. It also leads to rapid identification of high-risk activities, which in turn can lead to immediate remedial action (risk management response). The ERAEF approach is also precautionary, in the sense that risks will be scored high in the absence of information, evidence or logical argument to the contrary.

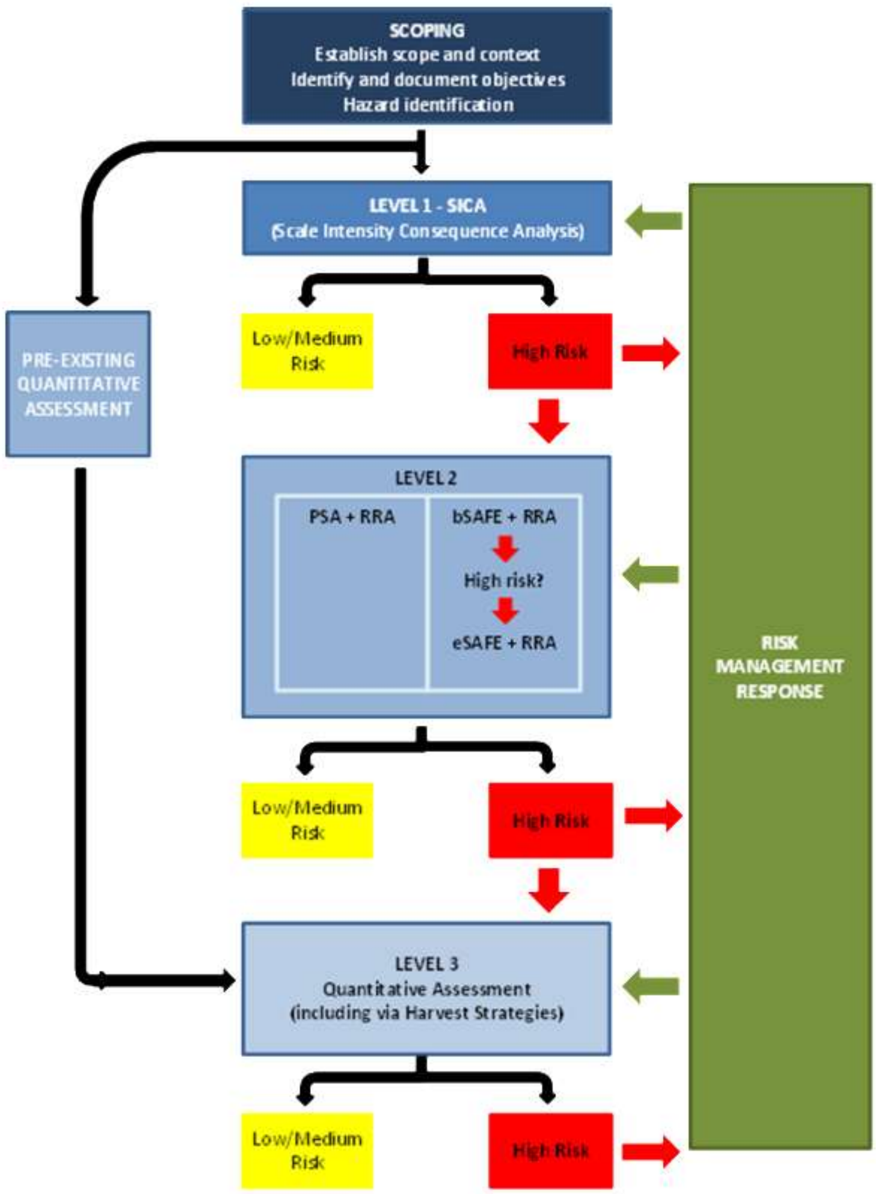


Figure 1.1. Structure of the 3 level hierarchical ERAEF methodology. SICA – Scale Intensity Consequence Analysis; PSA – Productivity Susceptibility Analysis; SAFE – Sustainability Assessment for Fishing Effects; RRA – Residual Risk Analysis. T1 – Tier 1. eSAFE may be used for species classified as high risk by bSAFE.

Conceptual Model

The approach makes use of a general conceptual model of how fishing impacts on ecological systems, which is used as the basis for the risk assessment evaluations at each level of analysis (Levels 1-3). For the ERAEF approach, five general ecological components are evaluated, corresponding to five areas of focus in evaluating impacts of fishing for strategic assessment under EPBC legislation. The five revised *components* are:

- Key commercial species and secondary commercial species
- Byproduct and bycatch species

- protected[1] species (formerly referred to as threatened, endangered and Protected[2] species or TEPs)
- Habitats
- Ecological communities

This conceptual model (Figure 1.2) progresses from *fishery characteristics* of the fishery or sub-fishery, → *fishing activities* associated with fishing and *external activities*, which may impact the five ecological components (target, byproduct and bycatch species, protected species, habitats, and communities); → *effects of fishing and external activities* which are the direct impacts of fishing and external activities; → *natural processes and resources* that are affected by the impacts of fishing and external activities; → *sub-components* which are affected by impacts to natural processes and resources; → *components*, which are affected by impacts to the sub-components. Impacts to the sub-components and components in turn affect achievement of management objectives.

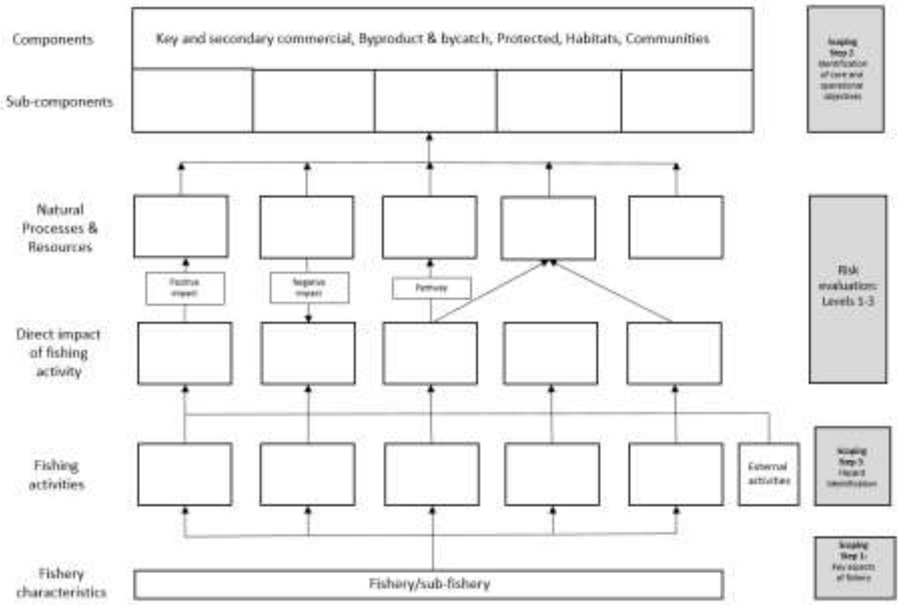


Figure 1.2. Generic conceptual model used in ERAEF.

The external activities that may impact the fishery objectives are also identified at the Scoping stage and evaluated at Level 1. This provides information on the additional impacts on the ecological components being evaluated, even though management of the external activities is outside the scope of management for that fishery.

[1] The term “protected species” refers to species listed under [Part 13] of the EPBC Act (1999) and replaces the term “Threatened, endangered and protected species (TEPs)” commonly used in past Commonwealth (including AFMA) documents.

[2] Note “protected” (with small “p”) refers to all species covered by the EPBC Act (1999) while “Protected” (capital P) refers only to those protected species that are threatened (vulnerable, endangered, or critically endangered).

The assessment of risk at each level considers current management strategies and arrangements. A crucial process in the risk assessment framework is to document the rationale behind assessments and decisions at each step in the analysis. The decision to proceed to subsequent levels depends on

- Estimated risk at the previous level
- Availability of data to proceed to the next level
- Management response (e.g. if the risk is high but immediate changes to management regulations or fishing practices will reduce the risk, then analysis at the next level may be unnecessary).

1.1.2 ERAEF stakeholder engagement process

A recognized part of conventional risk assessment is the involvement of stakeholders involved in the activities being assessed. Stakeholders can make an important contribution by providing expert judgment, fishery-specific and ecological knowledge, and process and outcome ownership. The ERAEF method also relies on stakeholder involvement at each stage in the process, as outlined below. Stakeholder interactions are recorded.

1.1.3 Scoping

In the first instance, scoping is based on review of existing documents and information, with much of it collected and completed to a draft stage prior to full stakeholder involvement. This provides all the stakeholders with information on the relevant background issues. Three key outputs are required from the scoping, each requiring stakeholder input.

1. <u>Identification of units of analysis</u> (species, habitats and communities) potentially impacted by fishery activities (Section 2.2.2; Scoping Documents S2A, S2B1, S2B2 and S2C1, S2C2).
2. <u>Selection of objectives</u> (Section 2.2.3; Scoping Document S3). The primary objective to be pursued for species assessed under ERAEF is that of ensuring populations are maintained at biomass levels above which recruitment failure is likely, as stated in Chapter 2 (ERM Guide; AFMA (2017)). This is consistent with current legislation and fisheries policies and represents a change from when the ERAEF was first developed and there was less policy or legislation-based guidance on sustainability objectives, with stakeholders able to choose from a range of “sustainability” objectives (e.g.: tables 5A-C in Hobday et al. 2007).
3. <u>Selection of activities</u> (hazards) (Section 2.2.4; Scoping Document S4) that occur in the sub-fishery is made using a checklist of potential activities provided. The checklist was developed following extensive review and allows repeatability between fisheries. Additional activities raised by the stakeholders can be included in this checklist (and would feed back into the original checklist). The background information and consultation with the stakeholders is used to finalize the set of activities. Many activities will be self-evident (e.g. fishing, which obviously occurs), but for others, expert or anecdotal evidence may be required.

1.1.4 Level 1. SICA (Scale, Intensity, Consequence Analysis)

The SICA analysis evaluates the risk to ecological components resulting from the stakeholder-agreed set of activities. Evaluation of the temporal and spatial scale, intensity, sub-component, unit of analysis, and credible scenario (consequence for a sub-component) should be prepared by the draft fishery ERAEF report author and reviewed at an appropriate stakeholder meeting (e.g. Resource Assessment Group meeting). Due to the number of activities (up to 24) in each of five components (resulting in up to 120 SICA elements), preparation before involving the full set of stakeholders may allow time and attention to be focused on the uncertain or controversial or high-risk elements. Documenting the rationale for each SICA element ahead of time for the straw-man scenarios is crucial to allow the workshop debate to focus on the right portions of the logical progression that resulted in the consequence score.

SICA elements are scored on a scale of 1 to 6 (negligible to extreme) using a "plausible worst case" approach (see ERAEF Methods Document for details; Smith et al. (2007)). Level 1 analysis potentially result in the elimination of activities (hazards) and in some cases whole components. Any SICA element that scores 2 or less is documented, but not considered further for analysis or management response.

1.1.5 Level 2. PSA and SAFE (semi-quantitative and quantitative methods)

When the risk of an activity at Level 1 (SICA) on a species component is moderate or higher and no planned management interventions that would remove this risk are identified, an assessment is required at Level 2 (to determine if the risk is real and provide further information on the risk). The tools used to assess risk at Level 2 allow units (e.g. all individual species) within any of the ecological species components (e.g. key/secondary commercial, byproduct/bycatch, and protected species) to be effectively and comprehensively screened for risk. The analysis units are identified at the scoping stage. To date, Level 2 tools have been designed to measure risk from direct impacts of fishing only (i.e., risk of overfishing, leading to an overfished fishery), which in all assessments to date has been the hazard with the greatest risks identified at Level 1[3].

In the period since the first ERAEF was implemented across Commonwealth fisheries, much of the management focus has been on the assessment results associated with Level 2 and Level 2.5 or 3 risk assessment methods, which comprise semi-quantitative or rapid simple quantitative methods (e.g. PSA and SAFE). This level has been subject to the greatest level of change and improvement which are discussed in the following sections. Additional improvements are being developed for implementation in the near future (see Chapter 4.13 of AFMA ERM Guide, AFMA 2017).

Level 2 was originally designed to rely on a single risk assessment methodology, the Productivity-Susceptibility Analysis (PSA) (see Chapter 4.8.3 of AFMA ERM Guide, AFMA 2017), however a more quantitative method called the Sustainability Assessment for Fishing Effects

[3] Future iterations of the methodology will include PSAs modified to measure the risk due to other activities, such as gear loss.

(SAFE) (see Chapter 4.8.4 of AFMA ERM Guide, AFMA 2017) was developed early in the implementation of the ERAEF and classed as a Level 2.5 or Level 3 tool.

Under the revised ERAEF:

- bSAFE has now been reclassified as the preferred Level 2 method (over PSA) where sufficient spatial and biological data (to support bSAFE) are available. Typically, this has been used for teleost and chondricthyan species.
- Species estimated to be at high risk under bSAFE may then be assessed under eSAFE which may provide reduced estimates of uncertainty pertaining to the actual risk.
- Where either the data or species biological characteristics are insufficient to support bSAFE analyses, it is recommended that PSA be applied instead. This will be the case for many protected species, invertebrate bycatch species and some other species.
- At Level 2, either PSA or SAFE methods should be applied to any given species, not both.
- For high-risk species it is a management choice whether to progress to eSAFE, pursue a Level 3 fully quantitative stock assessment, or to take more immediate management action to reduce the risk. The types of considerations required in making that choice (ie: moving up the ERAEF assessment hierarchy or taking direct management action) are outlined in Chapter 5.5 of the AFMA ERM Guide (AFMA, 2017).

It is also recognised that several additional tools, including some of the "data poor" assessment tools that are used to inform harvest strategies, could potentially be included within the Level 2 toolkit. They are distinguished from Level 3 quantitative tools (i.e., stock assessment models) that are more data rich and able to more precisely quantify uncertainty.

PSA (Productivity Susceptibility Analysis)

Details of the PSA method are described in the accompanying ERAEF Methods Document and also summarised in Section 4.8.3 of the AFMA ERM Guide (AFMA 2017). Stakeholders can provide input and suggestions on appropriate attributes, including novel ones, for evaluating risk in the specific fishery. Attribute values for many of the units (e.g. age at maturity, depth range, mean trophic level) can be obtained from published literature and other resources (e.g. scientific experts) without initial stakeholder involvement. Stakeholder input is required after preliminary attribute values are obtained. In particular, where information is missing, expert opinion can be used to derive the most "reasonable" conservative estimate. For example, if species attribute values for annual fecundity have been categorized as low, medium, or high on the set (<5, 5-500, >500), estimates for species with no data can still be made. Also, estimated fecundity of a broadcast-spawning fish species with unknown fecundity is still likely to be greater than the high fecundity category (>500). Susceptibility attribute estimates, such as "fraction alive when landed", can also be made based on input from experts such as scientific observers. Feedback to stakeholders regarding comments received during the preliminary PSA consultations is considered crucial. The final PSA is completed by scientists and results are presented to the relevant stakeholder group (e.g. RAG and/or MAC) before decisions regarding Level 3 analysis are considered. The stakeholder group may also decide on priorities for analysis at Level 3.

Residual Risk Analysis

There were several limitations due to the semi-quantitative nature of a Level 2 PSA assessment. For example, certain management arrangements which mitigate the risks posed by a fishery, as well as additional information concerning levels of direct mortality, may not be easily taken into account in assessments. To overcome this, Residual risk analyses (RRA) are used to consider additional information, particularly mitigating effects of management arrangements that were not explicitly included in the ERAs or introduced after the ERA process commenced. Priority for this process has typically been focused on those species attributed a high-risk rating (those likely to be most at risk from fishing activities). It could in theory be used to also determine if some species have been incorrectly classified as low risk.

Recently revised Residual risk guidelines have been developed (see below) to assist in making accurate judgments of residual risk consistently across all fisheries. At the moment, they are applied to species and not applicable to habitats or communities.

These guidelines are not seen as a definitive guide on the determination of residual risk, and it is expected they may not apply in a small number of cases. Care must also be taken when applying them to ensure residual risk results are appropriate in a practical sense. There are several conditions which underpin the residual risk guidelines and should be understood before the guidelines are applied:

- All assessments and management measures used within the residual risk assessment must be implemented prior to the assessment with sufficient data to demonstrate the effect. Any planned or proposed measures can be referred to in the assessment but cannot be used to revise the risk score.
- When applied, the guidelines generally result in changes to particular "attribute" scores for a particular species. Only after all the guidelines have been applied to a particular species, should the overall risk category be re-calculated. This will ensure consistency, as well as facilitating the application of multiple guidelines.
- Unless there is clear and substantiated information to support applying an individual guideline, then the attribute and residual risk score should remain unchanged. All supporting information considered in applying these Guidelines must be clearly documented and referenced where applicable. This is consistent with the precautionary approach applied in ERAs, with residual risk remaining high unless there is evidence to the contrary ensuring a transparent process is applied.

The results (including supporting information and justifications) from residual risk analyses must be documented in “Residual Risk Reports” for each fishery (or can be integrated into the Level 2 risk assessment report). These will be publically available documents.

SAFE (Sustainability Assessment for Fishing Effects)

The SAFE method developed is split into two categories: base SAFE (bSAFE) and an enhanced SAFE (eSAFE). eSAFE has greater data processing requirements and is recommended to only be used to assess species estimated to be at high risk via the bSAFE. It is also able to more appropriately model spatial availability aspects when sufficient data are available.

bSAFE

Relative to the PSA approach, the bSAFE approach (Zhou and Griffiths, 2008; Zhou et al. 2011):

- is a more quantitative approach (analogous to stock assessment) that can provide absolute measures of risk by estimating fishing mortality rates relative to fishing mortality rate reference points (based on life history parameters),
- requires less productivity data than the PSA,
- can account for cumulative risk and
- potentially outperforms PSA in several areas, including strength of relationship to Tier 1 assessment classifications (Zhou et al. 2016).

Like PSA, the bSAFE method is a transparent, relatively rapid and cost-effective process for screening large numbers of species for risk, and is far less demanding of data and much simpler to apply than a typical quantitative stock assessment.

As such it is recommended that bSAFE be used as the preferred Level 2 assessment tool for all fish species and some invertebrates and reptiles (eg: some sea snakes) with sufficient data.

In estimating fishing mortality, bSAFE utilises much of the same information as the PSA, to estimate:

- Spatial overlap between species distribution and fishing effort distribution,
- Catchability resulting from the probability of encountering the gear and size-dependent selectivity and
- Post-capture mortality.

The fishing mortality is essentially the fraction of overlap between fished area and the species distribution area within the jurisdiction, adjusted by catchability and post-capture mortality. Uncertainty around the estimated fishing mortality is estimated by including variances in encounterability, selectivity, survival rate and fishing effort between years.

The three biological reference points are based on a simple surplus production model:

- **F_{MSY}** – 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. The latter is the maximum sustainable fishing mortality (MSM) at B_{MSM}, as with target species MSY.
- **F_{LIM}** – instantaneous fishing mortality rate that corresponds to the limit biomass B_{LIM} where B_{LIM} is a assumed to be half of the biomass that supports a maximum sustainable fishing mortality ($0.5B_{MSM}$)
- **F_{CRASH}** – minimum unsustainable instantaneous fishing mortality rate that, in theory, will lead to population extinction in the long-term.

This methodology produces quantified indicators of performance against fishing mortality-based reference points and as such does allow calibration with other stock assessment and risk assessment tools that measure fishing mortality. It allows the risk of overfishing to be determined, via the score relative to the reference line. Uncertainty (error bars) are related to the variation in the estimation of the scores for each axis.

It is recommended that species assessed as being potentially at high risk under bSAFE are then progressed to analysis by eSAFE which can narrow uncertainties around the risk (but is more time and resource intensive than bSAFE).

Assumptions and issues to be aware of:

- Comparisons of PSA and SAFE analyses for the same fisheries and species support the claim that the PSA method generally avoids false negatives but can result in many false positives. Limited testing of SAFE results against full quantitative stock assessments suggests that there is less “bias” in the method, but that both false negatives and false positives can arise.
- SAFE analyses retain some of the key precautionary elements of the PSA method, including assumptions that fisheries are impacting local stocks (within the jurisdictional area of the fishery).
- Although the bSAFE analyses provide direct estimates of uncertainty in both the exploitation rate and associated reference points, they are less explicit about uncertainties arising from key assumptions in the method, including spatial distribution and movement of stocks.
- The method assumes there would be no local depletion effects from repeat trawls at the same location (ie: populations rapidly mix between fished and unfished areas). The fishing mortality will likely be overestimated if this assumption is not satisfied (ERA TWG 2015)[4].
- The method also assumes that the mean fish density does not vary between fished area and non-fished area within their distributional range. Hence, the level of risk would be over-estimated for species found primarily in non-fished habitat, while risk would be under-estimated for species that prefer fished habitat (ERA TWG 2015).
- The SAFE methodology makes greater assumptions than Tier 1 stock assessments in coming to its F estimates (due to a lack of the data relative to that used in a Tier 1 assessment) and it is not capable of measuring risk of a stock being already overfished (so the type of risk it measures relates only to overfishing, which may then lead to future overfished state). The limitations of SAFE with respect to measuring overfished risks are the same essentially as for PSA.

eSAFE

Enhanced SAFE (eSAFE) appears, based on calibration with Level 3 assessments, to provide improved estimates of fishing mortality relative to the base SAFE (bSAFE) method. The eSAFE requires more spatially explicit data and takes more analysis time than bSAFE, and so might only be used to further assess species that were identified as at high risk using bSAFE (and which have not had further direct management action taken). The eSAFE enhances the bSAFE method by estimating varying fish density across their distribution range as well as species- and gear-specific catch efficiency for each species.

[4] ERA Technical Working Group, September 2015

1.1.6 Level 3

This stage of the risk assessment is fully quantitative and relies on in-depth scientific studies on the units identified as at medium or greater risk in the Level 2. It will be both time and data intensive. Individual stakeholders are engaged as required in a more intensive and directed fashion. Results are presented to the stakeholder group and feedback incorporated, but live modification is not considered likely.

1.1.7 Conclusion and final risk assessment report

The conclusion of the stakeholder consultation process has resulted in a final risk assessment report for the individual fishery according to the ERAEF methods. It is envisaged that the completed assessment will be adopted by the fishery management group and used by AFMA for a range of management purposes, including to address the requirements of the EPBC Act as evaluated by Department of Agriculture, Water and the Environment (DAWE).

1.1.8 Subsequent risk assessment iterations for a fishery

The frequency at which each fishery must revise and update the risk assessment is not fully prescribed. As new information arises or management changes occur, the risks can be re-evaluated, and documented as before. The fishery management group or AFMA may take ownership of this process, or scientific consultants may be engaged. In any case the ERAEF should again be based on the input of the full set of stakeholders and reviewed by independent experts familiar with the process.

Fishery re-assessments for byproduct and bycatch species under the ERAEF will be undertaken every five years[5] or sooner if triggered by re-assessment triggers. The five-year timeframe is based on a number of factors including:

- The time it takes to implement risk management measures; for populations to respond to those measures to a degree detectable by monitoring processes; and to collect sufficient data to determine the effectiveness of those measures.
- Alignment with other management and accreditation processes.
- The cost of re-assessments.
- The review period for Fisheries Management Strategy (FMS).

For byproduct and bycatch species, in the periods between scheduled five-year ERA reviews[6], AFMA will develop and monitor a set of fishery indicators and triggers, on an annual basis, so

[5] Based on a recommendation by the ERA Technical Working Group, September 2015.

[6] In contrast to key and secondary commercial species managed via catch/effort limits under Harvest Strategies, which depending on species and Harvest Strategy, can be re-assessed any time between 1 and 5 years.

as to detect any changes (increase or decrease) in the level of risk posed by the fishery to any species. Where indicators exceed specified trigger levels, AFMA will investigate the causes and provide opportunity for RAG comment/advice during that process. Pending outcomes of that review, and RAG advice, AFMA can if necessary, request a species specific or full fishery re-assessment (i.e., prior to the scheduled re-assessment dates).

The ERA TWG (September 2015) identified five key indicators upon which such triggers could be based, these being changes in:

- Gear type/use
- Mitigation measures (use or type)
- Area fished
- Catch or interaction rate
- Fishing effort

Where possible, the triggers should consider additional sources of risk from interacting non-Commonwealth fisheries. In addition, if a major management change is planned for a fishery, such as a move from input to output controls, the fishery will need to be reassessed prior to that management change coming into effect. In considering each indicator and trigger level, the RAG should consider the following:

- The data upon which the indicator is based must be sufficiently representative of actual changes in catch, effort, area, gear, or mitigation methods. Consideration should be given to the level of uncertainty associated with the data underpinning any prospective indicator.
- The trigger level chosen should not be overly sensitive to the normal inter-annual variance that is typical of the indicator and independent of fishing pressure, assuming such variance is unlikely to relate to a significant change in the risk posed by the fishery to any or all species.
- The trigger level should equate to the minimum level of change that the RAG (by its expert opinion) considers might potentially represent a significant change in the risk posed by the fishery.
- The trigger level could represent an absolute change (number/level) in an indicator or a percentage change in an indicator.
- The RAG should consider whether a "temporal" condition should be placed on the trigger (i.e. the trigger is breached 2 years in a row) to further reduce the likelihood of natural population variance or data errors triggering a re-assessment unnecessarily.

The final set of indicators and triggers will be developed for each fishery by AFMA in consultation with its fishery RAG (or for fisheries lacking a RAG, the ERA TWG), in association with the next planned re-assessment (see Table 8 in AFMA ERM Guide, AFMA (2017)). A RAG may choose a subset of these indicators and triggers or include an additional indicator/trigger(s), based on consideration of the availability and reliability of data upon which to base any of the above indicators/triggers, however justification of this must be provided.

Research is currently underway to develop specific guidance for RAG to aid in the selection of appropriate triggers, which will in the meantime be determined using RAG expert opinion. In the longer term it may be possible to refine indicators and triggers using the existing PSA and SAFE methods to test which attributes the end risk scores are most sensitive to (ERA TWG 2015)[7]. The RAG will record both the final set of indicators and triggers chosen, and a justification for those, in the RAG minutes. Once the final set of indicators and triggers is determined for a fishery, they will require implementation within the FMS and a monitoring and review process.

[7] ERA TWG recommendation, September 2015

2 Results

The focus of analysis is the fishery as identified by the responsible management authority. The assessment area is defined by the fishery management jurisdiction within the Australian Fisheries Zone (AFZ). The fishery may also be divided into sub-fisheries based on fishing method and/or spatial coverage. These sub-fisheries should be clearly identified and described during the scoping stage. Portions of the scoping and analysis at Level 1 and beyond are specific to a particular sub-fishery. The fishery is a group of people carrying out certain activities as defined under a management plan. Depending on the jurisdiction, the fishery/sub-fishery may include any combination of commercial, recreational, and/or indigenous fishers.

The results presented below are for the Northern Prawn Banana Prawn sub-fishery. A full description of the ERAEF method is provided in the methodology document (Hobday et al. 2007; Hobday et al. 2011b). This fishery report contains figures and tables with numbers that correspond to this methodology document. Thus, table and figure numbers within this fishery ERAEF report are not sequential, as not all figures and tables are relevant to the fishery risk assessment results.

2.1 Stakeholder Engagement

Table 2.1. Summary Document SD1. Summary of stakeholder involvement for sub-fishery: NPF Banana Prawn sub-fishery.

FISHERY ERA REPORT STAGE	TYPE OF STAKEHOLDER INTERACTION	DATE OF STAKEHOLDER INTERACTION	COMPOSITION OF STAKEHOLDER GROUP (NAMES OR ROLES)	SUMMARY OF OUTCOME
Scoping	Phone calls and emails	April 2019	Stephen Eves and David Power (AFMA)	Scoping doc
Species list and Level 1 results	NPF RAG	June 2019	AFMA, Industry, scientific members and participants	Species list and Level 1 results presented
Draft report	NPF RAG	November 2019	Submitted to NPF RAG	
Draft report	NPF RAG	November 2019	AFMA, Industry, scientific members and participants	Level 1 and Level 2 results presented
Draft report	Video meetings and emails	September - November 2020	AFMA, Industry, scientific members and participants	Draft report feedback
Final draft report	NPF RAG	December 2020	AFMA, Industry, scientific members and participants	Presented overall results
Submitted updated risk scores following review	NPF RAG	12 May 2021	AFMA, Industry, scientific members and participants	Presented updated results following reviews
Final report	NPF RAG	29 June 2021	AFMA	Submitted final report
Final report	Meeting	20 August 2021	AFMA	Updated report following AFMA's review. Submitted final report

2.2 Scoping

The aim in the Scoping stage is to develop a profile of the fishery being assessed. This provides information needed at stakeholder meetings and to complete Levels 1 and 2. The focus of analysis is the fishery, which may be divided into sub-fisheries based on fishing method and/or spatial coverage. Scoping involves six steps:

Step 1. Document the general fishery characteristics
Step 2. Generating "unit of analysis" lists (species, habitat types, communities)
Step 3. Selection of objectives
Step 4. Hazard identification
Step 5. Bibliography
Step 6. Decision rules to move to Level 1

2.2.1 General Fishery Characteristics (Step 1).

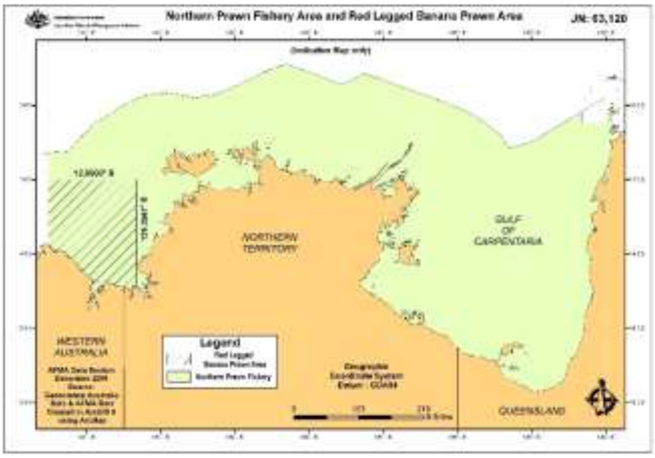
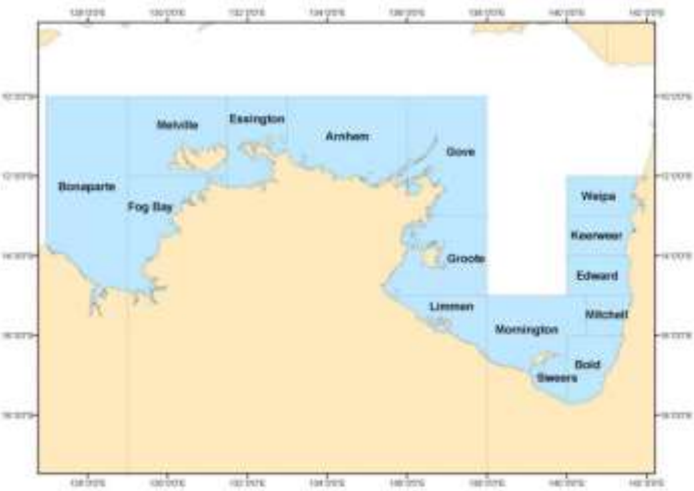
The information used to complete this step came from a range of documents such as the Fishery's Management Plan, Assessment Reports, Bycatch Action Plans, and any other relevant background documents.

Scoping Document S1 General Fishery Characteristics

Fishery Name: Northern Prawn Fishery: Banana Prawn sub-fishery
Assessment date: April 2019
Assessor: AFMA and authors of this report (CSIRO)

Table 2.2. General fishery characteristics. Note: information in this scoping document is identical to the Banana Prawn sub-fishery ERA assessment (Sporcic et al. 2019). Relevant information is separated by sub-fishery where applicable (e.g. catch and effort statistics, protected species interactions).

GENERAL FISHERY CHARACTERISTICS	
Fishery Name	Northern Prawn Fishery (NPF)
Sub-fisheries	Three spatially and temporally distinct demersal trawl fisheries exist: the White Banana Prawn, Redleg Banana Prawn and the Tiger Prawn sub-fisheries. The gear and fishing technique employed by each fishery is similar, with the exception that the headrope height of White Banana Prawn sub-fishery nets is generally higher than Redleg Banana Prawn/tiger prawn nets. 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 (banana, tiger, endeavour, and king prawns) when a vessel is defined as fishing in the banana prawn sub-fishery. Tiger prawn fishery catch is the catch of all species when a vessel is defined as operating in the tiger prawn fishery. The banana prawn sub-fishery is further split into the White Banana Prawn and Redleg Banana Prawn sub-fisheries based on the spatial extent of each species. Redleg Banana Prawns are caught almost exclusively in deep water (>45 metres) in the Joseph Bonaparte Gulf (JBG) and White Banana Prawns elsewhere (Dichmont et al. 2001). A JBG 'box' (129.3567°E, 12°S) is used to delineate the Redleg Banana Prawn sub-fishery from the White Banana Prawn sub-fishery (see map below).
Sub-fisheries assessed	Banana Prawn sub-fishery
Start date/ history	The fishery was discovered (principally for banana prawns) in 1964, logbooks were introduced in 1969 and the fishery since managed as a Commonwealth fishery. Catch and effort data and all interactions with protected species are recorded on a shot-by-shot basis reported daily by lat/long. Fishing effort peaked in 1981 at a level that exceeded the long-term sustainable yield of the resource with 286 vessels in the fishery reporting a total of 43419 fishing days. Effort has decreased to be reported from 52 vessels and 7418 fishing days in 2017. It is generally accepted that fishing effort

	was severely under-reported from around 1978 to the early 1980's, when completion of logbooks was voluntary. Since the early 1980's logbook coverage of the fishery has been virtually 100% (Dichmont et al. 2014).
Geographic extent of fishery	  The management area of the NPF covers over 771000 square kilometres off Australia's northern coast, from Cape Londonderry in Western Australia to Cape York in Queensland. The area actively fished within this is much smaller (around 220 000 square kilometres) and the fishery is regarded as having two components: a banana prawn fishery and a tiger prawn fishery.
Regions or Zones within the fishery	The NPF is partitioned into 15 statistical zones for the purpose of reporting of catch and effort in the NPF (Laird, 2018): 
Fishing season	The fishery has two seasons: • Season 1 (mainly banana prawns caught): 1 April – 15 June (season end date depends on catch rates) • Season 2 (mainly tiger prawns caught): 1 August – 30 November (season end date depends on catch rates).
Key/secondary commercial species and stock status	The Northern Prawn Fishery (NPF) uses otter trawl gear to target a range of tropical prawn species. White Banana Prawn and two species of tiger prawn (Brown and Grooved) account for around 80 per cent of the landed catch. Other species

include endeavour prawns, scampi (*Metanephrops* spp.), bugs (*Thenus* spp.) and saucer scallops (*Amusium* spp.) (Patterson et al. 2017).

Table 1: Status of the Northern Prawn Fishery (Patterson et al. 2017)

Status	2015		2016	
Biological status	**Fishing mortality**	**Biomass**	**Fishing mortality**	**Biomass**
Redleg Banana Prawn (*Penaeus indicus*)				
White Banana Prawn (*Penaeus merguiensis*)				
Brown Tiger Prawn (*Penaeus esculentus*)				
Grooved Tiger Prawn (*Penaeus semisulcatus*)				
Blue Endeavour Prawn (*Metapenaeus endeavouri*)				
Red Endeavour Prawn (*Metapenaeus ensis*)				

Fishing mortality	Not subject to overfishing	Subject to overfishing	Uncertain
Biomass	Not overfished	Overfished	Uncertain

Banana prawn sub-fishery

There is currently no formal stock assessment for White Banana Prawns. As recruitment varies markedly with environmental conditions no clear stock-recruitment relationship has been determined (Buckworth et al. 2013). Analyses are complicated by the highly variable CPUE data which result from the schooling behaviour of the species. The fishery is presently 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 sub-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 White Banana Prawn sub-fishery is resilient.

Management of the White Banana Prawn sub-fishery has in recent years included a catch rate trigger. The MEY trigger is variable and calculated in-season, based on information provided by industry on prawn prices and fuel costs.

Tiger Prawn sub-fishery

Table 2: Northern Prawn Fishery stock assessment indices

Year	2012	2013	2014	2015	2016	2017
Status *S(moving average over 5 years)/S_{MSY}*						
Tiger Prawns (Grooved)	116%	123%	Not assessed	114%	Not assessed	135%
Tiger Prawns (Brown)	116%	118%	Not assessed	122%	Not assessed	131%
Blue Endeavour	91%	94%	Not Assessed	76%	Not Assessed	67%
Effort (boat days)						
TAE Total Tiger prawns	5948	6661	6645	6041	8305	8300
TAE Tiger Prawns (Grooved)	2777	3781	3868	4840	3024	4042
% Grooved Tiger Prawns TAE/TAE total	46.69	56.76	58.21	80.12	36.41	48.70
TAE Tiger Prawns (Brown)	3171	2880	2777	1201	5281	4258
% Brown Tiger Prawns TAE/TAE total	53.31	43.24	41.79	19.88	63.59	51.30
NOMINAL effort (estimated)	4072	4176	3733	4840	3868	3494

Tiger Prawns (Grooved)						
NOMINAL effort (estimated) Tiger Prawns (Brown)	1324	1789	1395	1201	2092	1397
Total NOMINAL Effort (estimated) Tiger prawns	5396	5965	5128	6041	5960	4891

Grooved Tiger Prawns

In all scenarios tested, the Grooved Tiger Prawn stock abundance was under SMSY, ranging from 69% to 84%, at the end of 2017. Furthermore, effort in 2017 was below that at EMSY. The five-year average abundances were all above 100% of SMSY, and thus well above the reference point, 0.5 SMSY. Grooved Tiger Prawns are therefore considered not overfished, and overfishing is not occurring.

Brown Tiger Prawns

The Brown Tiger Prawn stock in 2017 ranged from 69% to 79% of SMSY in all scenarios tested. The five-year average abundances were all above 100% of SMSY, and thus well above the reference point, 0.5 SMSY. Therefore, the resource is considered not overfished. Effort in 2017 was well below that at EMSY. Overfishing is therefore not occurring.

Blue Endeavour Prawns

Blue Endeavour Prawns are considered a byproduct and are 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 sensitivity tests tested, the stock abundance was under SMSY at the end of 2017 (41% to 62 %). The five-year average abundance estimate ranged from 67% to 94% of SMSY.

Red Endeavour Prawns

Red Endeavour Prawns are considered a byproduct and are not considered to be over-fished relative to the target reference point of 0.5 SMSY (based on a 5-year moving average). In the 4 species test, the stock abundance was under SMSY at the end of 2017 (84%). The five-year average abundance is estimated to be 101% of SMSY. This is a preliminary result.

Bait collection and usage

No bait is used as the Northern Prawn Fishery (NPF) uses otter trawl gear to target prawns.

Current entitlements

Fishers must hold a valid boat fishing right to fish in this fishery. Fishers also need to have gear fishing rights that allow them to use a certain amount of net to catch fish in the fishery. These fishing rights are transferable to others.

In the fishery there are currently:

- 52 boat fishing rights (maximum number of vessels active at one time)
- 35 479 gear fishing rights.

Gear fishing rights entitle the holder to use a net with a certain headrope and footrope length. A gear right for operators using:

- two nets is currently worth 9 cm of headrope length
- three or four nets has a value of 8.1 cm per gear right.

Quota Year	No. Licence holders	No. Boat SFRs	No. Gear SFRs	No. active operators	No. inactive operators
2012	23	52	35 479	52	0
2013	22	52	35 479	52	0
2014	22	52	35 479	52	0
2015	22	52	35 479	52	0
2016	22	52	35 479	52	0
2017	22	52	35 479	52	0

Current and recent TACs, quota trends by method

There are no TACs in the NPF. The NPF is managed through a series of input controls, including limited entry to the fishery, individual transferable effort units, gear restrictions (limit on the total length of headrope) (NPF Fishing Capacity Determination No. NPFGD 07), byproduct restrictions (catch limits on certain teleost species, mud crabs, rock lobsters, and tuna) (NPF Direction No. 172), and a system of seasonal (NPF Direction No. 171) and spatial closures (NPF Direction No. 169).

Current and recent fishery effort trends by method

Year	No. of vessels	Tiger Prawn sub-fishery effort (days)	White Banana Prawn sub-fishery effort (days)
2008	53	4889	3347
2009	55	7741	3095
2010	52	4898	3146
2011	55	4143	3440
2012	52	5521	2526
2013	52	5908	2005
2014	52	5045	3100
2015	52	6036	2197
2016	52	5900	1980
2017	52	4716	2702

Current and recent fishery catch trends by method

Year	Tiger prawn (t)	White Banana Prawn (t)
2008	1021	5816
2009	1250	5881
2010	1628	5642
2011	749	7141
2012	1203	4901
2013	2215	3050
2014	1708	6330
2015	3186	3852
2016	2158	2904
2017	1087	5069

Current and recent value of fishery ($)

The most recent gross value of production of the NPF was estimated to be around $124 million in 2016. The value of the White Banana Prawn sub-fishery has gradually increased in recent years from a low at $37.9 million in 2013. Gross value trends over recent years in the White Banana Prawn sub-fishery are shown in the following Table.

Year	Tiger Prawn sub-fishery effort (days)	GVP (million $)	Banana Prawn sub-fishery effort (days)	GVP (million $)
2012	5521	26.0	2526	42.9
2013	5908	40.6	2005	37.9
2014	5045	34.8	3100	69.1
2015	6036	74.9	2197	62.9
2016	5900	46.1	1980	41.0
2017	4716	Not available	2702	62.1

Relationship with other fisheries

The NPF borders or shares common waters with international, Commonwealth, State, and recreational fisheries.

Commonwealth fisheries - Torres Strait Prawn Fishery, Eastern Tuna and Billfish Fishery, Western Tuna and Billfish Fishery, Northwest Slope Trawl, Western Deepwater Trawl.

WA fisheries - Kimberley Prawn Fishery, Kimberley Gillnet and Barramundi Fishery, Northern Demersal Scalefish Fishery, Mackerel Fishery

NT fisheries - Mud Crab Fishery, Coastal Line Fishery, Timor Reef Fishery, Demersal Fishery, Spanish Mackerel Fishery, Barramundi Fishery, Trepang Fishery, Coastal Net Fishery, Bait Net Fishery, Mollusc Fishery, Offshore Net and Line Fishery, Pearl Oyster Fishery

Qld fisheries – Blue Swimmer Crab Fishery, Coral Fishery, Coral Reef Fin Fish Fishery, Crayfish and Rocklobster Fishery, East Coast Inshore Fin Fish Fishery, East Coast Otter Trawl Fishery, East Coast Pearl Fishery, East Coast Spanish Mackerel Fishery, Gulf of Carpentaria Developmental Fin Fish Trawl Fishery, Gulf of Carpentaria Inshore Fin Fish Fishery, Gulf of Carpentaria Line Fishery, Marine Aquarium Fish Fishery, Mud Crab Fishery, Rocky Reef Fin Fish Fishery, Sea Cucumber Fishery (East Coast), Spanner Crab Fishery, Trochus Fishery

	Recreational fisheries – Recreational fishers use hand-held seine or bait nets of restricted sizes for catching prawns in both Queensland and the Northern Territory in the NPF area. Operators and management regard the interaction of these fisheries as insignificant. *Aquaculture* - Licensed aquaculturalists contract vessels operating within the NPF managed region, but not exclusively NPF operators, to trawl for gravid prawns for use in the aquaculture industry. This is permitted under an OCS agreement between the Commonwealth, Northern Territory and Queensland governments.
GEAR	
Fishing methods and gear	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 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) and relevant Determinations and Directions. In recent years, many vessels have transitioned from using twin gear to mostly using a quad rig comprising four trawl nets—a configuration that is more efficient. In addition to the main nets, a small 'try-net' is also used to test the potential catches for a given area. Most of the vessels in the NPF are purpose built from steel and range in length from 17 m to 30 m. All NPF boats have modern and sophisticated catch handling, packing and freezing capabilities as well as wet (brine) holding facilities. All vessels use electronic aids such as colour echo sounders, Global Positioning Systems (GPS) and plotters. Satellite phones and fax equipment are used by most vessels and most have introduced on-board computing facilities, electronic logbooks and Wi-Fi. All vessels are required to have a Vessel Monitoring System (VMS) installed. The most common NPF vessel length in 2017 was between 22.0-22.9 m. Total tiger prawn headrope increased slightly from 1524.17 fathoms (2.79km) in 2016 to 1542.36 fathoms (2.82km) in 2017 (Figure 9). The mean headrope length in 2017 was 29.66 fathoms (54.2 m) compared with 29.31 fathoms (53.6 m) in 2016 and 31 fathoms (56.7m) the most common headrope length in 2017 (Laird 2018).
Fishing gear restrictions	Fishers must hold a valid boat fishing right to fish in this fishery. Fishers also need to have gear fishing rights that allow them to use a certain amount of net to catch fish in the fishery. These fishing rights are transferable to others (the Management Plan). In the fishery there are currently: • 52 boat fishing rights (maximum number of vessels active at one time) • 35 479 gear fishing rights. Gear fishing rights entitle the holder to use a net with a certain headrope and footrope length. A gear right for operators using: • two nets is currently worth 9 cm of headrope length • three or four nets has a value of 8.1 cm per gear right. Since 2000 each net on a vessel is required to have an approved Turtle Excluder Device (TED) and a Bycatch Reduction Device (BRD) installed. In 2016 NPF fishers commenced trial of new BRD designs with the goal of further reducing bycatch by an additional 30%. There was progress over 2016-17 and by 2018 fishers had successfully trialled BRD designs that reduced bycatch by over 30%.
Selectivity of fishing methods	Although the trawl net mesh size is designed to be selective for prawns, trawling is an indiscriminate fishing method, which can capture organisms of various sizes, motile or sessile, which are in the path of the net. Tiger prawn trawling generally occurs close to the substratum and as a result selectivity of prawns is low and bycatch is high. Selectivity in the White Banana Prawn sub-fishery is much higher than the Redleg Banana and Tiger Prawn sub-fisheries due to fishers targeting prawn aggregations.
Spatial gear zone set	About 75% of the NPF fishing effort occurs within the neritic zone in the Gulf of Carpentaria between about 5-50 nm from shore. Along the Arnhem coast and Joseph Bonaparte Gulf trawling takes place in deeper water and the gear is deployed about 10- 50 nm from the coast.
Depth range gear set	In the Gulf of Carpentaria trawling takes place between 17-47 m, while along the Arnhem coast and the Joseph Bonaparte Gulf trawling takes place in 47-70 m.
How gear set	The trawl gear in the Tiger Prawn sub-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. In the White Banana Prawn sub-fishery, the trawl gear is generally only deployed once a prawn aggregation or 'mark' is located on the echo sounder. The gear is fished within about 5 m from the seabed, towed at an average of 3.2 knots and the trawl duration is less than 1 hour. It is believed that prawn aggregations are caught or dissipate within the first 2-3 weeks of the season and some operators change gear to then target tiger prawns. Trawling in this fishery is permitted during day and night.
Area of gear impact per set or shot	Fleet-wide, the average swept area performance in 2017 was estimated to be 28 hectares per hour (increased by 3% compared to 2016), the largest in the history of the fishery. Greater average swept area performance in the last seven

	years may be explained, in part, by more boats towing quad rig (most using bison boards), as well as the uptake by some fishers of a greater headline length allowance (approximately 8%) for the second season of 2011.
Capacity of gear	Net size in all sub-fisheries is restricted by the number of SFR gear units held by the operator, which controls the length of headrope permitted. Most nets have a capacity to retain about 1 tonne, meaning the total capacity of a single trawl shot using a twin gear configuration is about 2 tonnes and a quad configuration is about 4 tonnes.
Effort per annum all boats	Logbook entries are only required daily, where 3-4 shots are usually made. Therefore, the total number of trawls made in 2017 combined for all boats in the Tiger Prawn sub-fishery is about 14148 assuming an average of 3 shots per day of effort; and the total number of trawls made in 2017 combined for all boats in the White Banana Prawn sub-fishery is about 10,808 assuming an average of 4 shots per day effort.
Lost gear and ghost fishing	Trawl gear loss occurs mainly by the gear becoming bogged in soft sediments or excessively large catch weights. These occurrences are generally rare, less than about 5 occurrences per year. Lost gear is usually attempted to be retrieved. Small patches of net are sometimes lost, but again this is minimal. If lost, the net probably has minimal impact on marine communities, particularly TEP species, since the net generally sinks and remains on the substrata. A recent survey showed that ghost nets washed ashore in the NPF originated from Indonesian and Taiwanese fishers, while 7% could be identified as material used by Australian prawn operators.
ISSUES	
Key/secondary commercial species issues and Interactions	**White banana prawn** Recruitment for all species is variable, particularly for White Banana Prawn, in which recruitment is closely associated with rainfall. Therefore, no B_{MEY} target is defined for White Banana Prawn. Instead, an MEY-based catch-rate trigger, with mechanisms in place to adjust total annual effort levels to ensure that the fishery remains sustainable and profitable, was implemented for the 2014 banana prawn season, and continues to be in place during 2018. The environmentally driven variability of the White Banana Prawn means that a robust stock–recruitment relationship cannot be determined. Because annual yields are largely dependent on annual recruitment, it has not been possible to develop a stock assessment for White Banana Prawn. To explore the possibility of implementing total allowable catches for the fishery, CSIRO modelled the relationship between historical catch and rainfall, to investigate whether it is possible to predict the next year's catch based on the most recent wet-season rainfall. Unfortunately, large uncertainties remain because in some years the model cannot accurately predict catch levels, particularly in recent years (Buckworth et al. 2013). **Redleg banana prawn** Very low levels of effort occurred for Redleg Banana Prawns in the 2015 and 2016 seasons in Joseph Bonaparte Gulf, and levels of catch were consequently very low. Catch rates were also low but were poorly sampled because of the low effort. The stock assessment relies heavily on fishery-dependent catch and catch rates; for both 2015 and 2016, the model was not able to provide reliable estimates of stock status. **Red endeavour prawn** Until recently attempts had been made to assess red endeavour prawn with no reliable assessment available to determine stock status. Catches during recent years have been quite low compared with historical highs. This is most likely related to the overall decline in fishing effort directed at tiger prawn rather than any indication of a fall in red endeavour prawn biomass. In 2018, red endeavour prawns were included in the tiger prawn assessment model as a sensitivity test. Red Endeavour Prawns are considered a byproduct, and are not considered to be overfished relative to the limit reference point of 0.5 S_{MSY} (based on a 5-year moving average). In the 2018 assessment model, the stock abundance was under S_{MSY} at the end of 2017 (84%). The five-year average abundance is estimated to be 101% of S_{MSY}. This is a preliminary result.
Byproduct and bycatch issues and interactions	The main byproduct species in the NPF are squid (a mixture of mitre squid, north-west pink squid and northern calamari *Sepioteuthis lessoniana*), slipper lobster (bugs), scallops (*Amusium pleuronectes*), cuttlefishes, Scampi (*Metanephrops* spp.) and some larger fish species. Since 1993, a small number of vessels in the NPF have been opportunistically targeting squid. There is a 500 tonne catch trigger limit for squid. In 2017 the squid catch was 11 t. Currently there is little understanding of the species composition of the squid catch and their basic biology and distribution. A similar problem exists with bugs where approximately 110 t were taken by the NPF in 2016, exceeding the 100-t limit, triggering a review of survey and logbook data. The NPF Resource Assessment Group reviewed the data and advised that the data indicates that bugs are not being targeted and are an incidental byproduct and there does not appear to be a downward trend in abundance. Due to the indiscriminate nature of trawling, particularly the Redleg Banana Prawn and Tiger Prawn sub-fisheries, and the small net mesh size used, the NPF interacts with a diversity of organisms including teleosts (>411 spp.), invertebrates, elasmobranchs (~56 spp.), sea snakes (15 species.), and turtles (6 species.). Since 2000, TEDs have been compulsory in the fishery which has excluded 99% of turtles and large (>1 m) elasmobranchs and sponges. The Fishery has achieved significant milestones in the management of bycatch, including more than a 50% reduction of bycatch since its first Bycatch Action Plan (NORMAC 1998) was implemented in 1998 and through the introduction of Turtle Excluder Devices (TEDs), BRDs, reduced effort and implementation of spatial and temporal closures. Scampi is taken from a deepwater area on the edge of the AFZ north of Melville Island and is targeted during NPF prawn trawling closure periods be a small number of vessels (less than 5% of the overall fleet). This is a result of the high cost

associated with travel to and from the Scampi grounds, and the restricted market opportunities for sale of the catch. Some of the deepwater byproduct species (i.e., Red Champagne Lobster) are only caught when targeting Scampi.

Protected species issues and interactions

Protected species interactions for the NPF Tiger Prawn sub-fishery (NPF logbook data). Alive (A); Dead (D).

Common Name	Family and/or Scientific name	2013		2014		2015		2016		2017	
		A	D	A	D	A	D	A	D	A	D
Sawfish (unidentified)	Pristidae	124	15	120	25	126	62	118	94	107*	23
Green Sawfish	*Pristis zijsron*	47	20	9	14	3	1			12	1
Narrow Sawfish	*Anoxypristis cuspidata*	41	28	22	1	8	3	11	5	83	15
Freshwater Sawfish	*Pristis pristis*	4				3				5	
Dwarf Sawfish	*Pristis clavata*	2	1	20	4	2	4		1	1	
Seahorses and pipefishes (unidentified)	Syngnathidae	67	73	7	21	45	91	16	69	24	21
Turtles (unidentified)	Cheloniidae	18	1	31		42		40		26	1
Loggerhead Turtle	*Caretta caretta*	9				1				2	
Green Turtle	*Chelonia mydas*	16		11		6		5		6	
Hawksbill Turtle	*Eretmochelys imbricata*	1	1	1		1				1	
Pacific (Olive) Ridely Turtle	*Lepidochelys olivacea*	8	1	1		2		4		6	
Flatback Turtle	*Natator depressus*	5		5		5		1		2	2
Leatherback Turtle	*Dermochelys coriacea*					1				1	
Sea snakes (unidentified)	Hydrophiidae	4689	1545	4049	967	4316	2135	5602	1751	5493	1745
Birds	Avians					2					
Terns	Terns									1	
Dolphins (unidentified)	Delphinidae	1									

*Species recorded as common sawshark reclassified as unidentified sawfish (total of 2 individuals)

Protected species interactions for the NPF White Banana prawn sub-fishery (NPF logbook data). Alive (A); Dead (D).

Common Name	Family and/or Scientific name	2013		2014		2015		2016		2017	
		A	D	A	D	A	D	A	D	A	D
Sawfish (unidentified)	Pristidae	89	11	49	31	48	21	46	35	76	86
Green Sawfish	*Pristis zijsron*	28	3	37	24	1	1			7	
Narrow Sawfish	*Anoxypristis cuspidata*	22	15	10	33	5	3		6	16	14
Freshwater Sawfish	*Pristis pristis*	5		1						24	
Dwarf Sawfish	*Pristis clavata*	1	1			8	6				

Seahorses and pipefishes (unidentified)	Syngnathidae		1			1	3	4	4	1	3
Turtles (unidentified)	Cheloniidae	2				4		3		11	
Green Turtle	*Chelonia mydas*	2		2				1		3	
Pacific (Olive) Ridely Turtle	*Lepidochelys olivacea*	5	1			1					
Flatback Turtle	*Natator depressus*	3	1					1			
Sea snakes (unidentified)	Hydrophiidae	1454	244	1173	223	644	397	878	187	1121	383

	The fishery interacts with several TEP species including turtles (5 spp.), sea snakes (15 species), Syngnathids (4 spp.), sawfish (4spp.) and cetaceans (18 spp.). Turtles are rarely captured by the fishery since 2000 and the NPF does not overlap with key breeding or aggregation areas. In 2017, a total of 47 turtles were caught in the Tiger Prawn sub-fishery and 14 in the White Banana Prawn sub-fishery. Of these, 44 and 14 were released alive in the sub-fisheries, respectively. In the same year, a total of 247 sawfish were caught in the Tiger Prawn sub-fishery of which 208 were released alive, and 223 sawfish were caught in the white banana prawn sub-fishery of which 123 were released alive. Cetaceans are abundant in the NPF and feed on discards from trawlers; however, they are rarely caught. One dolphin (species not recorded) was recorded in 2013 in the Tiger Prawn sub-fishery and none in the White Banana Prawn sub-fishery. No cetaceans were caught between 2014 and 2017 in either sub-fishery. Sea snakes are frequently caught by trawlers with 7238 being caught in 2017 in the Tiger Prawn sub-fishery with at least 24% mortality. 1504 sea snakes were caught in 2017 in the white banana prawn sub-fishery with at least 25% mortality (AFMA logbook data). Catch trend analysis for seven sea snake species showed no detectable declines due to trawling (2003-2016; Fry et al. 2018). The breeding locations are largely unknown and there is no evidence of aggregation sites occurring within the NPF (David Milton, pers. comm. CSIRO). A current project is monitoring the impact of the NPFs interactions with TEP and at-risk species.
Habitat issues and interactions	There are risks to seabed habitat due to trawling, particularly in the Tiger Prawn sub-fishery, since commercial species occur on or near the seabed. Removal, modification, and disturbance of the seabed biota by trawling is well documented and is limited to the accessible areas of the fishery A network of marine parks is now in place that includes trawl closures and there are other permanent fishery closures that limit the trawl footprint. The extent and effects of these impacts on the ecosystem have been studied extensively on the Great Barrier Reef (Poiner et al. 1998) and more recently in the NPF (Haywood et al. 2005, Bustamante et al. 2010, Pitcher et al. 2016; 2018).
Community issues and interactions	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. 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.
Discarding	In all the sub-fisheries bycatch and juveniles of target species are generally processed and discarded overboard at sea. Discard biomass is generally lower in the White Banana Prawn sub-fishery due to operators targeting prawn aggregations. There tends to be minimal high grading in all sub-fisheries since the freezer capacity on NPF vessels is generally large. The majority of bycatch in the NPF are teleosts with small body sizes and short life spans (Stobutzki et al. 2001). Previous assessments have shown that it is unlikely that current fishing intensity in the NPF Tiger Prawn sub-fishery alone will cause risk to the sustainability of the teleost species caught in the fishery (Zhou, 2011).
MANAGEMENT: PLANNED AND THOSE IMPLEMENTED	
Management objectives	The objectives of the management plan are to make sure: a. that the objectives pursued by the Minister in the administration of the Fisheries Management 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.
Fishery management plan	A management plan was implemented in the NPF in 1995 and was last revised in 2011. The key features of the plan are: introductory provisions, statutory fishing rights, objectives of the plan, measures by which the objectives are to be attained, and performance criteria.
Input controls	The NPF is managed through a series of input controls, including limited entry to the fishery, gear restrictions, bycatch restrictions and a system of seasonal, spatial, and temporal closures. To fish in the NPF operators must hold Statutory Fishing Rights (SFRs), which control fishing capacity by placing limits on the numbers of trawlers and the amount of gear permitted in the fishery. There are two types of SFRs:

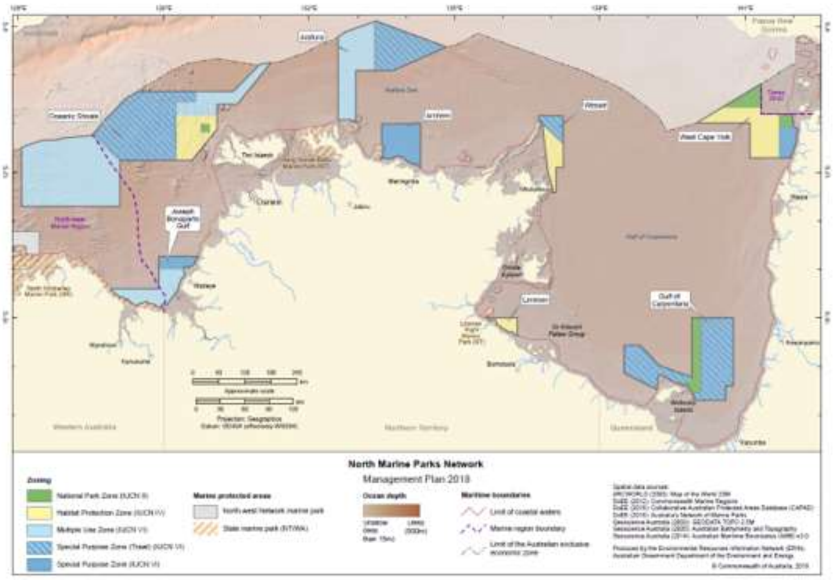
- a Class B SFR, which permits a boat to fish in the NPF; and
- a gear SFR, which limits the amount of net a fisher can use.

There are currently 35,479 gear SFRs issued for the fishery. The total number of Class B SFRs in the fishery is 52.

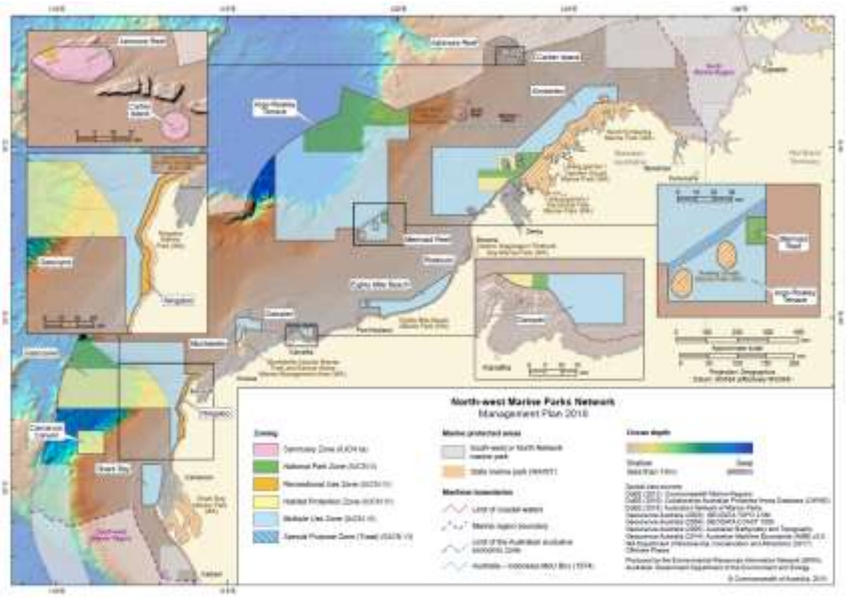
A gear SFR currently represents 9 cm of operational headrope for operators towing twin gear and 8.1 cm of headrope for operators towing quad gear or tongue nets.

Input controls also exist on fishing effort in the form of temporal and spatial closures (Northern Prawn Fishery (Closures) Direction No. 171) within the fishery; both to protect spawning stocks, and juvenile populations (and their habitats) before they reach a size whereby they contribute substantially to the economic and biological performance of the NPF (Kenyon et al. 2005).

There are also two marine park networks (the North Network and the North-west Network) covering the area of the fishery that protects examples of the region’s marine ecosystems and biodiversity. The Networks are located in Commonwealth waters, between three nautical miles (approximately 5.5 km) and 200 nautical miles (approximately 370 km) offshore (below two Figures). There are eight marine parks off the coast of the Northern Territory, Queensland and Western Australia that make up the North Network. The marine parks include habitats such as coral reefs, soft sediments, shelf, canyons and limestone pinnacles. They have high species diversity and globally significant populations of internationally threatened species.



Map of North Marine Parks Network



Map of North-west Marine Parks Network

<table>
<tr><td>Output controls</td><td>
There are currently no output controls in the NPF (i.e. ITQs) for target species due to difficulties in accurately determining total annual catch and individual quotas, particularly for White Banana Prawns. Under a management regime through output controls, there is the potential for high grading and dumping of lower value prawns.
Specific measures (harvest controls) for byproduct species are set in the NPF Harvest Strategy (see Table below; Dichmont et al. 2014). These measures and trigger limits apply for the overall NPF, not just a particular sub-fishery.
NPF byproduct catch limits.
<table>
<tr><th>COMMON NAME AND/OR SPECIES</th><th>CATCH LIMIT</th></tr>
<tr><td>Shark, Skates and Rays (all species)</td><td>NIL. No part of these species to be retained, including fins, teeth, skin or sawshark beaks.</td></tr>
<tr><td>Narrow barred Spanish mackerel (Scomberomorus commerson)

Broad barred Spanish mackerel (Scomberomorus semifasciatus)

Longtail tuna (Thunnus tonggol)

Gold band snapper (Pritipomoides multidens)

Coral trouts, rock cods, sea breams etc. (Serranidae)

Sweet lips (Lethrinidae).</td><td>10 whole fish per trip</td></tr>
<tr><td>Mud crabs (Scylla species)</td><td>10 per trip</td></tr>
<tr><td>Tropical rock lobster (Panulirus ornatus); also known as painted crayfish</td><td>6 lobsters or lobster tails per trip in total</td></tr>
<tr><td>Saddle tail snapper (Lutjanus malabaricus),

Red snapper (Lutjanus erythropterus),

Red emperor (Lutjanus sebae)</td><td>a) a total of 550 kg whole weight, 211 kg fillet weight, 500 kg gilled and gutted weight and 393 kg headed and gutted weight during the period beginning on 1 March in any year and ending 30 June the same year.
b) a total of 55 kg whole weight, 22 kg fillet weight, 50 kg gilled and gutted weight and 40 kg headed and gutted weight during the period beginning on 1 July in any year and ending on 28 February in the same year.</td></tr>
<tr><td>Barramundi (Lates calcarifer), threadfin salmon (Polydactylus sheridani), blue salmon (Eleutheronema tetradactylum), black jewfish (Protonibea diacanthus), jewelfish or yellow jew (Nibea squammosa), spotted grunter-bream (Pomadasys kaakan), queenfish (Scomberoides lysan; S. commersonianus), pearl shell (Pinctada spp.), trochus (Class Trochidae), trepang (Class Holothuridae), coral</td><td>NIL</td></tr>
<tr><td>Bugs (Thenus indicus, Thenus orientalis)</td><td>• 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</td></tr>
<tr><td>Squid</td><td>• 500 t catch trigger limit;
• Review event at 300 tonnes;
• Appropriate management measures to be developed and implemented if catch trigger is reached.</td></tr>
</table>
</td></tr>
<tr><td>Technical measures</td><td>
There are no size limits or restrictions on the sex or reproductive state of target prawn species.
There are various types of spatial and temporal closures in the banana prawn fishing season including permanent closures (14 areas), VMS start area (1), assembly areas (4), seasonal closures (9), prohibition on daylight trawling (Gulf of Carpentaria) * (1), end of season closure (1).
</td></tr>
</table>

	There are no specific regulations on gear or mesh size in the NPF. Permitted gear size is determined by the number of SFRs held by the operator. A try net can be used with otter boards or a beam and have up to 3.66 m and 5.49 m of operational headrope and footrope, respectively. All nets used in the sub-fisheries (except for try nets) must be fitted with an approved TED and a BRD listed under NPF (Gear Requirements) Direction No. 174 and in section 17(5A) and 17(5B) of the Fisheries Management Act. *if MEY decision rule triggered due to low banana prawn catches.
Regulations	There are numerous restrictions on byproduct species detailed under NPF (Closures) Direction No. 172 and in section 17(5A) and 17(5B) of the Fisheries Management Act. These restrictions apply to elasmobranchs, lobsters, mud crabs, and several fish species. NPF vessels are required to conform to regulations of MARPOL 73/78 and section 8.7 of the Code of Conduct for Responsible Fisheries administered by FAO, which details responsible practices for managing pollution and discarding at sea.
Initiatives, strategies and incentives	The NPF Bycatch Strategy 2015-2018 was developed and implemented by NPF Industry Pty Ltd (NPFI) in 2015. The NPF Bycatch Strategy is a voluntary industry initiative that aims to reduce the capture of small fish and other bycatch in the NPF by 30% within three years. AFMA has implemented a co-management policy in the NPF that provides for the cooperative management of the fishery with the NPFI. The co-management policy details the agreed basis for NPFI to advise AFMA directly on a range of operational and management issues in the NPF including season start and end dates, spatial and temporal closures, gear trial areas, in-season management arrangement and NPF fishery budgets. Other components which NPFI has delivered/is delivering as part of co-management are responsibility for the reconciliation of catch and effort data for stock assessment; undertaking NPF pre-season briefings; development and implementation of the NPF Bycatch Strategy 2015-2018; representation on Indigenous Protected Area management advisory committees; participation in tender processes for the NPF at-sea monitoring projects; management of broodstock collection and recommending research direction and strategies for the NPF. An Industry Code of Practice for Responsible Fishing was developed in 2004 to define principles and standards of behaviour for responsible fishing practices and continuous improvement in the sustainable management, conservation and utilisation of fishery resources within the NPF.
Enabling processes	The NPF currently have several monitoring methods in place including logbooks and scientific surveys. Paper logbooks have been in place since 1970 and are designed to provide a continuous record of fishing operations. The majority of NPF fishers now use electronic logbooks (e-logs) to enter and submit daily fishing logs. E-logs have been compulsory since 1 January 2019. Since 2002, the fishery has funded a scientific recruitment survey undertaken annually in January/February and a biennial spawning survey undertaken in June/July prior to the start of the fishing season in each sub-fishery. Stock assessments have mainly been undertaken on the tiger prawn stocks. The most recent assessment was undertaken in 2018. In the past, the management objective for the NPF tiger prawn fishery was Maximum Sustainable Yields (MSY). In 2003 NORMAC agreed to adopt MEY as the target reference point for the tiger prawn fishery. Spawner level target (S_{MSY}) was set as the point at which overfishing occurs and treated as the overfishing limit reference point once recovery has been achieved. MEY has subsequently been adopted as the aspirational target reference point in the Harvest Strategy Policy.
Other initiatives or agreements	The NPF adheres to the Offshore Constitutional Settlement agreement between the Commonwealth and Queensland, Northern Territory and Western Australia, which primarily relates to the take of byproduct species by the NPF. The NPF was reaccredited by the Department of Agriculture, Water and the Environment under the EPBC Act in 2018 to allow export of product from the fishery for a period of five years. The fishery will be reassessed again in 2023.
DATA	
Logbook data	Logbook data is verified in several ways: • by comparing trawler owner seasonal landing returns for each major species group with the logbook records for the boat • AFMA at-sea logbook monitoring and enforcement program. Data summaries of NPF catch and effort by species and region within the fishery are produced annually by NPFI and available on the AFMA website.
Observer data	Observer programs have been undertaken to monitor target prawn species, byproduct, bycatch, Threatened, Endangered and Protected (TEP) species and potentially at-risk species in the NPF. These include: • Crew-member Observer Program (2003 – 2018): long-term bycatch monitoring program in the NPF where trained crew members collect fishery-dependent catch data on TEP species and potentially at-risk species during the banana and tiger prawn seasons. • AFMA Scientific Observer Program (2005 – 2018): fishery independent data collection by AFMA scientific observers on-board NPF commercial vessels during the tiger and banana prawn seasons. Data collected includes operational information and catch data on target, byproduct, bycatch, TEP species and potentially at-risk species.

<table>
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NPF Prawn Population Monitoring Survey (2002 – 2018): annual (recruitment) and biennial (spawning) fishery-independent monitoring surveys carried out in the NPF by CSIRO to provide prawn recruitment and spawning indices and catch data on TEP species and potentially at-risk species.
CSIRO Scientific Research and Observer Surveys (1975 – 2005): fishery-independent research trawl surveys and CSIRO scientific observers on-board NPF commercial vessels collecting catch data on bycatch, TEP and potentially at-risk species.

Crew Member Observer (CMO) coverage of fishing effort by year
<table>
<tr><th>EFFORT</th><th>2012</th><th>2013</th><th>2014</th><th>2015</th><th>2016</th><th>2017</th></tr>
<tr><td>Total effort days</td><td>8047</td><td>7913</td><td>8145</td><td>8233</td><td>7880</td><td>7418</td></tr>
<tr><td>Total days monitored by CMOs</td><td>962</td><td>1040</td><td>949</td><td>1058</td><td>873</td><td>1169</td></tr>
<tr><td>Percentage of fishery effort monitored by CMOs</td><td>11.95</td><td>13.14</td><td>11.65</td><td>12.85</td><td>11.08</td><td>15.76</td></tr>
</table>
AFMA Scientific Observer (SO) coverage of fishing effort by year
<table>
<tr><th>EFFORT</th><th>2012</th><th>2013</th><th>2014</th><th>2015</th><th>2016</th><th>2017</th></tr>
<tr><td>Total effort days</td><td>8047</td><td>7913</td><td>8145</td><td>8233</td><td>7880</td><td>7418</td></tr>
<tr><td>Total days monitored by SOs</td><td>167</td><td>168</td><td>114</td><td>159</td><td>103</td><td>152</td></tr>
<tr><td>Percentage of fishery effort monitored by SOs</td><td>2.08</td><td>2.12</td><td>1.04</td><td>1.93</td><td>1.31</td><td>2.05</td></tr>
</table>
</td></tr>
<tr><td>Other data</td><td>
Target species projects
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2.2.2 Unit of Analysis Lists (Step 2)

The units of analysis for the sub-fishery are listed by component:

- Species Components: key commercial and secondary commercial; byproduct/bycatch and protected species components. [Scoping document S2A Species]
- Habitat Component: habitat types. [Scoping document S2B1 and S2B2 Habitats]
- Community Component: community types. [Scoping document S2C1 and S2C2 Communities]

Ecological Units Assessed

Key commercial and secondary species:	1 (C1); 0 (C2)
Byproduct and bycatch species:	14 (BP); 335 (BC)
Protected species:	42
Habitats:	22 demersal, 1 pelagic
Communities:	11 (10 demersal, 1 pelagic)

Scoping Document S2A. Species

Each species identified during the scoping is added to the ERAEF database used to run the Level 2 analyses. A CAAB code (Code for Australian Aquatic Biota) is required to input the information. The CAAB codes for each species may be found at http://www.cmar.csiro.au/caab/

Key commercial/secondary commercial species

- *Key commercial species* – defined in the Harvest Strategy Policy (HSP) Guidelines as a species that is, or has been, specifically targeted and is, or has been, a significant component of a fishery.
- *Secondary commercial species* – commercial species that, while not specifically targeted, are commonly caught and generally retained, and comprise a significant component of a fishery's catch and economic return. These can include quota species in some fisheries.

Table 2.3. Key commercial (C1) and secondary commercial (C2) species list for the NPF Banana Prawn sub-fishery. AFMA: refers to AFMA Logbook and/or Observer data.

ROLE IN FISHERY	TAXA NAME	FAMILY NAME	CAAB CODE	SCIENTIFIC NAME	COMMON NAME	SOURCE
C1	Invertebrate	Penaeidae	28711050	*Penaeus merguiensis*	White banana prawn	AFMA

Byproduct species

List the byproduct species of the sub-fishery. Byproduct species refers to any species that are retained for sale but comprise a minor component of the fishery catch and economic return. Byproduct are considered to be commercial species under the CPFB 2000. This list is obtained by reviewing all available fishery literature, including logbooks, observer reports and discussions with stakeholders.

Table 2.4. Byproduct (BP) species list for the NPF Banana Prawn sub-fishery. AFMA: refers to AFMA Logbook and/or Observer data.

ROLE IN FISHERY	TAXA NAME	FAMILY NAME	CAAB CODE	SCIENTIFIC NAME	COMMON NAME	SOURCE
BP	Invertebrate	Loliginidae	No CAAB	*Uroteuthis sp.* 4 of Yeatman 1993	A squid	M. Dunning (Queensland Museum)
BP	Invertebrate	Loliginidae	No CAAB	*Uroteuthis etheridgei*	A squid	M. Dunning (Queensland Museum)
BP	Invertebrate	Penaeidae	28711026	*Metapenaeus endeavouri*	Blue endeavour prawn	AFMA
BP	Invertebrate	Penaeidae	28711027	*Metapenaeus ensis*	Red endeavour prawn	AFMA
BP	Invertebrate	Penaeidae	28711044	*Penaeus esculentus*	Brown tiger prawn	AFMA
BP	Invertebrate	Penaeidae	28711045	*Penaeus indicus*	Redleg banana prawn	AFMA
BP	Invertebrate	Penaeidae	28711051	*Penaeus monodon*	Black tiger prawn - leader prawn	AFMA
BP	Invertebrate	Penaeidae	28711053	*Penaeus semisulcatus*	Grooved tiger prawn	AFMA
BP	Invertebrate	Nephropidae	28786001	*Metanephrops australiensis*	Australian scampi	AFMA
BP	Invertebrate	Palinuridae	28820004	*Linuparus sordidus*	Red champagne lobster	P. Davie (Queensland Museum)
BP	Invertebrate	Palinuridae	28820004	*Linuparus meridionalis*	Red champagne lobster	P. Davie (Queensland Museum)
BP	Invertebrate	Scyllaridae	28821007	*Thenus parindicus*	Mud bug	AFMA
BP	Invertebrate	Penaeidae	28711048	*Melicertus longistylus*	Redspot king prawn	AFMA; NPF RAG July 2019
BP	Invertebrate	Penaeidae	28711047	*Melicertus latisulcatus*	Western King Prawn	AFMA; NPF RAG July 2019

Bycatch (discard) species

Bycatch species are species that are not retained (i.e., are discarded and includes catch that does not reach the deck of the vessel but which nonetheless is killed (or effected) as a result of the interaction with the fishing gear) and as such make no contribution to the value of the fishery. The term bycatch does *not* include discards of commercial species. Bycatch species are divided, for management purposes, into:

- *General bycatch species* (i.e., species of fish, sharks, invertebrates, etc. that are never retained for sale).

Table 2.5. Bycatch (BC) species list for the NPF Banana Prawn sub-fishery. AFMA: refers to AFMA Logbook and/or Observer data.

ROLE IN FISHERY	TAXA NAME	FAMILY NAME	CAAB CODE	SCIENTIFIC NAME	COMMON NAME	SOURCE
BC	Invertebrate	Pectinidae	23270003	*Amusium pleuronectes*	Mud scallop	AFMA
BC	Invertebrate	Sepiidae	23607003	*Sepia elliptica*	Ovalbone cuttlefish	AFMA
BC	Invertebrate	Sepiidae	23607007	*Sepia papuensis*	Papuan cuttlefish	AFMA
BC	Invertebrate	Sepiidae	23607008	*Sepia pharaonis*	Pharaoh cuttlefish	AFMA
BC	Invertebrate	Sepiidae	23607011	*Sepia whitleyana*	Whitley's cuttlefish	AFMA
BC	Invertebrate	Sepiidae	23607013	*Sepia smithi*	A cuttlefish	AFMA
BC	Invertebrate	Loliginidae	23617006	*Sepioteuthis lessoniana*	Northern calamari	AFMA
BC	Invertebrate	Loliginidae	23617010	*Uroteuthis noctiluca*	Luminous bay squid	AFMA
BC	Invertebrate	Loliginidae	No CAAB	*Uroteuthis sp* 1	A squid	M. Dunning (Australian Museum)
BC	Invertebrate	Loliginidae	No CAAB	*Uroteuthis sp* 2	A squid	M. Dunning (Australian Museum)
BC	Invertebrate	Octopodidae	23659021	*Octopus cyanea*	Day octopus	AFMA
BC	Invertebrate	Octopodidae	23659039	*Octopus sp. A* (other names: *O. membranaceus* which is a misidentification)	An octopus	AFMA
BC	Invertebrate	Tonnidae	24177010	*Tonna sulcosa*	Sulcosa tun shell	AFMA
BC	Invertebrate	Luidiidae	25105003	*Luidia hardwicki*	Starfish	AFMA
BC	Invertebrate	Luidiidae	25105005	*Luidia maculata*	Starfish	AFMA
BC	Invertebrate	Goniasteridae	25122010	*Iconaster longimanus*	Starfish	AFMA
BC	Invertebrate	Goniasteridae	25122026	*Stellaster childreni*	Starfish	AFMA

ROLE IN FISHERY	TAXA NAME	FAMILY NAME	CAAB CODE	SCIENTIFIC NAME	COMMON NAME	SOURCE
BC	Invertebrate	Archasteridae	25124002	*Archaster typicus*	Starfish	AFMA
BC	Invertebrate	Oreasteridae	25127018	*Anthenea tuberculosa*	Starfish	AFMA
BC	Invertebrate	Pterasteridae	25139001	*Euretaster insignis*	Seastar	AFMA
BC	Invertebrate	Echinasteridae	25143013	*Metrodira subulata*	Starfish	AFMA
BC	Invertebrate	Diadematidae	25211004	*Chaetodiadema granulatum*	Sea urchin	AFMA
BC	Invertebrate	Laganidae	25266005	*Peronella lesueuri*	Sea urchin	AFMA
BC	Invertebrate	Cucumariidae	25408007	*Cercodemas anceps*	A holothurian	AFMA
BC	Invertebrate	Cucumariidae	25408031	*Psuedocolochirus axiologus*	Selenka's sea cucumber	AFMA
BC	Invertebrate	Holothuriidae	25416003	*Holothuria atra*	Lolly fish	AFMA
BC	Invertebrate	Holothuriidae	25416004	*Holothuria scabra*	Sand fish	AFMA
BC	Invertebrate	Holothuriidae	25416029	*Holothuria martensi*	Holothurian	AFMA
BC	Invertebrate	Holothuriidae	25416030	*Holothuria ocellata*	Holothurian	AFMA
BC	Invertebrate	Holothuriidae	25416031	*Holothuria lessoni*	Golden sandfish	AFMA
BC	Invertebrate	Holothuriidae	25416032	*Holothuria fuscopunctata*	Elephant's trunk fish	AFMA
BC	Invertebrate	Holothuriidae	25416033	*Holothuria whitmaei*	Black teatfish	AFMA
BC	Invertebrate	Holothuriidae	25416039	*Holothuria flavomaculata*	Holothurian	AFMA
BC	Invertebrate	Holothuriidae	25416050	*Holothuria arenicola*	Holothurian	AFMA
BC	Invertebrate	Holothuriidae	25416064	*Actinopyga spinea*	Burrowing blackfish	AFMA
BC	Invertebrate	Stichopodidae	25417004	*Thelenota anax*	Amberfish	AFMA
BC	Invertebrate	Stichopodidae	25417006	*Stichopus herrmanni*	Curryfish	AFMA
BC	Invertebrate	Stichopodidae	25417007	*Stichupus horrens*	Holothurian	AFMA
BC	Invertebrate	Stichopodidae	25417011	*Stichopus naso*	Holothurian	AFMA
BC	Invertebrate	Squillidae	28051030	*Dictyosquilla tuberculata*	Warty mantis shrimp	AFMA
BC	Invertebrate	Squillidae	28051039	*Harpiosquilla stephensoni*	Stephenson's mantis shrimp	AFMA
BC	Invertebrate	Penaeidae	28711003	*Atypopenaeus formosus*	Orange prawn	AFMA
BC	Invertebrate	Penaeidae	28711016	*Metapenaeopsis novaeguineae*	Northern velvet prawn	AFMA

ROLE IN FISHERY	TAXA NAME	FAMILY NAME	CAAB CODE	SCIENTIFIC NAME	COMMON NAME	SOURCE
BC	Invertebrate	Penaeidae	28711031	*Kishinouyepenaeopsis cornuta*	Coral prawn	AFMA
BC	Invertebrate	Penaeidae	28711037	*Parapenaeus lanceolatus*	Lance prawn	AFMA
BC	Invertebrate	Penaeidae	28711054	*Trachypenaeus anchoralis*	Northern rough prawn	AFMA
BC	Invertebrate	Penaeidae	28711057	*Megokris gonospinifer*	Rough prawn	AFMA
BC	Invertebrate	Penaeidae	28714011	*Solenocera australiana*	Coral prawn	AFMA
BC	Invertebrate	Nephropidae	28786004	*Metanephrops sibogae*	Siboga scampi	AFMA
BC	Invertebrate	Palinuridae	28820006	*Panulirus ornatus*	Ornate rocklobster	AFMA
BC	Invertebrate	Palinuridae	28820007	*Puerulus angulatus*	Banded whip lobster	AFMA
BC	Invertebrate	Palinuridae	28820013	*Panulirus versicolor*	Painted rocklobster - green cray	AFMA
BC	Invertebrate	Scyllaridae	28821005	*Scyllarides haanii*	Aesop slipper lobster	AFMA
BC	Invertebrate	Scyllaridae	28821008	*Thenus australiensis*	Sandbug	AFMA
BC	Invertebrate	Scyllaridae	28821013	*Petrarctus rugosus*	Slipper lobster	AFMA
BC	Invertebrate	Scyllaridae	28821015	*Petrarctus demani*	Shovel-nosed lobster; slipper lobster	AFMA
BC	Invertebrate	Portunidae	28911001	*Charybdis feriata*	Coral crab	AFMA
BC	Invertebrate	Portunidae	28911005	*Portunus armatus*	Blue swimmer crab	AFMA
BC	Invertebrate	Portunidae	28911006	*Portunus sanguinolentus*	Three-spotted crab	AFMA
BC	Invertebrate	Portunidae	28911014	*Podophthalmus vigil*	Sentinel crab	AFMA
BC	Chondrichthyan	Alopiidae	37012001	*Alopias vulpinus*	Thresher shark	AFMA
BC	Chondrichthyan	Alopiidae	37012002	*Alopias superciliosus*	Bigeye thresher	AFMA
BC	Chondrichthyan	Alopiidae	37012003	*Alopias pelagicus*	Pelagic thresher	AFMA
BC	Chondrichthyan	Hemiscyllidae	37013008	*Chiloscyllium punctatum*	Brownbanded bambooshark	AFMA
BC	Chondrichthyan	Carcharhinidae	37018006	*Rhizoprionodon acutus*	Milk shark	AFMA
BC	Chondrichthyan	Carcharhinidae	37018009	*Carcharhinus coatesi*	Whitecheek shark	AFMA
BC	Chondrichthyan	Hemigaleidae	37018011	*Hemipristis elongata*	Fossil shark	AFMA
BC	Chondrichthyan	Carcharhinidae	37018013	*Carcharhinus sorrah*	Spot-tail shark	AFMA
BC	Chondrichthyan	Carcharhinidae	37018014	*Carcharhinus tilstoni*	Australian blacktip shark	AFMA
BC	Chondrichthyan	Hemigaleidae	37018020	*Hemigaleus australiensis*	Sicklefin weasel shark	AFMA
BC	Chondrichthyan	Carcharhinidae	37018021	*Carcharhinus leucas*	Bull shark	AFMA

ROLE IN FISHERY	TAXA NAME	FAMILY NAME	CAAB CODE	SCIENTIFIC NAME	COMMON NAME	SOURCE
BC	Chondrichthyan	Carcharhinidae	37018023	*Carcharhinus brevipinna*	Spinner shark	AFMA
BC	Chondrichthyan	Carcharhinidae	37018024	*Rhizoprionodon taylori*	Australian sharpnose shark	AFMA
BC	Chondrichthyan	Carcharhinidae	37018025	*Carcharhinus macloti*	Hardnose shark	AFMA
BC	Chondrichthyan	Carcharhinidae	37018026	*Carcharhinus amboinensis*	Pigeye shark	AFMA
BC	Chondrichthyan	Carcharhinidae	37018035	*Carcharhinus fitzroyensis*	Creek whaler	AFMA
BC	Chondrichthyan	Carcharhinidae	37018039	*Carcharhinus limbatus*	Blacktip shark	AFMA
BC	Chondrichthyan	Sphyrnidae	37019001	*Sphyrna lewini*	Scalloped hammerhead	AFMA
BC	Chondrichthyan	Sphyrnidae	37019003	*Eusphyra blochii*	Winghead shark	AFMA
BC	Chondrichthyan	Sphyrnidae	37019004	*Sphyrna zygaena*	Smooth hammerhead	AFMA
BC	Chondrichthyan	Centrophoridae	37020001	*Centrophorus moluccensis*	Endeavour dogfish	AFMA
BC	Chondrichthyan	Rhinidae	37026005	*Rhynchobatus australiae*	Whitespotted guitarfish	AFMA
BC	Chondrichthyan	Dasyatidae	37035004	*Neotrygon australiae*	Blue-spotted stingray	AFMA
BC	Chondrichthyan	Dasyatidae	37035012	*Neotrygon annotata*	Plain maskray	AFMA
BC	Chondrichthyan	Dasyatidae	37035013	*Neotrygon leylandi*	Painted maskray	AFMA
BC	Chondrichthyan	Dasyatidae	37035017	*Taeniurops meyeni*	Blotched fantail ray	AFMA
BC	Chondrichthyan	Dasyatidae	37035020	*Maculabatis astra* (synonym: *Himantura astra*)	Black-spotted whipray	AFMA
BC	Chondrichthyan	Dasyatidae	37035026	*Himantura leoparda*	Leopard whipray	AFMA
BC	Chondrichthyan	Gymnuridae	37037001	*Gymnura australis*	Australian butterfly ray	AFMA
BC	Chondrichthyan	Urolophidae	37038001	*Urolophus bucculentus*	Sandyback stingaree	AFMA
BC	Chondrichthyan	Myliobatidae	37039002	*Aetomylaeus caeruleofasciatus*	Banded eagle ray	AFMA
BC	Chondrichthyan	Aetobatidae	37039003	*Aetobatus ocellatus*	Spotted eagle ray	AFMA
BC	Teleost	Muraenesocidae	37063002	*Muraenesox cinereus*	Daggertooth pike conger	AFMA
BC	Teleost	Congridae	37067015	*Conger cinereus*	Blacklip conger	AFMA
BC	Teleost	Ophichthidae	37068017	*Ichthyapus vulturis*	Vulture eel	AFMA
BC	Teleost	Ophichthidae	37068033	*Phyllopichthus xenodontus*	Flappy snake eel	AFMA
BC	Teleost	Clupeidae	37085006	*Amblygaster sirm*	Spotted sardinella	AFMA

ROLE IN FISHERY	TAXA NAME	FAMILY NAME	CAAB CODE	SCIENTIFIC NAME	COMMON NAME	SOURCE
BC	Teleost	Clupeidae	37085007	*Herklotsichthys koningsbergeri*	Largespotted herring	AFMA
BC	Teleost	Clupeidae	37085008	*Herklotsichthys lippa*	Smallspotted herring	AFMA
BC	Teleost	Pristigasteridae	37085009	*Pellona ditchela*	Indian pellona	AFMA
BC	Teleost	Clupeidae	37085010	*Dussumieria elopsoides*	Slender rainbow sardine	AFMA
BC	Teleost	Pristigasteridae	37085012	*Ilisha lunula*	Longtail Ilisha	AFMA
BC	Teleost	Clupeidae	37085013	*Sardinella gibbosa*	Goldstripe sardinella	AFMA
BC	Teleost	Clupeidae	37085014	*Sardinella albella*	White sardinella	AFMA
BC	Teleost	Clupeidae	37085015	*Anodontostoma chacunda*	Chacunda gizzard shad	AFMA
BC	Teleost	Clupeidae	37085025	*Herklotsichthys quadrimaculatus*	Goldspot herring	AFMA
BC	Teleost	Clupeidae	37085030	*Spratelloides gracilis*	Silver-stripe round herring	AFMA
BC	Teleost	Pristigasteridae	37085034	*Ilisha striatula*	Banded Ilisha	AFMA
BC	Teleost	Engraulidae	37086004	*Thryssa setirostris*	Longjaw thryssa	AFMA
BC	Teleost	Engraulidae	37086005	*Thryssa hamiltonii*	Hamilton's thryssa	AFMA
BC	Teleost	Engraulidae	37086006	*Stolephorus indicus*	Indian anchovy	AFMA
BC	Teleost	Engraulidae	37086008	*Setipinna tenuifilis*	Common hairfin anchovy	AFMA
BC	Teleost	Chirocentridae	37087001	*Chirocentrus dorab*	Dorab wolf herring	AFMA
BC	Teleost	Synodontidae	37118001	*Saurida undosquamis*	Brushtooth lizardfish	AFMA
BC	Teleost	Synodontidae	37118005	*Saurida argentea*	Shortfin saury	AFMA
BC	Teleost	Synodontidae	37118028	*Saurida tumbil*	Common saury	AFMA
BC	Teleost	Synodontidae	37119001	*Harpadon translucens*	Glassy Bombay duck	AFMA
BC	Teleost	Myctophidae	37122079	*Benthosema pterotum*	Opaline lanternfish	AFMA
BC	Teleost	Ariidae	37188001	*Netuma thalassina*	Giant Sea Catfish	AFMA
BC	Teleost	Ariidae	37188006	*Arius leptaspis*	Salmon catfish	AFMA
BC	Teleost	Ariidae	37188013	*Plicofollis nella*	Shieldhead catfish	AFMA
BC	Teleost	Plotosidae	37192003	*Euristhmus nudiceps*	Nakedhead catfish	AFMA
BC	Teleost	Plotosidae	37192004	*Euristhmus lepturus*	Longtail catfish	AFMA

ROLE IN FISHERY	TAXA NAME	FAMILY NAME	CAAB CODE	SCIENTIFIC NAME	COMMON NAME	SOURCE
BC	Teleost	Tetrabrachiidae	37210010	*Tetrabrachium ocellatum*	Humpback anglerfish	AFMA
BC	Teleost	Bregmacerotidae	37225002	*Bregmaceros mcclellandi*	Unicorn codlet	AFMA
BC	Teleost	Bregmacerotidae	37225003	*Bregmaceros atlanticus*	Antenna codlet	AFMA
BC	Teleost	Ophidiidae	37228005	*Sirembo imberbis*	Golden cusk	AFMA
BC	Teleost	Hemiramphidae	37234016	*Hyporhamphus affinis*	Tropical garfish	AFMA
BC	Teleost	Belonidae	37235001	*Ablennes hians*	Barred longtom	AFMA
BC	Teleost	Belonidae	37235002	*Tylosurus gavialoides*	Stout longtom	AFMA
BC	Teleost	Belonidae	37235003	*Strongylura leiura*	Slender longtom	AFMA
BC	Teleost	Belonidae	37235004	*Strongylura strongylura*	Blackspot longtom	AFMA
BC	Teleost	Belonidae	37235005	*Tylosurus crocodilus*	Crocodile longtom	AFMA
BC	Teleost	Belonidae	37235006	*Tylosurus punctulatus*	Spongyjaw longtom	AFMA
BC	Teleost	Belonidae	37235007	*Strongylura incisa*	Reef longtom	AFMA
BC	Teleost	Belonidae	37235008	*Platybelone argalus*	Flat-tail longtom	AFMA
BC	Teleost	Belonidae	37235011	*Tylosurus acus*	Keeljaw longtom	AFMA
BC	Teleost	Holocentridae	37261001	*Sargocentron rubrum*	Red squirrelfish	AFMA
BC	Teleost	Holocentridae	37261002	*Myripristis murdjan*	Pinecone soldierfish	AFMA
BC	Teleost	Veliferidae	37269002	*Velifer hypselopterus*	Sailfin velifer	AFMA
BC	Teleost	Fistulariidae	37278002	*Fistularia petimba*	Red cornetfish	AFMA
BC	Teleost	Centriscidae	37280001	*Centriscus scutatus*	Grooved razorfish	AFMA
BC	Teleost	Apistidae	37287011	*Apistus carinatus*	Longfin waspfish	AFMA
BC	Teleost	Pteroidae	37287012	*Pterois russelii*	Plaintail lionfish	AFMA
BC	Teleost	Tetrarogidae	37287014	*Cottapistus cottoides*	Marbled stingfish	AFMA
BC	Teleost	Synanceiidae	37287021	*Minous versicolor*	Plumbstriped stingfish	AFMA
BC	Teleost	Apistidae	37287033	*Apistops caloundra*	Shortfin waspfish	AFMA
BC	Teleost	Pteroidae	37287040	*Pterois volitans*	Red lionfish	AFMA
BC	Teleost	Tetrarogidae	37287060	*Paracentropogon vespa*	Wasp roguefish	AFMA
BC	Teleost	Synanceiidae	37287089	*Synanceia verrucosa*	Reef stonefish	AFMA

ROLE IN FISHERY	TAXA NAME	FAMILY NAME	CAAB CODE	SCIENTIFIC NAME	COMMON NAME	SOURCE
BC	Teleost	Pteroidae	37287101	*Brachypterois serrulifer*	Sawcheek scorpionfish	AFMA
BC	Teleost	Aploactinidae	37290004	*Adventor elongatus*	Sandpaper velvetfish	AFMA
BC	Teleost	Platycephalidae	37296010	*Inegocia harrisii*	Harris' flathead	AFMA
BC	Teleost	Platycephalidae	37296013	*Elates ransonnettii*	Dwarf flathead	AFMA
BC	Teleost	Platycephalidae	37296018	*Cociella hutchinsi*	Brownmargin flathead	AFMA
BC	Teleost	Platycephalidae	37296023	*Cymbacephalus nematophthalmus*	Fringe-eye flathead	AFMA
BC	Teleost	Platycephalidae	37296029	*Inegocia japonica*	Japanese flathead	AFMA
BC	Teleost	Platycephalidae	37296033	*Platycephalus australis*	Bartail flathead	AFMA
BC	Teleost	Dactylopteridae	37308004	*Dactyloptena orientalis*	Purple flying gurnard	AFMA
BC	Teleost	Pegasidae	37309002	*Pegasus volitans*	Longtail seamouth	AFMA
BC	Teleost	Serranidae	37311017	*Epinephelus sexfasciatus*	Sixbar grouper	AFMA
BC	Teleost	Acropomatidae	37311028	*Synagrops philippinensis*	Sharptooth seabass	AFMA
BC	Teleost	Serranidae	37311062	*Epinephelus bilobatus*	Frostback rockcod	AFMA
BC	Teleost	Terapontidae	37321001	*Pelates quadrilineatus*	Fourlined terapon	AFMA
BC	Teleost	Terapontidae	37321002	*Terapon jarbua*	Jarbua terapon	AFMA
BC	Teleost	Terapontidae	37321003	*Terapon theraps*	Largescaled terapon	AFMA
BC	Teleost	Terapontidae	37321006	*Terapon puta*	Spinycheek grunter	AFMA
BC	Teleost	Priacanthidae	37326001	*Priacanthus macracanthus*	Red bigeye	AFMA
BC	Teleost	Priacanthidae	37326003	*Priacanthus tayenus*	Purple-spotted bigeye	AFMA
BC	Teleost	Priacanthidae	37326005	*Priacanthus hamrur*	Lunartail bigeye	AFMA
BC	Teleost	Apogonidae	37327008	*Apogon fasciatus*	Broadbanded cardinalfish	AFMA
BC	Teleost	Apogonidae	37327014	*Ozichthys albimaculosus*	Creamspotted cardinalfish	AFMA
BC	Teleost	Apogonidae	37327016	*Jaydia melanopus*	Monster cardinalfish	AFMA
BC	Teleost	Apogonidae	37327026	*Jaydia poecilopterus*	Pearlyfin cardinalfish	AFMA
BC	Teleost	Sillaginidae	37330003	*Sillago analis*	Sand whiting	AFMA
BC	Teleost	Sillaginidae	37330006	*Sillago sihama*	Northern whiting	AFMA
BC	Teleost	Sillaginidae	37330015	*Sillago maculata*	Trumpeter whiting	AFMA
BC	Teleost	Lactariidae	37333001	*Lactarius lactarius*	False trevally	AFMA

ROLE IN FISHERY	TAXA NAME	FAMILY NAME	CAAB CODE	SCIENTIFIC NAME	COMMON NAME	SOURCE
BC	Teleost	Rachycentridae	37335001	*Rachycentron canadum*	Cobia	AFMA
BC	Teleost	Echeneidae	37336001	*Echeneis naucrates*	Live sharksucker	AFMA
BC	Teleost	Echeneidae	37336002	*Remora remora*	Shark sucker	AFMA
BC	Teleost	Carangidae	37337005	*Carangoides malabaricus*	Malabar trevally	AFMA
BC	Teleost	Carangidae	37337008	*Selar boops*	Oxeye scad	AFMA
BC	Teleost	Carangidae	37337010	*Alepes apercna*	Smallmouth scad	AFMA
BC	Teleost	Carangidae	37337012	*Gnathanodon speciosus*	Golden trevally	AFMA
BC	Teleost	Carangidae	37337014	*Seriolina nigrofasciata*	Blackbanded trevally	AFMA
BC	Teleost	Carangidae	37337015	*Selaroides leptolepis*	Yellowstripe scad	AFMA
BC	Teleost	Carangidae	37337016	*Caranx bucculentus*	Bluespotted trevally	AFMA
BC	Teleost	Carangidae	37337017	*Decapterus macrosoma*	Shortfin scad	AFMA
BC	Teleost	Carangidae	37337021	*Carangoides caeruleopinnatus*	Coastal trevally	AFMA
BC	Teleost	Carangidae	37337022	*Carangoides gymnostethus*	Bludger	AFMA
BC	Teleost	Carangidae	37337024	*Atule mate*	Barred yellowtail scad	AFMA
BC	Teleost	Carangidae	37337028	*Megalaspis cordyla*	Torpedo scad	AFMA
BC	Teleost	Carangidae	37337031	*Carangoides humerosus*	Duskyshoulder trevally	AFMA
BC	Teleost	Carangidae	37337032	*Scomberoides commersonnianus*	Talang queenfish	AFMA
BC	Teleost	Carangidae	37337036	*Alepes kleinii*	Razorbelly trevally	AFMA
BC	Teleost	Carangidae	37337037	*Carangoides fulvoguttatus*	Yellowspotted trevally	AFMA
BC	Teleost	Carangidae	37337038	*Alectis indica*	Indian threadfish	AFMA
BC	Teleost	Carangidae	37337039	*Caranx sexfasciatus*	Bigeye trevally	AFMA
BC	Teleost	Carangidae	37337041	*Ulua aurochs*	Silvermouth trevally	AFMA
BC	Teleost	Carangidae	37337042	*Carangoides hedlandensis*	Bumpnose trevally	AFMA
BC	Teleost	Carangidae	37337043	*Carangoides talamparoides*	Whitetongue trevally; imposter trevally	AFMA
BC	Teleost	Carangidae	37337044	*Scomberoides tol*	Needlescaled queenfish	AFMA
BC	Teleost	Carangidae	37337045	*Scomberoides tala*	Barred queenfish	AFMA
BC	Teleost	Carangidae	37337046	*Scomberoides lysan*	Doublespotted queenfish	AFMA

ROLE IN FISHERY	TAXA NAME	FAMILY NAME	CAAB CODE	SCIENTIFIC NAME	COMMON NAME	SOURCE
BC	Teleost	Carangidae	37337047	*Pantolabus radiatus*	Fringefin trevally	AFMA
BC	Teleost	Carangidae	37337049	*Caranx tille*	Tille trevally	AFMA
BC	Teleost	Carangidae	37337056	*Decapterus kurroides*	Redtail scad	AFMA
BC	Teleost	Carangidae	37337064	*Caranx papuensis*	Brassy trevally	AFMA
BC	Teleost	Carangidae	37337068	*Carangoides ferdau*	Blue trevally	AFMA
BC	Teleost	Carangidae	37337072	*Parastromateus niger*	Black pomfret	AFMA
BC	Teleost	Carangidae	37337073	*Trachinotus anak*	Giant oystercracker	AFMA
BC	Teleost	Carangidae	37337074	*Trachinotus baillonii*	Smallspotted dart	AFMA
BC	Teleost	Carangidae	37337075	*Trachinotus blochii*	Snubnose dart	AFMA
BC	Teleost	Menidae	37340001	*Mene maculata*	Moonfish	AFMA
BC	Teleost	Leiognathidae	37341002	*Photopectoralis bindus*	Orangefin ponyfish	AFMA
BC	Teleost	Leiognathidae	37341004	*Aurigequula longispina*	Longspine ponyfish	AFMA
BC	Teleost	Leiognathidae	37341005	*Equulites leuciscus*	Whipfin ponyfish	AFMA
BC	Teleost	Leiognathidae	37341006	*Deveximentum insidiator [synonym: Secutor insidiator]*	Pugnose ponyfish	AFMA
BC	Teleost	Leiognathidae	37341007	*Gazza minuta*	Toothpony	AFMA
BC	Teleost	Leiognathidae	37341009	*Aurigequula fasciata*	Striped ponyfish	AFMA
BC	Teleost	Leiognathidae	37341010	*Eubleekeria splendens*	Splendid ponyfish	AFMA
BC	Teleost	Leiognathidae	37341013	*Nuchequula glenysae*	Twoblotch ponyfish	AFMA
BC	Teleost	Leiognathidae	37341014	*Leiognathus equulus*	Common ponyfish	AFMA
BC	Teleost	Leiognathidae	37341015	*Leiognathus ruconius*	Deep pugnosed ponyfish	AFMA
BC	Teleost	Bramidae	37342008	*Taractes asper*	Flathead pomfret	AFMA
BC	Teleost	Bramidae	37342014	*Taractes rubescens*	Knifetail pomfret	AFMA
BC	Teleost	Bramidae	37342015	*Taractichthys steindachneri*	Sickle pomfret	AFMA
BC	Teleost	Lutjanidae	37346003	*Lutjanus vitta*	Brownstripe Red snapper	AFMA
BC	Teleost	Lutjanidae	37346007	*Lutjanus malabaricus*	Saddletail snapper	AFMA
BC	Teleost	Lutjanidae	37346008	*Lutjanus lutjanus*	Bigeye snapper	AFMA
BC	Teleost	Lutjanidae	37346030	*Lutjanus johnii*	Golden snapper	AFMA
BC	Teleost	Lutjanidae	37346034	*Lutjanus fulviflamma*	Blackspot snapper	AFMA

ROLE IN FISHERY	TAXA NAME	FAMILY NAME	CAAB CODE	SCIENTIFIC NAME	COMMON NAME	SOURCE
BC	Teleost	Lutjanidae	37346057	*Lutjanus timoriensis*	Timor snapper	AFMA
BC	Teleost	Lutjanidae	37346065	*Lutjanus russellii*	Moses' snapper	AFMA
BC	Teleost	Nemipteridae	37347008	*Scolopsis meridiana* (synoym: *Scolopsis taenioptera*)	Redspot monocle bream	AFMA
BC	Teleost	Nemipteridae	37347014	*Nemipterus hexodon*	Ornate threadfin bream	AFMA
BC	Teleost	Nemipteridae	37347028	*Pentapodus paradiseus*	Paradise whiptail	AFMA
BC	Teleost	Gerreidae	37349002	*Pentaprion longimanus*	Longfin mojarra	AFMA
BC	Teleost	Gerreidae	37349003	*Gerres filamentosus*	Whipfin silver-biddy	AFMA
BC	Teleost	Gerreidae	37349004	*Gerres oyena*	Blacktip silverbiddy	AFMA
BC	Teleost	Gerreidae	37349005	*Gerres subfasciatus*	Common silverbiddy	AFMA
BC	Teleost	Haemulidae	37350002	*Pomadasys maculatus*	Blotched javelin	AFMA
BC	Teleost	Haemulidae	37350003	*Diagramma pictum*	Painted sweetlip	AFMA
BC	Teleost	Haemulidae	37350008	*Pomadasys trifasciatus*	Black-ear Javelin	AFMA
BC	Teleost	Haemulidae	37350011	*Pomadasys kaakan*	Javelin grunter	AFMA
BC	Teleost	Lethrinidae	37351006	*Lethrinus laticaudis*	Grass emperor	AFMA
BC	Teleost	Lethrinidae	37351012	*Lethrinus rubrioperculatus*	Spotcheek emperor	AFMA
BC	Teleost	Lethrinidae	37351026	*Monotaxis grandoculis*	Humpnose big-eye bream	AFMA
BC	Teleost	Sciaenidae	37354003	*Protonibea diacanthus*	Black jewfish	AFMA
BC	Teleost	Sciaenidae	37354004	*Johnius laevis*	Smooth jewfish	AFMA
BC	Teleost	Sciaenidae	37354006	*Otolithes ruber*	Silver teraglin	AFMA
BC	Teleost	Sciaenidae	37354007	*Johnius borneensis*	River jewfish	AFMA
BC	Teleost	Sciaenidae	37354009	*Johnius amblycephalus*	Bearded jewfish	AFMA
BC	Teleost	Sciaenidae	37354012	*Atrobucca brevis*	Orange jewfish	AFMA
BC	Teleost	Sciaenidae	37354026	*Larimichthys pamoides*	Southern yellow jewfish	AFMA
BC	Teleost	Mullidae	37355003	*Upeneus moluccensis*	Goldband goatfish	AFMA
BC	Teleost	Mullidae	37355005	*Parupeneus indicus*	Yellowspot goatfish	AFMA
BC	Teleost	Mullidae	37355007	*Upeneus sulphureus*	Sulphur goatfish	AFMA
BC	Teleost	Mullidae	37355013	*Upeneus sundaicus*	Ochrebanded goatfish	AFMA
BC	Teleost	Mullidae	37355014	*Upeneus tragula*	Bartail goatfish	AFMA

ROLE IN FISHERY	TAXA NAME	FAMILY NAME	CAAB CODE	SCIENTIFIC NAME	COMMON NAME	SOURCE
BC	Teleost	Mullidae	37355031	*Upeneus vittatus*	Striped goatfish	AFMA
BC	Teleost	Ephippidae	37362003	*Zabidius novemaculeatus*	Shortfin batfish	AFMA
BC	Teleost	Ephippidae	37362004	*Platax teira*	Roundface batfish	AFMA
BC	Teleost	Drepaneidae	37362005	*Drepane punctata*	Sicklefish	AFMA
BC	Teleost	Scatophagidae	37363001	*Selenotoca multifasciata*	Striped scat	AFMA
BC	Teleost	Rhinoprenidae	37364001	*Rhinoprenes pentanemus*	Threadfin scat	AFMA
BC	Teleost	Chaetodontidae	37365015	*Chelmon muelleri*	Blackfin coralfish	AFMA
BC	Teleost	Chaetodontidae	37365068	*Forcipiger flavissimus*	Longnose butterfly fish	AFMA
BC	Teleost	Cepolidae	37380002	*Acanthocepola abbreviata*	Yellowspotted bandfish	AFMA
BC	Teleost	Mugilidae	37381002	*Mugil cephalus*	Sea mullet	AFMA
BC	Teleost	Mugilidae	37381010	*Valamugil buchanani*	Bluetail mullet	AFMA
BC	Teleost	Sphyraenidae	37382001	*Sphyraena pinguis*	Striped barracuda	AFMA
BC	Teleost	Sphyraenidae	37382004	*Sphyraena jello*	Pickhandle barracuda	AFMA
BC	Teleost	Sphyraenidae	37382009	*Sphyraena qenie*	Darkfinned seapike	AFMA
BC	Teleost	Polynemidae	37383001	*Polydactylus nigripinnis*	Blackfin threadfin	AFMA
BC	Teleost	Polynemidae	37383002	*Polydactylus multiradiatus*	Australian threadfin	AFMA
BC	Teleost	Polynemidae	37383004	*Eleutheronema tetradactylum*	Blue threadfin	AFMA
BC	Teleost	Labridae	37384004	*Choerodon cephalotes*	Purple tuskfish	AFMA
BC	Teleost	Labridae	37384008	*Choerodon monostigma*	Darkspot tuskfish	AFMA
BC	Teleost	Labridae	37384009	*Choerodon sugillatum*	Wedgetail tuskfish	AFMA
BC	Teleost	Labridae	37384166	*Thalassoma jansenii*	Jansen's wrasse	AFMA
BC	Teleost	Labridae	37384167	*Thalassoma lunare*	Moon wrasse	AFMA
BC	Teleost	Labridae	37384169	*Thalassoma purpureum*	Surge wrasse	AFMA
BC	Teleost	Labridae	37384170	*Thalassoma quinquevittatum*	Red-ribbon wrasse	AFMA
BC	Teleost	Pinguipedidae	37390005	*Parapercis nebulosa*	Pinkbanded grubfish	AFMA
BC	Teleost	Uranoscopidae	37400010	*Ichthyscopus fasciatus*	Banded stargazer	AFMA
BC	Teleost	Callionymidae	37427007	*Calliurichthys grossi*	Longnose stinkfish	AFMA
BC	Teleost	Gobiidae	37428001	*Yongeichthys nebulosus*	Hairfin goby	AFMA

ROLE IN FISHERY	TAXA NAME	FAMILY NAME	CAAB CODE	SCIENTIFIC NAME	COMMON NAME	SOURCE
BC	Teleost	Siganidae	37438004	*Siganus canaliculatus*	White-spotted rabbitfish	AFMA
BC	Teleost	Siganidae	37438005	*Siganus javus*	Java rabbitfish	AFMA
BC	Teleost	Siganidae	37438008	*Siganus corallinus*	Blue-spotted rabbitfish	AFMA
BC	Teleost	Scombridae	37441007	*Scomberomorus commerson*	Spanish mackerel	AFMA
BC	Teleost	Scombridae	37441012	*Rastrelliger kanagurta*	Mouth mackerel	AFMA
BC	Teleost	Scombridae	37441014	*Scomberomorus queenslandicus*	School mackerel	AFMA
BC	Teleost	Scombridae	37441015	*Scomberomorus munroi*	Spotted mackerel	AFMA
BC	Teleost	Centrolophidae	37445007	*Psenopsis humerosa*	Blackspot butterfish	AFMA
BC	Teleost	Psettodidae	37457001	*Psettodes erumei*	Australian halibut	AFMA
BC	Teleost	Paralichthyidae	37460002	*Pseudorhombus jenynsii*	Smalltooth flounder	AFMA
BC	Teleost	Paralichthyidae	37460008	*Pseudorhombus elevatus*	Deep flounder	AFMA
BC	Teleost	Paralichthyidae	37460009	*Pseudorhombus arsius*	Largetooth flounder	AFMA
BC	Teleost	Soleidae	37462001	*Aesopia cornuta*	Thickray sole, unicorn sole	AFMA
BC	Teleost	Soleidae	37462003	*Zebrias craticulus*	Wicker-work sole	AFMA
BC	Teleost	Soleidae	37462007	*Brachirus muelleri*	Tufted sole	AFMA
BC	Teleost	Cynoglossidae	37463002	*Paraplagusia longirostris*	Pinocchio tongue sole	AFMA
BC	Teleost	Triacanthidae	37464001	*Trixiphichthys weberi*	Blacktip tripodfish	AFMA
BC	Teleost	Triacanthidae	37464002	*Triacanthus biaculeatus*	Short-nosed tripodfish	AFMA
BC	Teleost	Triacanthidae	37464008	*Pseudotriacanthus strigilifer*	Blotched tripodfish	AFMA
BC	Teleost	Triacanthidae	37464009	*Triacanthus nieuhofi*	Silver tripodfish	AFMA
BC	Teleost	Monacanthidae	37465009	*Monacanthus chinensis*	Fan-bellied leatherjacket	AFMA
BC	Teleost	Monacanthidae	37465010	*Anacanthus barbatus*	Bearded leatherjacket	AFMA
BC	Teleost	Monacanthidae	37465020	*Pseudomonacanthus peroni*	Potbelly leatherjacket	AFMA
BC	Teleost	Monacanthidae	37465024	*Paramonacanthus filicauda*	Threadfin leatherjacket	AFMA
BC	Teleost	Ostraciidae	37466002	*Anoplocapros inermis*	Eastern smooth boxfish	AFMA
BC	Teleost	Ostraciidae	37466005	*Ostracion nasus* (synonym: *Rhynchostracion nasus*)	Shortnose boxfish	AFMA
BC	Teleost	Ostraciidae	37466019	*Ostracion meleagris*	Black boxfish	AFMA
BC	Teleost	Tetraodontidae	37467007	*Lagocephalus sceleratus*	Silver toadfish	AFMA

ROLE IN FISHERY	TAXA NAME	FAMILY NAME	CAAB CODE	SCIENTIFIC NAME	COMMON NAME	SOURCE
BC	Teleost	Tetraodontidae	37467010	*Feroxodon multistriatus*	Ferocious puffer	AFMA
BC	Teleost	Tetraodontidae	37467012	*Lagocephalus lunaris*	Rough golden toadfish	AFMA
BC	Teleost	Tetraodontidae	37467015	*Chelonodon patoca*	Milkspotted puffer	AFMA
BC	Teleost	Tetraodontidae	37467017	*Lagocephalus spadiceus*	Brownback toadfish	AFMA
BC	Teleost	Diodontidae	37469004	*Tragulichthys jaculiferus*	Longspine porcupinefish	AFMA
BC	Teleost	Diodontidae	37469007	*Cyclichthys orbicularis*	Shortspine porcupinefish	AFMA
BC	Teleost	Diodontidae	37469008	*Cyclichthys hardenbergi*	Plain porcupinefish	AFMA
BC	Invertebrate	Comatulidae	25030002	*Capillaster multiradiatus*	A crinoid	AFMA
BC	Invertebrate	Comatulidae	25030030	*Comatula pectinata*	A crinoid	AFMA
BC	Invertebrate	Comatulidae	25030031	*Comatula rotalaria*	A crinoid	AFMA
BC	Invertebrate	Comatulidae	25030032	*Comatula solaris*	A crinoid	AFMA
BC	Invertebrate	Comatulidae	25030037	*Clarkcomanthus comanthipinna*	A crinoid	AFMA
BC	Invertebrate	Himerometridae	25038002	*Amphimetra tessellata*	A crinoid	AFMA
BC	Invertebrate	Ptilometridae	25047001	*Ptilometra macronema*	A crinoid	AFMA

Protected species

A protected species[2] refers to all species listed/covered under the EPBC Act 1999, which include Protected[3] species (listed threatened species i.e. vulnerable, endangered or critically endangered), cetaceans, listed migratory species and listed marine species.

Protected species that occur in the area of the sub-fishery. Protected species are often poorly listed by fisheries due to low frequency of direct interaction. Both direct (capture) and indirect (e.g. food source captured) interaction are considered in the ERAEF approach. A list of protected species has been generated for this sub-fishery and included in the PSA and SAFE (chondrichthyans) species list. This list was initially provided by AFMA which was further validated and reviewed using information on EPBC Act List of Threatened Fauna website; http://www.environment.gov.au/cgi-bin/sprat/public/publicthreatenedlist.pl and available literature on protected species occurrence e.g., marine birds: Menkhorst et al. (2017), Reid et al. (2002); marine mammals: Woinarski et al.(2014), Jefferson et al. (2015); teleosts: Atlas of Living Australia Fishmap http://fish.ala.org.au/, CAAB http://www.cmar.csiro.au/caab/index.html , Fishes of Australia http://fishesofaustralia.net.au/). Species from higher order family categories that were considered to have potential to interact with fishery (based on geographic range and proven/perceived susceptibility to the fishing gear/methods and examples from other similar fisheries across the globe) were also included.

Table 2.6. Protected species (PS) list for the NPF Banana Prawn sub-fishery. AFMA: refers to AFMA Logbook (Log) and/or Observer data (Obs).

ROLE IN FISHERY	TAXA	FAMILY NAME	CAAB CODE	SCIENTIFIC NAME	COMMON NAME	SOURCE(S)
PS	Chondrichthyan	Pristidae	37025001	*Pristis zijsron*	Green sawfish	AFMA Log, AFMA Obs. Apportioned 37025000 to this species and 3 other species in list (37025002, 37025003, 37025004)
PS	Chondrichthyan	Pristidae	37025002	*Anoxypristis cuspidata*	Narrow sawfish	AFMA Log. Apportioned 37025000 to this species and 3 other species in list (37025001, 37025003, 37025004)
PS	Chondrichthyan	Pristidae	37025003	*Pristis pristis*	Freshwater sawfish	AFMA Log. Apportioned 37025000 to this species and 3 other species in list (37025001, 37025002, 37025004)
PS	Chondrichthyan	Pristidae	37025004	*Pristis clavata*	Dwarf sawfish	AFMA Log. Apportioned 37025000 to this species and 3 other species in list (37025001, 37025002, 37025003)
PS	Teleost	Syngnathidae	37282006	*Trachyrhamphus bicoarctata*	Bentstick pipefish	AFMA Obs. Also 37282000: Syngnathidae.

[2] The term "protected" species refers to species listed under [Part 13] the EPBC Act 1999 and replaces the term "Threatened, endangered and protected species (PS)" commonly used in past Commonwealth Government (including AFMA) documents.

[3] Note "protected" (with small "p") refers to all species covered by the EPBC Act 1999 while "Protected" (capital P) refers only to those protected species that are threatened (vulnerable, endangered or critically endangered).

ROLE IN FISHERY	TAXA	FAMILY NAME	CAAB CODE	SCIENTIFIC NAME	COMMON NAME	SOURCE(S)
PS	Teleost	Syngnathidae	37282101	*Trachyrhamphus longirostris*	Straightstick pipefish	AFMA Obs
PS	Teleost	Syngnathidae	37282124	*Hippocampus multispinus*	Northern spiny seahorse	AFMA Obs. Also 37282000: Syngnathidae. Also 37282900: Hippocampus spp
PS	Marine reptile	Cheloniidae	39020001	*Caretta caretta*	Loggerhead turtle	AFMA CMO. Also 39001001 (Testudines; AFMA Log) and 39020000 (Cheloniidae; CMO)
PS	Marine reptile	Cheloniidae	39020002	*Chelonia mydas*	Green turtle	AFMA Log. Also 39001001 (Testudines; AFMA Log) and 39020000 (Cheloniidae; CMO)
PS	Marine reptile	Cheloniidae	39020003	*Eretmochelys imbricata*	Hawksbill turtle	Added from 39001001 (Testudines; AFMA Log) and 39020000 (Cheloniidae; CMO)
PS	Marine reptile	Cheloniidae	39020004	*Lepidochelys olivacea*	Olive ridley turtle	AFMA Log, AFMA Obs. Also 39001001 (Testudines; AFMA Log) and 39020000 (Cheloniidae; CMO)
PS	Marine reptile	Cheloniidae	39020005	*Natator depressus*	Flatback turtle	AFMA Log. CMO. Also 39001001 (Testudines; AFMA Log) and 39020000 (Cheloniidae; CMO)
PS	Marine reptile	Dermochelyidae	39021001	*Dermochelys coriacea*	Leatherback turtle	Added from 39001001 (Testudines; AFMA Log).
PS	Marine reptile	Elapidae	39125001	*Acalyptophis peronii*	Horned sea snake	AFMA Obs. Also 39125000: Hydrophiidae (AFMA Log). Sub-family: Hydrophiinae
PS	Marine reptile	Elapidae	39125003	*Aipysurus duboisii*	Reef shallows sea snake	CMO. Also 39125000: Hydrophiidae (AFMA Log). Sub-family: Hydrophiinae
PS	Marine reptile	Elapidae	39125004	*Aipysurus mosaicus*	Stagger-banded sea snake	CMO. Also 39125000: Hydrophiidae (AFMA Log). Sub-family: Hydrophiinae
PS	Marine reptile	Elapidae	39125007	*Aipysurus laevis*	Golden sea snake	AFMA Obs. Also 39125000: Hydrophiidae (AFMA Log). Sub-family: Hydrophiinae
PS	Marine reptile	Elapidae	39125009	*Astrotia stokesii*	Stokes' sea snake	AFMA Obs. Also 39125000: Hydrophiidae (AFMA Log). Sub-family: Hydrophiinae
PS	Marine reptile	Elapidae	39125010	*Disteira kingii*	Spectacled sea snake	AFMA Obs. Also 39125000: Hydrophiidae (AFMA Log). Sub-family: Hydrophiinae
PS	Marine reptile	Elapidae	39125011	*Disteira major*	Olive-headed sea snake	AFMA Obs. Also 39125000: Hydrophiidae (AFMA Log). Sub-family: Hydrophiinae
PS	Marine reptile	Elapidae	39125012	*Emydocephalus annulatus*	Turtle-headed sea snake	AFMA Obs. Also 39125000: Hydrophiidae (AFMA Log). Sub-family: Hydrophiinae
PS	Marine reptile	Elapidae	39125013	*Enhydrina schistosa*	Beaked sea snake	AFMA Obs. Also 39125000: Hydrophiidae (AFMA Log). Sub-family: Hydrophiinae
PS	Marine reptile	Elapidae	39125021	*Hydrophis elegans*	Elegant sea snake	AFMA Obs. Also 39125000: Hydrophiidae (AFMA Log). Sub-family: Hydrophiinae
PS	Marine reptile	Elapidae	39125025	*Hydrophis mcdowelli*	Small-headed sea snake	AFMA Obs. Also 39125000: Hydrophiidae (AFMA Log). Sub-family: Hydrophiinae
PS	Marine reptile	Elapidae	39125028	*Hydrophis ornatus*	Spotted sea snake	AFMA Obs. Also 39125000: Hydrophiidae (AFMA Log). Sub-family: Hydrophiinae

ROLE IN FISHERY	TAXA	FAMILY NAME	CAAB CODE	SCIENTIFIC NAME	COMMON NAME	SOURCE(S)
PS	Marine reptile	Elapidae	39125029	*Hydrophis pacificus*	Large-headed sea snake	AFMA Obs. Also 39125000: Hydrophiidae (AFMA Log). Sub-family: Hydrophiinae
PS	Marine reptile	Elapidae	39125031	*Lapemis curtis*	Spine-bellied sea snake	AFMA Obs. Also 39125000: Hydrophiidae (AFMA Log). Sub-family: Hydrophiinae
PS	Marine reptile	Elapidae	39125033	*Pelamis platurus*	Yellow-bellied sea snake	AFMA Obs. Also 39125000: Hydrophiidae (AFMA Log). Sub-family: Hydrophiinae
PS	Marine bird	Hydrobatidae	40042004	*Oceanites oceanicus*	Wilson's storm-petrel	Added from 40042000: Hydrobatidae (AFMA Obs). Blaber pers.comm.
PS	Marine bird	Laridae	40128002	*Anous stolidus*	Common noddy	Added from 40128000: Laridae (AFMA Obs). Blaber and Milton 1994
PS	Marine bird	Laridae	40128006	*Chlidonias hybridus*	Whiskered tern	Added from 40128000: Laridae (AFMA Obs). Blaber pers.comm.
PS	Marine bird	Laridae	40128007	*Chlidonias leucopterus*	White-winged black tern	Added from 40128000: Laridae (AFMA Obs). Blaber pers.comm.
PS	Marine bird	Laridae	40128013	*Larus novaehollandiae / Chroicocephalus novaehollandiae*	Silver gull	Added from 40128000: Laridae (AFMA Obs). Blaber pers.comm.
PS	Marine bird	Laridae	40128023	*Sterna anaethetus*	Bridled tern	Added from 40128000: Laridae (AFMA Obs). Blaber pers.comm.
PS	Marine bird	Laridae	40128024	*Sterna bengalensis*	Lesser crested tern	Added from 40128000: Laridae (AFMA Obs). Blaber pers.comm.
PS	Marine bird	Laridae	40128025	*Sterna bergii*	Crested tern	Added from 40128000: Laridae (AFMA Obs). Blaber and Milton 1994
PS	Marine bird	Laridae	40128026	*Sterna caspia*	Caspian tern	Added from 40128000: Laridae (AFMA Obs). Blaber pers.comm.
PS	Marine bird	Laridae	40128027	*Sterna dougallii*	Roseate tern	Added from 40128000: Laridae (AFMA Obs). Blaber and Milton 1994
PS	Marine bird	Laridae	40128028	*Sterna fuscata*	Sooty tern	Added from 40128000: Laridae (AFMA Obs). Blaber and Milton 1994
PS	Marine bird	Laridae	40128029	*Sterna hirundo*	Common tern	Added from 40128000: Laridae (AFMA Obs). Blaber and Milton 1994
PS	Marine bird	Laridae	40128031	*Sterna nilotica*	Gull-billed tern	Added from 40128000: Laridae (AFMA Obs). Blaber pers.comm.
PS	Marine bird	Laridae	40128034	*Sterna sumatrana*	Black-naped tern	Added from 40128000: Laridae (AFMA Obs). Blaber and Milton 1994

Scoping Document S2B1. Benthic Habitats

Since the previous assessments over a decade ago, there has been considerable research and habitat identification and modelling of demersal habitats around Australia (Williams et al. 2009; 2010a, b, 2011; Hobday et al. 2011; Pitcher et al. 2015, 2016, 2018). This has culminated in Pitcher et al. (2016; 2018), redefining much of the Australian seafloor based on meso-scale surrogates collated from data from biological surveys, environmental data, and protected area/fishery closure data. The temporal range of the fishery effort data of Pitcher et al. (2016; 2018) was from 1985 -2012 which is immediately prior to this current assessment period and was considered relevant. The new data and methodology are not directly mappable to the original analyses, but these assessments are more comprehensive than the previous one and will therefore be used in preference to the original scoping of habitats.

In the NPF region, 12 survey datasets (five fish trawl, two prawn trawl, four epibenthic sled, and one grab) contributed to mapping the NPF regional environment resulting in 22 assemblages (Pitcher et al. 2016). Also, 20.5% of the area is closed (~19.6% within CMRs, ~0.2% in MPAs and 0.7% by fishery regulation). The footprint of the NPF was 1.6% or about 2% over multiple years.

The most vulnerable habitat type identified in Pitcher et al. (2016) were:

- Habitat–forming benthos (NPF assemblages 2 and 9).

The corresponding most vulnerable habitat type identified in Pitcher et al. (2018) were:

- Habitat–forming benthos (NPF region 1: assemblage 11; region 2: assemblage 6).

The most vulnerable habitat-forming benthos included bryozoans, corals sponges, gorgonians, anemones, and ascidians and are present in the more exposed assemblages and were abundant in assemblage 2 (largest area but lower intensity) but relatively less, but patchily high in assemblage 9 (largest swept area, highest intensity, low protection). These habitats were the most exposed types to trawling with footprints of 5.7% and 13% respectively, and total swept areas of 7.9% and 24.7% respectively (Table 6 in Pitcher et al. (2016)).

The lack of evidence to prove direct impact from trawling impedes further analysis. Some of the benthos may be more widely distributed in areas where prawn trawling does not occur thus lower their overall risk, but corals and anemones and most bryozoans appear to be restricted to assemblage 2. Furthermore, using these assessments by Pitcher et al. 2016 (and Pitcher et al. 2018) ideally need to be incorporated into the ERAEF protocol. Consequently, the SICA is preliminary and further assessment at Level 2 is not currently possible.

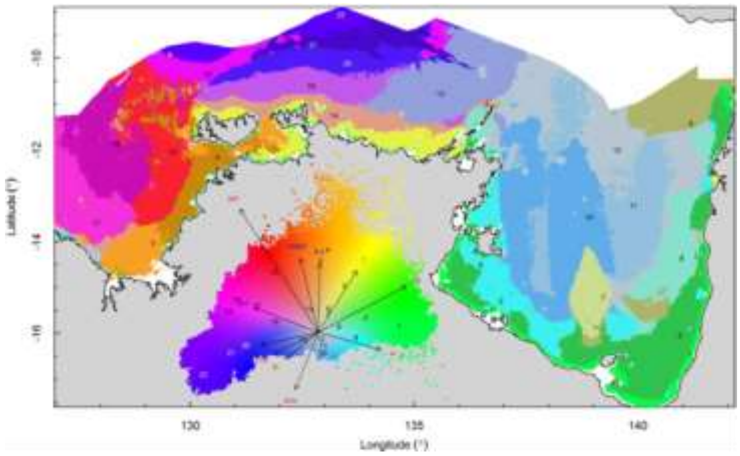


Figure 2.1. Map of the NPF region showing the 22 assemblages derived by Pitcher et. al 2016. (Excerpt from Pitcher et al. 2016). Each assemblage is used as proxies for habitat in the assessment.

Table 2.7. Benthic habitats that occur within the jurisdictional boundary of the NPF Banana Prawn sub-fishery (from Pitcher et. al. 2016). The description details of these assemblages were not available at the time of assessment. While records suggest trawl operations occurred across some of these assemblages (shaded) it was not possible to determine exactly the overlap with these assemblages.

BIOME	ASSEMBLAGE	HABITAT TYPE
NPF	1	
	2	Habitat–forming benthos- bryozoans, corals sponges, gorgonians, anemones and ascidians
	3	
	4	
	5	
	6	
	7	
	8	
	9	Habitat–forming benthos-particularly gorgonians and bryozoans
	10	
	11	
	12	
	13	
	14	
	15	
	16	
	17	
	18	
	19	
	20	
	21	
	22	

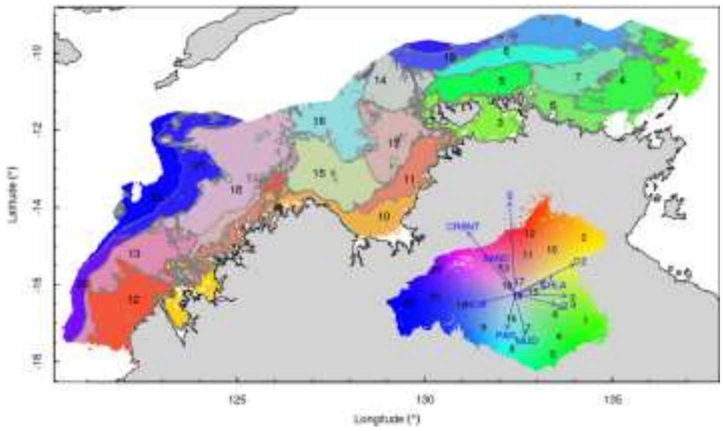


Figure 2.2. Map of the Arafura Sea / Timor Sea region 1 showing the 19 assemblages (within the NPF) derived by Pitcher et al. 2018. (Excerpt from Pitcher et al. 2018). Each assemblage is used as proxies for habitat in the assessment.

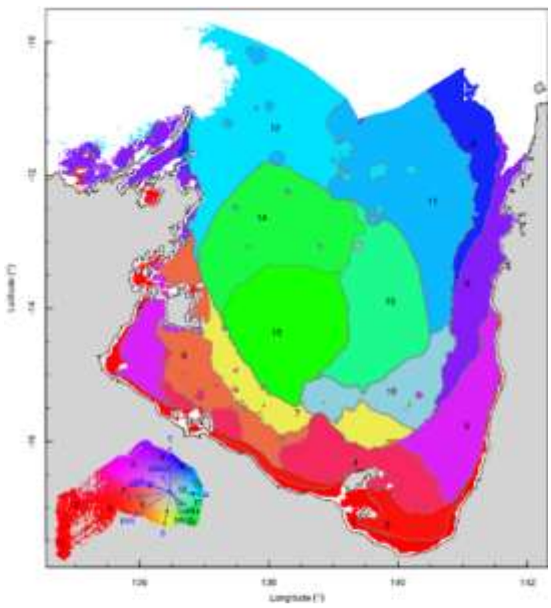


Figure 2.3. Map of the Gulf of Carpentaria region 2 showing the 15 assemblages derived by Pitcher et al. 2018. (Excerpt from Pitcher et al. 2018). Each assemblage is used as proxies for habitat in the assessment.

Table 2.8. Benthic habitats in region 1 that occur within the jurisdictional boundary of the NPF Banana Prawn sub-fishery (from Pitcher et. al. 2018). The details of these assemblages were not available at the time of assessment. While records suggest trawl operations occurred across some of these assemblages (shaded) it was not possible to determine exactly the overlap with these assemblages.

BIOME	ASSEMBLAGE	HABITAT TYPE
NPF	1	
	4	
	5	
	6	
	7	
	8	
	9	
	10	
	11	Biogenic, low outcrop, seagrass, coastal margin
	14	
	15	
	16	
	17	
	19	

Table 2.9. Benthic habitats in region 2 that occur within the jurisdictional boundary of the NPF Banana Prawn sub-fishery (from Pitcher et. al. 2018). The details of these assemblages were not available at the time of assessment. While records suggest trawl operations occurred across some of these assemblages (shaded) it was not possible to determine exactly the overlap with these assemblages.

BIOME	ASSEMBLAGE	HABITAT TYPE
NPF	1	
	2	
	3	
	4	Habitat–forming benthos- bryozoans, corals sponges, gorgonians, anemones and ascidians
	5	Habitat–forming benthos- bryozoans, corals sponges, gorgonians, anemones and ascidians
	6	Habitat–forming benthos-particularly gorgonians and bryozoans
	7	
	8	
	9	
	10	
	11	
	12	
	13	
	14	
	15	

The previous ERAEF assessment of the NPF trawl (Griffiths et al. 2007) determined that habitats encountered by the Banana Prawn sector were restricted to coastal margin depths while those of Tiger Prawn encompassed both coastal margin and (shallow) inner shelf depths. They concluded that habitats and attached communities could be expected to sustain damage, mortality and habitat modification from trawling and the rate of recovery while unknown, is likely to be variable depending on taxa and frequency of targeting. The medium risk habitats comprised inner shelf habitats that were mostly “flat to highly irregular unconsolidated sediment habitats of mud to coarse grained biogenic gravels, with large erect sponges, hard and soft corals (of variable flexibility), complex communities of mixed fauna, and individual animals” (Griffiths et al. 2007); and coastal habitats that were sediment habitats supporting seagrasses, and vulnerable bivalve-dominated habitats. Low risk shelf habitats were sediment-based with low and encrusting epifauna of corals, sponges, ascidians, bryozoans), bioturbating infauna or no fauna at all; and coastal margin habitats considered either unlikely to be trawled or were rock or sediment-based with tall, erect fauna.

Scoping Document S2B2. Pelagic Habitats

Table 2.10. Pelagic habitats for the NPF Banana Prawn sub-fishery. Shading denotes habitats occurring within the jurisdictional boundary of the fishery. Bolded text refers to pelagic habitats where fishing effort has occurred.

ERAEF PELAGIC HABITAT NO.	PELAGIC HABITAT TYPE	DEPTH (M)	COMMENTS	SOURCE
P1	Eastern Pelagic Province - Coastal	0 – 200		ERA pelagic habitat database based on pelagic communities definitions
P2	Eastern Pelagic Province - Oceanic	0 – > 600	this is a compilation of the range covered by Oceanic Community (1) and (2)	ERA pelagic habitat database based on pelagic communities definitions
P3	Heard/ McDonald Islands Pelagic Provinces - Oceanic	0 - >1000	this is a compilation of the range covered by Oceanic Community (1) and (2)	ERA pelagic habitat database based on pelagic communities definitions
P4	North Eastern Pelagic Province - Oceanic	0 – > 600	this is a compilation of the range covered by Oceanic Community (1) and (2)	ERA pelagic habitat database based on pelagic communities definitions
P5	Northern Pelagic Province - Coastal	0 – 200		ERA pelagic habitat database based on pelagic communities definitions
P6	North Western Pelagic Province - Oceanic	0 – > 800	this is a compilation of the range covered by Oceanic Community (1) and (2)	ERA pelagic habitat database based on pelagic communities definitions
P7	Southern Pelagic Province - Coastal	0 – 200	this is a compilation of the range covered by Coastal pelagic Tas and GAB	ERA pelagic habitat database based on pelagic communities definitions
P8	Southern Pelagic Province - Oceanic	0 – > 600	this is a compilation of the range covered by Oceanic Communities (1, 2 and 3)	ERA pelagic habitat database based on pelagic communities definitions
P9	Southern Pelagic Province - Seamount Oceanic	0 – > 600	this is a compilation of the range covered by Seamount Oceanic Communities (1), (2), and (3)	ERA pelagic habitat database based on pelagic communities definitions

ERAEF PELAGIC HABITAT NO.	PELAGIC HABITAT TYPE	DEPTH (M)	COMMENTS	SOURCE
P10	Western Pelagic Province - Coastal	0 – 200		ERA pelagic habitat database based on pelagic communities definitions
P11	Western Pelagic Province - Oceanic	0 – > 400	this is a compilation of the range covered by Oceanic Community (1) and (2)	ERA pelagic habitat database based on pelagic communities definitions
P12	Eastern Pelagic Province - Seamount Oceanic	0 – > 600	this is a compilation of the range covered by Seamount Oceanic Communities (1) and (2)	ERA pelagic habitat database based on pelagic communities definitions
P13	Heard/ McDonald Islands Pelagic Provinces - Plateau	0 -1000	this is a the same as community Heard Plateau 0-1000m	ERA pelagic habitat database based on pelagic communities definitions
P14	North Eastern Pelagic Province - Coastal	0 – 200		ERA pelagic habitat database based on pelagic communities definitions
P15	North Eastern Pelagic Province - Plateau	0 – > 600	this is a compilation of the range covered by the Northeastern Seamount Oceanic (1) and (2)	ERA pelagic habitat database based on pelagic communities definitions
P16	North Eastern Pelagic Province - Seamount Oceanic	0 – > 600		ERA pelagic habitat database based on pelagic communities definitions
P17	Macquarie Island Pelagic Province - Oceanic	0 – 250		ERA pelagic habitat database based on pelagic communities definitions
P18	Macquarie Island Pelagic Province - Coastal	0 - > 1500	this is a compilation of the range covered by Oceanic Community (1) and (2)	ERA pelagic habitat database based on pelagic communities definitions

Scoping Document S2C1. Demersal Communities

In ERAEF, communities are defined as the set of species assemblages that occupy the large scale provinces and biomes identified from national bioregionalisation studies. The biota includes mobile fauna, both vertebrate and invertebrate, but excludes sessile organisms such as corals that are largely structural and are used to identify benthic habitats. The same community lists are used for all fisheries, with those selected as relevant for a particular fishery being identified on the basis of spatial overlap with effort in the fishery. The spatial boundaries for demersal communities are based on IMCRA boundaries for the shelf, and on slope bioregionalisations for the slope (IMCRA 1998; Last et al. 2005). The spatial boundaries for the pelagic communities are based on pelagic bioregionalisations and on oceanography (Condie et al. 2003; Lyne and Hayes 2004). Fishery and region specific modifications to these boundaries are described in detail in Hobday et al. (2007) and briefly outlined in the footnotes to the community Tables below.

Table 2.11. Demersal communities in which fishing activity occurred in the NPF Banana Prawn sub-fishery (black; x). Shaded cells indicate all communities within the province.

DEMERSAL COMMUNITY	CAPE	NORTH EASTERN TRANSITION	NORTH EASTERN	CENTRAL EASTERN TRANSITION	CENTRAL EASTERN	SOUTH EASTERN TRANSITION	CENTRAL BASS	TASMANIAN	WESTERN TAS TRANSITION	SOUTHERN	SOUTH WESTERN TRANSITION	CENTRAL WESTERN	CENTRAL WESTERN TRANSITION	NORTH WESTERN	NORTH WESTERN TRANSITION	TIMOR	TIMOR TRANSITION	HEARD AND MCDONALD IS	MACQUARIE IS
Inner Shelf 0 – 110m [1,2]																x	x		
Outer Shelf 110 – 250m [1,2,]																x			
Upper Slope 250 – 565m [3]																			
Mid–Upper Slope 565 – 820m[3]																			
Mid Slope 820 – 1100m[3]																			
Lower slope/ Abyssal > 1100m[6]																			
Reef 0 -110m[7, 8]																			
Reef 110-250m[8]																			
Seamount 0 – 110m																			
Seamount 110- 250m																			
Seamount 250 – 565m																			
Seamount 565 – 820m																			

DEMERSAL COMMUNITY	CAPE	NORTH EASTERN TRANSITION	NORTH EASTERN	CENTRAL EASTERN TRANSITION	CENTRAL EASTERN	SOUTH EASTERN TRANSITION	CENTRAL BASS	TASMANIAN	WESTERN TAS TRANSITION	SOUTHERN	SOUTH WESTERN TRANSITION	CENTRAL WESTERN	CENTRAL WESTERN TRANSITION	NORTH WESTERN	NORTH WESTERN TRANSITION	TIMOR	TIMOR TRANSITION	HEARD AND MCDONALD IS	MACQUARIE IS
Seamount 820 – 1100m																			
Seamount 1100 – 3000m																			
Plateau 0 – 110m																			
Plateau 110- 250m[4]																			
Plateau 250 – 565m[4]																			
Plateau 565 – 820m[5]																			
Plateau 820 – 1100m[5]																			

[1] Four inner shelf communities occur in the Timor Transition (Arafura, Groote, Cape York and Gulf of Carpentaria) and three inner shelf communities occur in the Southern (Eyre, Eucla and South West Coast). At Macquarie Is: [2]inner and outer shelves (0-250m), and [3]upper and midslope communities combined (250-1100m). At Heard/McDonald Is: [4]outer and upper slope plateau communities combined to form four communities: Shell Bank, inner and outer Heard Plateau (100-500m) and Western Banks (200-500m), [5]mid and upper plateau communities combined into 3 trough (Western, North Eastern and South Eastern), southern slope and North Eastern plateau communities (500-1000m), and [6] 3 groups at Heard Is: Deep Shell Bank (>1000m), Southern and North East Lower slope/abyssal, [7]Great Barrier Reef in the North Eastern Province and Transition and [8] Rowley Shoals in North Western Transition.

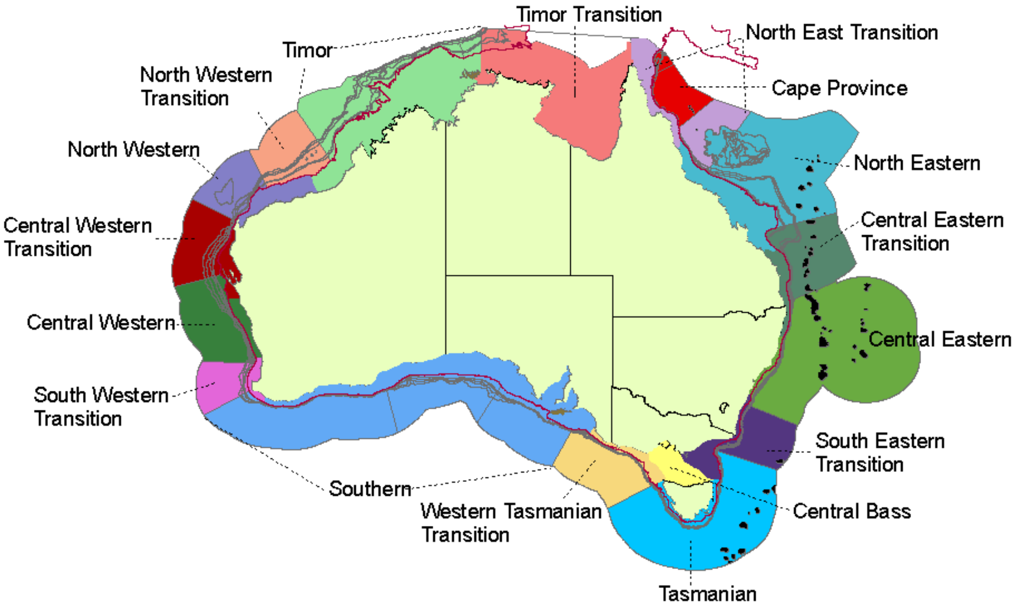
Scoping Document S2C2. Pelagic Communities

Table 2.12. Pelagic communities in which fishing activity occurs in the NPF Banana Prawn sub-fishery (black; x). Shaded cells indicate all communities that exist in the province.

PELAGIC COMMUNITY	NORTHEASTERN	EASTERN	SOUTHERN	WESTERN	NORTHERN	NORTHWESTERN	HEARD AND MCDONALD IS2	MACQUARIE IS
Coastal pelagic 0-200m[1,2]					x			
Oceanic (1) 0 – 600m								
Oceanic (2) >600m								
Seamount oceanic (1) 0 – 600m								
Seamount oceanic (2) 600–3000m								
Oceanic (1) 0 – 200m								
Oceanic (2) 200-600m								
Oceanic (3) >600m								
Seamount oceanic (1) 0 – 200m								
Seamount oceanic (2) 200 – 600m								
Seamount oceanic (3) 600–3000m								
Oceanic (1) 0-400m								
Oceanic (2) >400m								
Oceanic (1) 0-800m								
Oceanic (2) >800m								
Plateau (1) 0-600m								
Plateau (2) >600m								
Heard Plateau 0-1000m[3]								
Oceanic (1) 0-1000m								
Oceanic (2) >1000m								
Oceanic (1) 0-1600m								
Oceanic (2) >1600m								

[1] Northern Province has five coastal pelagic zones (NWS, Bonaparte, Arafura, Gulf and East Cape York) and Southern Province has two zones (Tas, GAB). [2] At Macquarie Is: coastal pelagic zone to 250m. [3] At Heard and McDonald Is: coastal pelagic zone broadened to cover entire plateau to maximum of 1000 m.

(a)



(b)

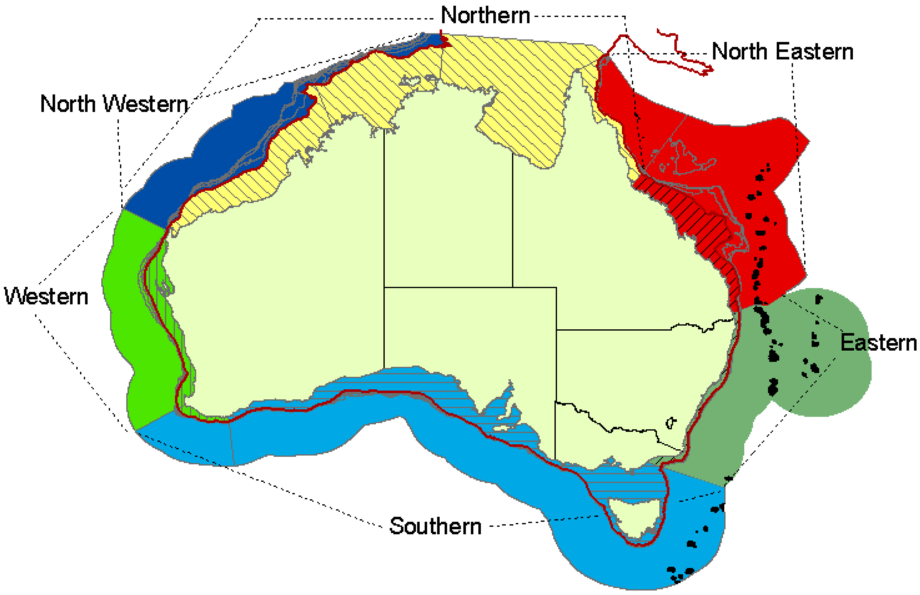


Figure 2.4 (a) Demersal communities around mainland Australia based on bioregionalisation schema. Some inshore (0-110 m) communities comprise more than one community e.g. Timor Transition comprises 4 distinct communities. (b) Australian pelagic provinces. Hatched areas indicate coastal epipelagic zones overlying the shelf. Offshore (oceanic) provinces comprise two or more overlaying pelagic zones as indicated in Table 2.10. Seamounts (black) and plateaux (light green) are illustrated in their demersal or pelagic provinces.

2.2.3 Identification of objectives for components and sub-components (Step 3)

Objectives are identified for each sub-fishery for the five ecological components (target, bycatch/byproduct, protected species, habitats, and communities) and sub-components, and are clearly documented. It is important to identify objectives that managers, the fishing industry, and other stakeholders can agree on, and that scientists can quantify and assess. The criteria for selecting ecological operational objectives for risk assessment are that they:

- be biologically relevant;
- have an unambiguous operational definition;
- be accessible to prediction and measurement; and
- that the quantities they relate to be exposed to the hazards.

For fisheries that have completed Ecological Sustainable Development (ESD) reports, use can be made of the operational objectives stated in those reports.

Each ‘operational objective’ is matched to example indicators. **Scoping Document S3** provides suggested examples of operational objectives and indicators. Where operational objectives are already agreed for a fishery (Existing Management Objectives; EMOs), those should be used (e.g. Strategic Assessment Reports). The objectives need not be exactly specified, with regard to numbers or fractions of removal/impact but should indicate that an impact in the sub-component is of concern/interest to the sub-fishery. The rationale for including or discarding an operational objective is a crucial part of the table and must explain why the objective has or has not been selected for in the (sub) fishery. Only the operational objectives selected for inclusion in the (sub) fishery are used for Level 1 analysis (**Level 1 SICA Document L1.1**).

Scoping Document S3. Components and sub-components identification of objectives

Table 2.13. Components and sub-components identification of operational objectives and rationale. Operational objectives that are eliminated are shaded out. EMO: Existing Management Objective; AMO: Existing AFMA Objective.

Component	Core Objective	Sub-component	Example Operational Objectives	Example Indicators	Rationale
Key commercial and secondary commercial species	Avoid recruitment failure of the key/secondary commercial species Avoid negative consequences for species or population sub-components	1. Population size	1.1 No trend in biomass 1.2 Maintain biomass above a specified level 1.3 Maintain catch at specified level 1.4 Species do not approach extinction or become extinct	Biomass, numbers, density, CPUE, yield	1.1 Increases in biomass of the key/secondary commercial species would be acceptable. 1.2. To ensure that population at acceptable level by the assessment. 1.3. TAE levels are specified. 1.4. This is a general objective for all AFMA fisheries as per Fisheries Management Act 1991 (objective (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).
		2. Geographic range	2.1 Geographic range of the population, in terms of size and continuity does not change outside acceptable bounds	Presence of population across the known distribution range	2.1 Not currently monitored. No specific management objective based on the geographic range of key/secondary commercial species.
		3. Genetic structure	3.1 Genetic diversity does not change outside acceptable bounds	Frequency of genotypes in the population, effective population size (N_e), number of spawning units	3.1 Genetic studies may identify multiple stocks of key commercial species, but not currently monitored.
		4. Age/size /sex structure	4.1 Age/size /sex structure does not change outside acceptable bounds (e.g. more than X% from reference structure)	Biomass, numbers, or relative proportion in age /size/sex classes Biomass of spawners Mean size, sex ratio	4.1 Covered in general by 1.2 EMO and AMO. Monitoring Survey/recruitment (annual) provides indication of size/sex/species split deviations and spawner survey every second year – but no levels set for unacceptable bounds. Large deviations of the size range of key commercial species have not been observed.

Component	Core Objective	Sub-component	Example Operational Objectives	Example Indicators	Rationale
		5. Reproductive capacity	5.1 Fecundity of the population does not change outside acceptable bounds (e.g. more than X% of reference population fecundity) 2 Recruitment to the population does not change outside acceptable bounds	Recruitment survey (annual) of population Recruitment indices	5.1 Covered by 1.2 EMO and AMO. Reproductive capacity in terms of annual recruitment survey may be easier to monitor via changes in age/size/sex structure. 5.2 Covered by 1.2 EMO and AMO. May be easier to monitor via changes in age/size/sex structure in the fishery. Large deviations of recruitment indices of key commercial species have not been observed.
		6. Behaviour /movement	6.1 Behaviour and movement patterns of the population do not change outside acceptable bounds	Presence of population across space, movement patterns within the population (e.g. attraction to bait, lights)	6.1. Changes to behaviour that are deleterious to the species and populations are to be avoided.
Byproduct and Bycatch	Avoid recruitment failure of the byproduct and bycatch species Avoid negative consequences for species or population sub-components	1. Population size	1.1 No trend in biomass 1.2 Species do not approach extinction or become extinct 1.3 Maintain biomass above a specified level 1.4 Maintain catch at specified level	Biomass, numbers, density, CPUE, yield	1.1 Increases in biomass of the byproduct/bycatch species would be acceptable. 1.2. To ensure that population at acceptable level by the assessment. Covered by EMO and AMO that ensures the fishery does not threaten bycatch species. 1.3. TAE levels are specified. EMO/AMO - annual reviews of all information on bycatch species with the aim of developing species specific bycatch (trigger, trip) limits. These exist for bycatch species. 1.4. This is a general objective for all AFMA fisheries as per Fisheries Management Act 1991 (objective (b): and mentions specifically non-target species and the long-term sustainability of the marine environment).
		2. Geographic range	2.1 Geographic range of the population, in terms of size and continuity does not change	Presence of population across space	2.1 Not currently monitored. No specific management objective based on the geographic range of byproduct/bycatch species.

Component	Core Objective	Sub-component	Example Operational Objectives	Example Indicators	Rationale
			outside acceptable bounds		
		3. Genetic structure	3.1 Genetic diversity does not change outside acceptable bounds	Frequency of genotypes in the population, effective population size (N_e), number of spawning units	3.1 Not currently monitored. No reference levels established. No specific management objective based on the genetic structure of bycatch species.
		4. Age/size /sex structure	4.1 Age/size /sex structure does not change outside acceptable bounds (e.g. more than X% from reference structure).	Biomass, numbers, or relative proportion in age /size/sex classes Biomass of spawners Mean size, sex ratio	4.1 Not currently monitored. However, size/sex data is collected for some byproduct/bycatch species during monitoring surveys, e.g., bugs and scallops. Monitoring the age/size/sex structure of byproduct/bycatch species populations is a useful management tool allowing the identification of possible fishery impacts and that cross-section of the population most at risk.
		5 Reproductive capacity	5.1 Fecundity of the population does not change outside acceptable bounds (e.g. more than X% of reference population fecundity) Recruitment to the population does not change outside acceptable bounds	Egg production of population Abundance of recruits	5.1 Beyond the generality of the EMO "Fishing is conducted in a manner that does not threaten stocks of byproduct/bycatch species". Reproductive capacity is not currently measured for bycatch/byproduct species (except for bugs) and is largely covered by other objectives.
		6. Behaviour /movement	6.1 Behaviour and movement patterns of the population do not change outside acceptable bounds	Presence of population across space, movement patterns within the population (e.g. attraction to bait, lights)	6.1 Trawling does not appear to attract bycatch species or alter their behaviour and movement patterns, resulting in the attraction of species to fishing grounds.
Protected species	Avoid recruitment failure of protected species Avoid negative consequences for protected	1. Population size	1.1 Species do not further approach extinction or become extinct 1.2 No trend in biomass	Biomass, numbers, density, CPUE, yield	1.1 EMO – This is a general objective for all AFMA fisheries as per Fisheries Management Act 1991 (objective 1b): 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) and

Component	Core Objective	Sub-component	Example Operational Objectives	Example Indicators	Rationale
	species or population sub-components Avoid negative impacts on the population from fishing		1.3 Maintain biomass above a specified level 1.4 Maintain catch at specified level		objective (2) ensuring, through proper conservation and management measures, that the living resources of the AFZ are not endangered by over-exploitation; Therefore The fishery is conducted in a manner that avoids mortality of, or injuries to, endangered, threatened or protected species. 1.2 A positive trend in biomass is desirable for protected species. 1.3 Maintenance of protected species biomass above specified levels not currently a fishery operational objective. 1.4 The above EMO states 'must avoid mortality/injury to protected species'.
		2. Geographic range	2.1 Geographic range of the population, in terms of size and continuity does not change outside acceptable bounds	Presence of population across space	2.1 Change in geographic range of protected species may have serious consequences e.g. population fragmentation and/or forcing species into sub-optimal areas.
		3. Genetic structure	3.1 Genetic diversity does not change outside acceptable bounds	Frequency of genotypes in the population, effective population size (N_e), number of spawning units	3.1 Because population size of protected species is often small, protected species are sensitive to loss of genetic diversity. Genetic monitoring may be an effective approach to measure possible fishery impacts and is currently being studied in the NPF.
		4. Age/size /sex structure	4.1 Age/size /sex structure does not change outside acceptable bounds (e.g. more than X% from reference structure)	Biomass, numbers, or relative proportion in age /size/sex classes Biomass of spawners Mean size, sex ratio	4.1 Not currently monitored. However, data is being collected on size and/or sex for some TEP species. Monitoring the age/size/sex structure of protected species populations is a useful management tool allowing the identification of possible fishery impacts and that cross-section of the population most at risk.
		5. Reproductive capacity	5.1 Fecundity of the population does not change outside acceptable bounds (e.g. more than X% of reference	Egg production of population Abundance of recruits	5.1 The reproductive capacity of protected species is of concern because potential fishery induced changes in reproductive ability may have immediate impact on the population size of protected species. This is currently not being done, apart from size data being collected annually.

Component	Core Objective	Sub-component	Example Operational Objectives	Example Indicators	Rationale
			population fecundity) Recruitment to the population does not change outside acceptable bounds		
		6. Behaviour /movement	6.1 Behaviour and movement patterns of the population do not change outside acceptable bounds	Presence of population across space, movement patterns within the population (e.g. attraction to bait, lights)	6.1 Trawling operations may attract protected species and alter behaviour and movement patterns, resulting in the habituation of protected species to fishing vessels. The overall effect may be to prevent juveniles from learning to fend for themselves therefore increasing the animals' reliance on fishing vessels. Subsequently this could substantially increase the risk of injury/mortality by collision, entrapment or entanglement with a vessel or fishing gear.
		7. Interactions with fishery	7.1 Survival after interactions is maximised 7.2 Interactions do not affect the viability of the population or its ability to recover	Survival rate of species after interactions Number of interactions, biomass or numbers in population	7.1, 7.2, EMO – The fishery is conducted in a manner that avoids mortality of, or injuries to, endangered, threatened or protected species. Includes the prohibition on discarding offal (fish processing waste, unwanted dead fish), gear restrictions and reduced lighting levels to minimise interactions and attraction of the vessel to protected species.
Habitats	Avoid negative impacts on quality of environment Avoid reduction in the amount and quality of habitat	1. Water quality	1.1 Water quality does not change outside acceptable bounds	Water chemistry, noise levels, debris levels, turbidity levels, pollutant concentrations, light pollution from artificial light	1.1 EMO control the discharge or discarding of waste (fish offal) and limit lighting on the vessels. MARPOL regulations prohibit discharge of oils, discarding of plastics.
		2. Air quality	2.1 Air quality does not change outside acceptable bounds	Air chemistry, noise levels, visual pollution, pollutant concentrations, light pollution from artificial light	2.1 Not currently perceived as an important habitat sub-component, trawling operations not believed to strongly influence air quality.
		3. Substrate quality	3.1 Sediment quality does not change outside acceptable bounds	Sediment chemistry, stability, particle size, debris, pollutant concentrations	3.1 EMO – General objective for all AFMA fisheries as per Fisheries Management Act 1991 (objective 1b): 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. The fishery is conducted, in a manner that minimises the impact of fishing operations on benthic habitat.

Component	Core Objective	Sub-component	Example Operational Objectives	Example Indicators	Rationale
		4. Habitat types	4.1 Relative abundance of habitat types does not vary outside acceptable bounds	Extent and area of habitat types, % cover, spatial pattern, landscape scale	4.1 Trawling activities may result in changes to the local habitat types on fishing grounds.
		5. Habitat structure and function	5.1 Size, shape and condition of habitat types does not vary outside acceptable bounds	Size structure, species composition and morphology of biotic habitats	5.1 Trawling activities may result in local disruption to pelagic and benthic processes.
Communities	Avoid negative impacts on the composition/ function/ distribution/ structure of the community	1. Species composition	1.1 Species composition of communities does not vary outside acceptable bounds	Species presence/absence, species numbers or biomass (relative or absolute) Richness Diversity indices Evenness indices	1.1 EMO – General objective for all AFMA fisheries as per Fisheries Management Act 1991 (objective 1b): 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) 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.
		2. Functional group composition	2.1 Functional group composition does not change outside acceptable bounds	Number of functional groups, species per functional group (e.g. autotrophs, filter feeders, herbivores, omnivores, carnivores)	2.1 The presence/abundance of 'functional group' members may fluctuate widely, however in terms of maintenance of ecosystem processes it is important that the aggregate effect of a functional group is maintained.
		3. Distribution of the community	3.1 Community range does not vary outside acceptable bounds	Geographic range of the community, continuity of range, patchiness	3.1 Demersal trawling operations have unknown impacts on the benthos in the fishing grounds. The current MPA and conservation areas reserve large areas of the known habitat types from fishing disturbance.
		4. Trophic/size structure	4.1 Community size spectra/trophic structure does not vary outside acceptable bounds	Size spectra of the community Number of octaves, Biomass/number in each size class Mean trophic level Number of trophic levels	4.1 Trawling activities for key/secondary commercial species have the potential to remove a significant component of the predator functional group. Increased abundance of the prey groups may then allow shifts in relative abundance of higher trophic level organisms.
		5. Bio- and geo-chemical cycles	5.1 Cycles do not vary outside acceptable bounds	Indicators of cycles, salinity, carbon, nitrogen, phosphorus flux	5.1 Trawling operations not perceived to have a detectable effect on bio and geochemical cycles but other activities might e.g. aquaculture.

2.2.4 Hazard Identification (Step 4)

Hazards are the activities undertaken in the process of fishing, and any external activities, which have the potential to lead to harm.

The effects of fishery/sub-fishery specific hazards are identified under the following categories:

- capture
- direct impact without capture
- addition/movement of biological material
- addition of non biological material
- disturbance of physical processes
- external hazards

These fishing and external activities are scored on a presence/absence basis for each fishery/sub-fishery. An activity is scored as a zero if it does not occur and as a one if it does occur. The rationale for the scoring is also documented in detail and must include if/how the activity occurs and how the hazard may impact on organisms/habitat.

Scoping Document S4. Hazard Identification Scoring Sheet

This table is completed once for each sub-fishery. See Table 2.15 provides a set of examples of fishing activities for the effects of fishing to be used as a guide to assist in scoring the hazards.

Fishery name: Northern Prawn Fishery

Sub-fishery name: Banana Prawn

Date completed: April 2019

Table 2.14. Hazard identification, score and rationale(s) for the NPF Banana Prawn sub-fishery.

DIRECT IMPACT OF FISHING	FISHING ACTIVITY	SCORE (0/1)	DOCUMENTATION OF RATIONALE
Capture	Bait collection	0	Not required by this fishery method.
	Fishing	1	Actual fishing, i.e. capture of species resulting from deployment and retrieval of gillnet including key commercial, bycatch, byproduct and protected species caught but not landed.
	Incidental behaviour	0	None occurs
Direct impact without capture	Bait collection	0	Not required for this fishery method.
	Fishing	1	Fishing is most likely to impact benthic habitats and animals as the gear contacts seafloor. Unknown mortality on fish arising from net escapement. Organisms may come into contact with TEDs, BRDs or fishing net.
	Incidental behaviour	0	None occurs
	Gear loss	1	Major gear loss reported rarely and no information on minor components but likely to occur.

DIRECT IMPACT OF FISHING	FISHING ACTIVITY	SCORE (0/1)	DOCUMENTATION OF RATIONALE
	Anchoring/mooring	1	Vessels might anchor inshore when not fishing. Occurs during daylight hours.
	Navigation/steaming	1	Continuous searching and trawling during the night, some steaming between locations during the day. Steaming/navigation to fishing grounds may result in collisions.
Addition/ movement of biological material	Translocation of species	1	Vessel travel relatively constrained, however, known reports of incursion of introduced species: black-striped mussel (*Mytilopsis sallei*).
	On board processing	0	No onboard processing occurs
	Discarding catch	1	Discarding is common.
	Stock enhancement	0	None occurs
	Provisioning	0	None occurs
	Organic waste disposal	1	Disposal of organic wastes should not occur under MARPOL regulations, but do occur (e.g., food scraps and sewage).
Addition of non-biological material	Debris	0	Rubbish generated during general fishing vessel operations usually disposed of ashore.
	Chemical pollution	0	Waste discharge from vessels should not occur under MARPOL regulations. Leakage of substances such as fuel, oil, bilge discharges, natural decay of antifouling agents may occur in normal course of operations
	Exhaust	1	Vessel introduces exhaust into the environment.
	Gear loss	1	Major gear losses of whole nets rare and usually retrieved. No information on minor components loss
	Navigation/steaming	1	Vessels navigate to and from fishing grounds introduces noise and visual stimuli into the environment. Depth sounders/acoustic net positioning systems have potential to disturb marine species.
	Activity/presence on water	1	Vessel introduces noise and visual stimuli into the environment.
Disturb physical processes	Bait collection	0	Bait not required by fishery.
	Fishing	1	Fishing may disturb seabed sediments and structure.
	Boat launching	0	Not applicable. Vessels in fishery come from designated ports.
	Anchoring/mooring	1	Anchoring/mooring may affect the physical processes in the area where anchors and anchor chains contact the seafloor.
	Navigation/steaming	1	Fishing operations involve navigating to and from fishing grounds. Navigation/steaming introduces noise, water turbulence to environment. Depth sounders/ acoustic net positioning systems have potential to disturb marine species.
External Hazards (specify the particular example within each activity area)	Other capture fishery methods	1	Other fisheries which occur in the same area which include gillnetting, fish trawling, longlining, recreational and indigenous fishing: e.g. C1 - Crab fishery (other than spanner crab); C3 - Crab fishery (spanner crab - managed area B); L4 - Line fishery (Queensland Fisheries Joint Authority no. 1); N3 - Net fishery (Gulf of Carpentaria - no. 1); N11 - Net fishery (Gulf of Carpentaria - no. 11); N12 – Net fishery (Gulf of Carpentaria - offshore); N13 – Net fishery (Gulf of Carpentaria - offshore)).
	Aquaculture	1	Special permit for *P. monodon* for aquaculture industry
	Coastal development	1	Sewage discharge, agricultural runoff, pollution from ports and coastal towns could impact shelf fisheries and may affect

DIRECT IMPACT OF FISHING	FISHING ACTIVITY	SCORE (0/1)	DOCUMENTATION OF RATIONALE
			breeding grounds and nursery areas for some of the species in the fishery.
	Other extractive activities	1	Oil, gas and mining minerals on shore may require the development of port facilities which directly impact the nursery habitat of target species.
	Other non-extractive activities	1	Shipping and sub-marine (telecommunication) cables.
	Other anthropogenic activities	1	Recreational boating and fishing leading to coral damage when anchoring possible collisions with turtles and dugongs, Shipping and possible oil spills. Loading and spillage of mine concentrate at sea and in rivers. Catchment issues including alter water flows and hence target species emigration cues; as well as long-term effects on water quality and habitat productivity. Tourist activities and charter fishing occurs in the fishery.

Table 2.15. Examples of fishing activities (Modified from Fletcher et al. 2002).

DIRECT IMPACT OF FISHING	FISHING ACTIVITY	EXAMPLES OF ACTIVITIES INCLUDE
Capture		Activities that result in the capture or removal of organisms. This includes cryptic mortality due to organisms being caught but dropping out prior to the gear's retrieval (i.e. They are caught but not landed)
	Bait collection	Capture of organisms due to bait gear deployment, retrieval and bait fishing. This includes organisms caught but not landed.
	Fishing	Capture of organisms due to gear deployment, retrieval and actual fishing. This includes organisms caught but not landed.
	Incidental behaviour	Capture of organisms due to crew behaviour incidental to primary fishing activities, possible in the crew's down time; e.g. crew may line or spear fish while anchored, or perform other harvesting activities, including any land-based harvesting that occurs when crew are camping in their down time.
Direct impact, without capture		This includes any activities that may result in direct impacts (damage or mortality) to organisms without actual capture.
	Bait collection	Direct impacts (damage or mortality) to organisms due to interactions (excluding capture) with bait gear during deployment, retrieval and bait fishing. This includes: damage/mortality to organisms through contact with the gear that doesn't result in capture, e.g. Damage/mortality to benthic species by gear moving over them, organisms that hit nets but aren't caught.
	Fishing	Direct impacts (damage or mortality) to organisms due to interactions (excluding capture) with fishing gear during deployment, retrieval and fishing. This includes: damage/mortality to organisms through contact with the gear that doesn't result in capture, e.g. Damage/mortality to benthic species by gear moving over them, organisms that hit nets but are not caught.
	Incidental behaviour	Direct impacts (damage or mortality) without capture, to organisms due to behaviour incidental to primary fishing activities, possibly in the crew's down time; e.g. the use of firearms on scavenging species, damage/mortality to organisms through contact with the gear that the crew use to fish during their down time. This does not include impacts on predator species of removing their prey through fishing.
	Gear loss	Direct impacts (damage or mortality), without capture on organisms due to gear that has been lost from the fishing boat. This includes damage/mortality to species when the lost gear contacts them or if species swallow the lost gear.
	Anchoring/mooring	Direct impact (damage or mortality) that occurs and when anchoring or mooring. This includes damage/mortality due to physical contact of the anchor, chain or rope with organisms, e.g. An anchor damaging live coral.
	Navigation/steaming	Direct impact (damage or mortality) without capture may occur while vessels are navigating or steaming. This includes collisions with marine organisms or birds.
Addition/ movement of biological material		Any activities that result in the addition or movement of biological material to the ecosystem of the fishery.
	Translocation of species (boat movements, reballasting)	The translocation and introduction of species to the area of the fishery, through transportation of any life stage. This transport can occur through movement on boat hulls or in ballast water as boats move throughout the fishery or from outside areas into the fishery.

DIRECT IMPACT OF FISHING	FISHING ACTIVITY	EXAMPLES OF ACTIVITIES INCLUDE
	On board processing	The discarding of unwanted sections of target after on board processing introduces or moves biological material, e.g. heading and gutting, retaining fins but discarding trunks.
	Discarding catch	The discarding of unwanted organisms from the catch can introduce or move biological material. This includes individuals of target and byproduct species due to damage (e.g. shark or marine mammal predation), size, high grading and catch limits. Also includes discarding of all non-retained bycatch species. This also includes discarding of catch resulting from incidental fishing by the crew. The discards could be alive or dead.
	Stock enhancement	The addition of larvae, juveniles or adults to the fishery or ecosystem to increase the stock or catches.
	Provisioning	The use of bait or berley in the fishery.
	Organic waste disposal	The disposal of organic wastes (e.g. food scraps, sewage) from the boats.
Addition of non-biological material		Any activities that result in non-biological material being added to the ecosystem of the fishery, this includes physical debris, chemicals (in the air and water), lost gear, noise and visual stimuli.
	Debris	Non-biological material may be introduced in the form of debris from fishing vessels or mother ships. This includes debris from the fishing process: e.g. cardboard thrown over from bait boxes, straps and netting bags lost. Debris from non-fishing activities can also contribute to this e.g. Crew rubbish – discarding plastics or other rubbish. Discarding at sea is regulated by MARPOL, which forbids the discarding of plastics.
	Chemical pollution	Chemicals can be introduced to water, sediment and atmosphere through: oil spills, detergents other cleaning agents, any chemicals used during processing or fishing activities.
	Exhaust	Exhaust can be introduced to the atmosphere and water through operation of fishing vessels
	Gear loss	The loss of gear will result in the addition of non-biological material, this includes hooks, line, sinkers, nets, otter boards, light sticks, buoys etc.
	Navigation/steaming	The navigation and steaming of vessels will introduce noise and visual stimuli into the environment. Boat collisions and/or sinking of vessels. Echo-sounding may introduce noise that may disrupt some species (e.g. whales, orange roughy)
	Activity/presence on water	The activity or presence of fishing vessels on the water will noise and visual stimuli into the environment.
Disturb physical processes		Any activities that will disturb physical processes, particularly processes related to water movement or sediment and hard substrate (e.g. boulders, rocky reef) processes.
	Bait collection	Bait collection may disturb physical processes if the gear contacts seafloor-disturbing sediment, or if the gear disrupts water flow patterns.
	Fishing	Fishing activities may disturb physical processes if the gear contacts seafloor-disturbing sediment, or if the gear disrupts water flow patterns.

DIRECT IMPACT OF FISHING	FISHING ACTIVITY	EXAMPLES OF ACTIVITIES INCLUDE
	Boat launching	Boat launching may disturb physical processes, particularly in the intertidal regions, if dredging is required, or the boats are dragged across substrate. This would also include foreshore impacts where fishers drive along beaches to reach fishing locations and launch boats. Impacts of boat launching that occurs within established marinas are outside the scope of this assessment.
	Anchoring/mooring	Anchoring/mooring may affect the physical processes in the area that anchors and anchor chains contact the seafloor.
	Navigation/steaming	Navigation /steaming may affect the physical processes on the benthos and the pelagic by turbulent action of propellers or wake formation.
External hazards		Any outside activities that will result in an impact on the component in the same location and period that the fishery operates. The particular activity as well as the mechanism for external hazards should be specified.
	Other capture fishery methods	Take or habitat impact by other commercial, indigenous or recreational fisheries operating in the same region as the fishery under examination
	Aquaculture	Capture of feed species for aquaculture. Impacts of cages on the benthos in the region
	Coastal development	Sewage discharge, ocean dumping, agricultural runoff
	Other extractive activities	Oil and gas pipelines, drilling, seismic activity
	Other non-extractive activities	Defense, shipping lanes, dumping of munitions, submarine cables
	Other anthropogenic activities	Recreational activities, such as scuba diving leading to coral damage, power boats colliding with whales, dugongs, turtles. Shipping, oil spills

2.2.5 Bibliography (Step 5)

All references used in the scoping assessment are included in the References section.

Key documents can be found on the AFMA web page at www.afma.gov.au and include the following:

- Management Plan and Regulation Guidelines
- Bycatch Action Plans
- Data Summary Reports (logbook and observer)

Other publications that provided information include:

- ABARES Fishery Status Reports
- Strategic Plans

2.2.6 Decision rules to move to Level 1 (Step 6)

Any hazards that are identified at Step 4 Hazard Identification as occurring in the fishery are carried forward for analysis at Level 1.

In this case, 21 out of 32 possible activities were identified as occurring in this sub-fishery, including all six external scenarios. Thus, a total of 21 activity-component scenarios were considered at Level 1. This resulted in 105 scenarios (of 160 possible) to be developed and evaluated using the unit lists (Key commercial/secondary, byproduct/bycatch, protected species, habitats, communities).

2.3 Level 1 Scale, Intensity and Consequence Analysis (SICA)

Level 1 aims to identify which hazards lead to a significant impact on any species, habitat or community. Analysis at Level 1 is for whole components (key/secondary commercial; bycatch and byproduct; protected species; habitat; and communities), not individual sub-components. Since Level 1 is used mainly as a rapid screening tool, a "worst case" approach is used to ensure that elements screened out as low risk (either activities or components) are genuinely low risk. Analysis at Level 1 for each component is accomplished by considering the most vulnerable sub-component and the most vulnerable unit of analysis (e.g. most vulnerable species, habitat type or community). This is known as credible scenario evaluation (Richard Stocklosa e-systems Pty Ltd (March 2003) Review of CSIRO Risk Assessment Methodology: ecological risk assessment for the effects of fishing) in conventional risk assessment. In addition, where judgments about risk are uncertain, the highest level of risk that is still regarded as plausible is chosen. For this reason, the measures of risk produced at Level 1 cannot be regarded as absolute.

At Level 1 each fishery/sub-fishery is assessed using a scale, intensity, and consequence analysis (SICA). SICA is applied to the component as a whole by choosing the most vulnerable sub-component (linked to an operational objective) and most vulnerable unit of analysis. The rationale for these choices must be documented in detail. These steps are outlined below. Scale, intensity, and consequence analysis (SICA) consists of thirteen steps. The first ten steps are performed for each activity and component and correspond to the columns of the SICA table. The final three steps summarise the results for each component.

Step1. Record the hazard identification score (absence (0) presence (1) scores) identified at Step 3 at the scoping level (Scoping Document S3) onto the SICA table

Step 2. Score spatial scale of the activity

Step 3. Score temporal scale of the activity

Step 4. Choose the sub-component most likely to be affected by activity

Step 5. Choose the most vulnerable unit of analysis for the component e.g. species, habitat type or community assemblage

Step 6. Select the most appropriate operational objective

Step 7. Score the intensity of the activity for that sub-component

Step 8. Score the consequence resulting from the intensity for that sub component

Step 9. Record confidence/uncertainty for the consequence scores

Step 10. Document rationale for each of the above steps

Step 11. Summary of SICA results

Step 12. Evaluation/discussion of Level 1

Step 13. Components to be examined at Level 2

2.3.1 Record the hazard identification score (absence (0) presence (1) scores) identified at step 3 in the scoping level onto the SICA Document (Step 1)

Record the hazard identification score absence (0) presence (1) identified at Step 3 at the scoping level onto the SICA sheet. A separate sheet will be required for each component (key/secondary commercial, bycatch and byproduct, and protected species, habitat, and communities). Only those activities that scored a 1 (presence) will be analysed at Level 1.

2.3.2 Score spatial scale of activity (Step 2)

The greatest spatial extent must be used for determining the spatial scale score for each identified hazard. For example, if fishing (e.g. capture by longline) takes place within an area of 200 nm by 300 nm, then the spatial scale is scored as 4. The score is then recorded onto the SICA Document, and the rationale documented.

Table 2.16. Spatial scale score of activity.

<1 NM	1-10 NM	10-100 NM	100-500 NM	500-1000 NM	>1000 NM
1	2	3	4	5	6

Maps and graphs may be used to supplement the information (e.g. sketches of the distribution of the activity relative to the distribution of the component) and additional notes describing the nature of the activity should be provided. The spatial scale score at Step 2 is not used directly, but the analysis is used in making judgments about level of intensity at Step 7. Obviously, two activities can score the same with regard to spatial scale, but the intensity of each can differ vastly. The reasons for the score are recorded in the rationale column of the SICA spreadsheet.

2.3.3 Score temporal scale of activity (Step 3)

The highest frequency must be used for determining the temporal scale score for each identified hazard. If the fishing activity occurs daily, the temporal scale is scored as 6. If oil spillage occurs about once per year, then the temporal scale of that hazard scores a 3. The score is then recorded onto the SICA Document and the rationale documented.

Table 2.17. Temporal scale score of activity.

DECADAL (1 DAY EVERY 10 YEARS OR SO)	EVERY SEVERAL YEARS (1 DAY EVERY SEVERAL YEARS)	ANNUAL (1-100 DAYS PER YEAR)	QUARTERLY (100-200 DAYS PER YEAR)	WEEKLY (200-300 DAYS PER YEAR)	DAILY (300-365 DAYS PER YEAR)
1	2	3	4	5	6

It may be more logical for some activities to consider the aggregate number of days that an activity occurs. For example, if the activity “fishing” was undertaken by 10 boats during the same 150 days of the year, the score is 4. If the same 10 boats each spend 30 non-overlapping days fishing, the temporal scale of the activity is a sum of 300 days, indicating that a score of 6 is appropriate. In the case where the activity occurs over many days, but only every 10 years, the number of days by the number of years in the cycle is used to determine the score. For example, 100 days of an activity every 10 years averages to 10 days every year, so that a score of 3 is appropriate.

The temporal scale score at Step 3 is not used directly, but the analysis is used in making judgments about level of intensity at Step 7. Obviously, two activities can score the same with regard to temporal scale, but the intensity of each can differ vastly. The reasons for the score are recorded in the rationale column.

2.3.4 Choose the sub-component most likely to be affected by activity (Step 4)

The most vulnerable sub-component must be used for analysis of each identified hazard. This selection must be made on the basis of expected highest potential risk for each ‘direct impact of fishing’ and ‘fishing activity’ combination, and recorded in the ‘sub-component’ column of the SICA Document. The justification is recorded in the rationale column.

2.3.5 Choose the unit of analysis most likely to be affected by activity and to have highest consequence score (Step 5)

The most vulnerable ‘unit of analysis’ (i.e. most vulnerable species, habitat type or community) must be used for analysis of each identified hazard. The species, habitats, or communities (depending on which component is being analysed) are selected from **Scoping Document S2 (A – C)**. This selection must be made on the basis of expected highest potential risk for each ‘direct impact of fishing’ and ‘fishing activity’ combination, and recorded in the ‘unit of analysis’ column of the SICA Document. The justification is recorded in the rationale column.

2.3.6 Select the most appropriate operational objective (Step 6)

To provide linkage between the SICA consequence score and the management objectives, the most appropriate operational objective for each sub-component is chosen. The most relevant operational objective code from **Scoping Document S3** is recorded in the ‘operational objective’ column in the SICA document. Note that SICA can only be performed on operational objectives agreed as important for the (sub) fishery during scoping and contained in **Scoping Document S3**. If the SICA process identifies reasons to include sub-components or operational objectives that were previously not included/eliminated then these sub-components or operational objectives must be re-instated.

2.3.7 Score the intensity of the activity for the component (Step 7)

The score for intensity of an activity considers the direct impacts in line with the categories shown in the conceptual model (Figure 1.2) (capture, direct impact without capture, addition/movement of biological material, addition of non-biological material, disturbance to physical processes, external hazards). The intensity of the activity is judged based on the scale of the activity, its nature and extent. Activities are scored as per intensity scores below.

Table 2.18. Intensity score of activity (Modified from Fletcher et al. 2002).

LEVEL	SCORE	DESCRIPTION
Negligible	1	remote likelihood of detection at any spatial or temporal scale
Minor	2	occurs rarely or in few restricted locations and detectability even at these scales is rare
Moderate	3	moderate at broader spatial scale, or severe but local
Major	4	severe and occurs reasonably often at broad spatial scale
Severe	5	occasional but very severe and localized or less severe but widespread and frequent
Catastrophic	6	local to regional severity or continual and widespread

This score is then recorded on the **Level 1 (SICA) Document** and the rationale documented.

2.3.8 Score the consequence of intensity for that component (Step 8)

The consequence of the activity is a measure of the likelihood of not achieving the operational objective for the selected sub-component and unit of analysis. It considers the flow on effects of the direct impacts from Step 7 for the relevant indicator (e.g. decline in biomass below the selected threshold due to direct capture). Activities are scored as per consequence scores defined below. A more detailed description of the consequences at each level for each component (key/secondary commercial, bycatch, and byproduct, protected species, habitats, and communities) is provided as a guide for scoring the consequences of the activities in the description of consequences table (Table 2.19).

Table 2.19. Consequence score for ERAEF activities (Modified from Fletcher et al. 2002).

LEVEL	SCORE	DESCRIPTION
Negligible	1	Impact unlikely to be detectable at the scale of the stock/habitat/community
Minor	2	Minimal impact on stock/habitat/community structure or dynamics
Moderate	3	Maximum impact that still meets an objective (e.g. sustainable level of impact such as full exploitation rate for a target species).
Major	4	Wider and longer term impacts (e.g. long-term decline in CPUE)
Severe	5	Very serious impacts now occurring, with relatively long time period likely to be needed to restore to an acceptable level (e.g. serious decline in spawning biomass limiting population increase).
Intolerable	6	Widespread and permanent/irreversible damage or loss will occur-unlikely to ever be fixed (e.g. extinction)

The score should be based on existing information and/or the expertise of the risk assessment group. The rationale for assigning each consequence score must be documented. The conceptual model may be used to link impact to consequence by showing the pathway that was considered. In the absence of agreement or information, the highest score (worst case scenario) considered plausible is applied to the activity.

2.3.9 Record confidence/uncertainty for the consequence scores (Step 9)

The information used at this level is qualitative and each step is based on expert (fishers, managers, conservationists, scientists) judgment. The confidence rating for the consequence score is rated as 1 (low confidence) or 2 (high confidence) for the activity/component. The score is recorded on the SICA Document and the rationale documented. The confidence will reflect the levels of uncertainty for each score at steps 2, 3, 7 and 8 (see description; Table 2.20).

Table 2.20. Description of Confidence scores for Consequences. The confidence score appropriate to the rationale is used, and documented on the SICA Document.

CONFIDENCE	SCORE	RATIONALE FOR THE CONFIDENCE SCORE
Low	1	Data exists, but is considered poor or conflicting
		No data exists
		Disagreement between experts
High	2	Data exists and is considered sound
		Consensus between experts
		Consequence is constrained by logical consideration

2.3.10 Document rationale for each of the above steps (Step 10)

The rationale forms a logical pathway to the consequence score. It is provided for each choice at each step of the SICA analysis.

SICA steps 1-10. Tables of descriptions of consequences for each component and each sub component provide a guide for scoring the level of consequence (see Table above)

Level 1 (SICA) Document L1.1 Key commercial/secondary commercial species.

DIRECT IMPACT OF FISHING	FISHING ACTIVITY	PRESENCE (1) ABSENCE (0)	SPATIAL SCALE OF HAZARD (1-6)	TEMPORAL SCALE OF HAZARD (1-6)	SUB-COMPONENT	UNIT OF ANALYSIS	OPERATIONAL OBJECTIVE (S2.1)	INTENSITY SCORE (1-6)	CONSEQUENCE SCORE (1-6)	CONFIDENCE SCORE (1-2)	RATIONALE
Capture	Bait collection	0									
	Fishing	1	5	3	Population size	White banana prawn (*Penaeus merguiensis*)	1.2	3	2	2	Fishing in the NPF has a 1.6% annual footprint on the 770,000 km^2 managed area (Pitcher et al. 2016) for ~3 months each year. Population size likely to be affected before major changes in other sub-components due to removal of individuals. White banana prawn is the most likely species to be affected by this activity (they are the only C1 species in the banana prawn sub-fishery). Intensity: moderate as although fishing has a severe impact, it is localized due to suitable habitat for trawling. Consequence: minor as stocks are not overfished so there is a minimal impact on the stock. Confidence: high as NPF Monitoring data series of indices for white banana prawns supports this as does general consensus from experts.
	Incidental behaviour	0									
Direct impact without capture	Bait collection	0									
	Fishing	1	5	3	Population size	White banana prawn (*Penaeus merguiensis*)	1.2	1	1	1	Fishing in the NPF has a 1.6% annual footprint of the 770,000 km^2 managed area (Pitcher et al. 2016). Population size likely to be affected before major changes in other sub-components due to damaging/injuring the prawns leading to death. White banana prawn is the most likely species to be affected by this activity. Intensity: negligible as fishing often localized due to suitable habitat and most animals are caught with few

DIRECT IMPACT OF FISHING	FISHING ACTIVITY	PRESENCE (1) ABSENCE (0)	SPATIAL SCALE OF HAZARD (1-6)	TEMPORAL SCALE OF HAZARD (1-6)	SUB-COMPONENT	UNIT OF ANALYSIS	OPERATIONAL OBJECTIVE (S2.1)	INTENSITY SCORE (1-6)	CONSEQUENCE SCORE (1-6)	CONFIDENCE SCORE (1-2)	RATIONALE
											escaping. Consequence: negligible as fishing does not impact an additional component of the population that is not caught. Confidence: low as data unavailable for direct impacts without capture.
	Incidental behaviour	0									
	Gear loss	1	1	1	Population size	White banana prawn (*Penaeus merguiensis*)	1.2	2	1	2	Fishing in the NPF has a 1.6% annual footprint of the 770,000 km^2 managed area (Pitcher et al. 2016), yet these days gear loss rarely occurs (e.g. one large commercial company stated only 1 gear loss in the last 10 years). Population size likely to be affected before major changes in other sub-components due to entrapment of individuals. White banana prawn is the most likely species to be affected by this activity. Intensity: minor as gear loss is rare and interaction of White banana prawn with gear remote. Consequence: negligible as impact unlikely to be measurable. Confidence: high as it is known that very little gear is lost, and interaction with white banana prawn is considered unlikely.
	Anchoring/mooring	1	1	3	Population size	White banana prawn (*Penaeus merguiensis*)	1.2	1	1	2	Anchoring sometimes occurs throughout the banana prawn sub-fishery. Population size likely to be affected before major changes in other sub-components due to impact with the anchor. White banana prawn is the most likely species to be affected by this activity. Intensity: negligible as vessels don't often anchor and anchoring has a very small footprint. Consequence: negligible as impact unlikely to be measurable. Confidence: high as expert consensus is that interaction with White banana prawn is considered unlikely.
	Navigation/steaming	1	3	3	Population size	White banana prawn	1.2	2	1	2	Navigation to and from fishing grounds and steaming between trawls can occur throughout the NPF managed areas and has the potential to cause collision with animals. Population size likely to be affected before major changes in other sub-components due to injury/death from collision.

DIRECT IMPACT OF FISHING	FISHING ACTIVITY	PRESENCE (1) ABSENCE (0)	SPATIAL SCALE OF HAZARD (1-6)	TEMPORAL SCALE OF HAZARD (1-6)	SUB-COMPONENT	UNIT OF ANALYSIS	OPERATIONAL OBJECTIVE (S2.1)	INTENSITY SCORE (1-6)	CONSEQUENCE SCORE (1-6)	CONFIDENCE SCORE (1-2)	RATIONALE
						(*Penaeus merguiensis*)					White banana prawn is the most likely species to be affected by this activity. Intensity: negligible as White banana prawn are demersal species and will not collide with a vessel. Consequence: negligible as any impact is unlikely to be detectable. Confidence: high as it is known that prawns and vessels do not collide.
Addition/ movement of biological material	Translocation of species	1	5	6	Population size	White banana prawn (*Penaeus merguiensis*)	1.2	1	2	1	Translocation may occur throughout the NPF, through ballast water or hull fouling, gear or anchor entanglement, and has the potential to establish as the majority of fishing areas and ports used are of similar depths. The black-striped mussel (*Mytilopsis sallei*) is now eradicated (Summerson et al. 2013), but establishes precedence for translocation to occur in the NPF area. Population size likely to be affected before major changes in other sub-components, by introducing a foreign competitor or through transmission of disease, but also directly or indirectly through changing trophic linkages. No mitigating measures are currently in place. White banana prawn are the most likely species to be affected by this activity. Intensity: negligible at present as White banana prawns are currently not affected by introduced organisms. Consequence: minor as although there is the potential for impacts to significantly alter population size, the previously introduced pest was quickly eradicated. Confidence: low as it not known to what extent trawling in the NPF contributes to the spread of the species. No data exists to refute this risk.
	On board processing	0									
	Discarding catch	1	5	3	Population size	White banana prawn (*Penaeus merguiensis*)	1.2	3	1	2	Discarding of bycatch occurs extensively throughout the fished region. Population size likely to be affected before major changes in other sub-components if scavengers and predators (e.g. sharks and trevally) are attracted to prawn habitat due to the addition of discards, and in turn prey upon prawns. White banana prawn is the most likely species to be affected by this activity. Intensity: major as this occurs daily throughout the fishery. Consequence: negligible as discarded catch wouldn't have a

DIRECT IMPACT OF FISHING	FISHING ACTIVITY	PRESENCE (1) ABSENCE (0)	SPATIAL SCALE OF HAZARD (1-6)	TEMPORAL SCALE OF HAZARD (1-6)	SUB-COMPONENT	UNIT OF ANALYSIS	OPERATIONAL OBJECTIVE (S2.1)	INTENSITY SCORE (1-6)	CONSEQUENCE SCORE (1-6)	CONFIDENCE SCORE (1-2)	RATIONALE
											detectable change on the prawns. Confidence: high as the effects of discarding of bycatch is well documented in the NPF.
	Stock enhancement	0									
	Provisioning	0									
	Organic waste disposal	1	5	3	Behaviour/ movement	White banana prawn (*Penaeus merguiensis*)	6.1	1	1	2	Fishing in the NPF has a 1.6% annual footprint of the 770,000 km^2 managed area (Pitcher et al. 2016), for ~3 months each year, so organic waste disposal is possible over this scale. Behaviour/movement likely to be affected before major changes in other sub-components as a result of the attraction (e.g. food scraps) or repulsion (e.g. raw sewage) of the organic waste. White banana prawn is the most likely species to be affected by this activity. Intensity: negligible as each disposal event wouldn't have a detectable change on behaviour/movement. Consequence: negligible as impact is unlikely to be detectable. Confidence: high because expert consensus is that general fishing waste disposal is unlikely to impact the behaviour/movement of demersal prawns.
Addition of non-biological material	Debris	0									
	Chemical pollution	0									
	Exhaust	1	5	3	Behaviour/ movement	White banana prawn (*Penaeus merguiensis*)	6.1	1	1	2	Fishing vessels travel throughout the NPF for ~3 months each year so exhaust emissions possible over this scale. Behaviour/movement likely to be affected before major changes in other sub-components due to the introduction of the exhaust emissions. White banana prawn is the most likely species to be affected by this activity. Intensity: negligible because although the hazard could occur over a large range/scale, exhaust wouldn't have a detectable change on behaviour/movement. Consequence: negligible as the impact of exhaust emissions is unlikely to

DIRECT IMPACT OF FISHING	FISHING ACTIVITY	PRESENCE (1) ABSENCE (0)	SPATIAL SCALE OF HAZARD (1-6)	TEMPORAL SCALE OF HAZARD (1-6)	SUB-COMPONENT	UNIT OF ANALYSIS	OPERATIONAL OBJECTIVE (S2.1)	INTENSITY SCORE (1-6)	CONSEQUENCE SCORE (1-6)	CONFIDENCE SCORE (1-2)	RATIONALE
											be detectable. Confidence: high because expert consensus is that exhaust is unlikely to impact the behaviour/movement of demersal prawns.
	Gear loss	1	1	1	Population size	White banana prawn (*Penaeus merguiensis*)	1.2	2	1	2	Fishing in the NPF has a 1.6% annual footprint of the 770,000 km^2 managed area (Pitcher et al. 2016), yet these days gear loss rarely occurs (e.g. one large commercial company stated only 1 gear loss in the last 10 years). Population size likely to be affected before major changes in other sub-components due to entrapment of individuals. White banana prawn is the most likely species to be affected by this activity. Intensity: minor as lost gear would rarely interact with prawns. Consequence: negligible as the impact is unlikely to be detectable. Confidence: high because it is known that very little gear is lost, and interaction with prawns is considered unlikely.
	Navigation/steaming	1	5	3	Behaviour/ movement	White banana prawn (*Penaeus merguiensis*)	6.1	2	1	2	Navigation to and from fishing grounds and steaming between trawls can occur throughout the NPF managed areas and introduces noise and visual stimuli into the environment. Behaviour and movement likely to be affected before major changes in other sub-components due to the repellent nature of the noise and visual stimuli. White banana prawn is the most likely species to be affected by this activity. Intensity: minor as white banana prawn are demersal species and unlikely to be affected by the shipping which is localised. Consequence: negligible as any impact is unlikely to be detectable. Confidence: high as no research has shown prawns are affected by noise and visual stimuli introduced into the environment by vessels.
	Activity/presence on water	1	5	3	Behaviour/ movement	White banana prawn (*Penaeus merguiensis*)	6.1	1	1	2	Fishing throughout the NPF managed area introduces noise and visual stimuli into the environment. Behaviour and movement likely to be affected before major changes in other sub-components due to the repellent nature of the noise and visual stimuli. White banana prawn is the most likely species to be affected by this activity. Intensity: negligible as white banana prawn are demersal species and unlikely to be affected.

DIRECT IMPACT OF FISHING	FISHING ACTIVITY	PRESENCE (1) ABSENCE (0)	SPATIAL SCALE OF HAZARD (1-6)	TEMPORAL SCALE OF HAZARD (1-6)	SUB-COMPONENT	UNIT OF ANALYSIS	OPERATIONAL OBJECTIVE (S2.1)	INTENSITY SCORE (1-6)	CONSEQUENCE SCORE (1-6)	CONFIDENCE SCORE (1-2)	RATIONALE
											Consequence: negligible as any impact is unlikely to be detectable. Confidence: high as no research has shown prawns are affected by noise and visual stimuli introduced into the environment by vessels.
Disturb physical processes	Bait collection	0									
	Fishing	1	5	3	Population size	White banana prawn (*Penaeus merguiensis*)	1.2	3	2	1	Fishing in the NPF has a 1.6% annual footprint of the 770,000 km^2 managed area (Pitcher et al. 2016), for ~3 months each year, with the action of direct disturbance to the seafloor. Population size likely to be affected before major changes in other sub-components due to trawl gear disturbing the seafloor habitat of benthic organisms. White banana prawn is the most likely species to be affected by this activity. Intensity: moderate as although fishing has a severe impact, it is localized due to suitable habitat for trawling. Consequence: minor as disturbance of sediment will have a minimal impact on stocks. Confidence: low as no data available.
	Boat launching	0									
	Anchoring/mooring	1	2	3	Population size	White banana prawn (*Penaeus merguiensis*)	1.2	1	1	2	Anchoring sometimes occurs throughout the banana prawn sub-fishery. Population size likely to be affected before major changes in other sub-components due to the anchor disturbing the seafloor. White banana prawn is the most likely species to be affected by this activity. Intensity: negligible as vessels don't often anchor and anchoring has a very small footprint. Consequence: negligible as impact unlikely to be measurable. Confidence: high because expert consensus is that interaction with white banana prawn is considered unlikely.

DIRECT IMPACT OF FISHING	FISHING ACTIVITY	PRESENCE (1) ABSENCE (0)	SPATIAL SCALE OF HAZARD (1-6)	TEMPORAL SCALE OF HAZARD (1-6)	SUB-COMPONENT	UNIT OF ANALYSIS	OPERATIONAL OBJECTIVE (S2.1)	INTENSITY SCORE (1-6)	CONSEQUENCE SCORE (1-6)	CONFIDENCE SCORE (1-2)	RATIONALE
	Navigation/steaming	1	5	3	Behaviour/ movement	White banana prawn (*Penaeus merguiensis*)	6.1	2	1	2	Navigation to and from fishing grounds and steaming between trawls can occur throughout the NPF managed areas and creates turbulent action from the propellers. Behaviour and movement likely to be affected before major changes in other sub-components due to the repellent nature of this turbulence. White banana prawn is the most likely species to be affected by this activity. Intensity: minor as White banana prawn are demersal species and unlikely to be affected by the shipping which is localised. Consequence: negligible as impact unlikely to be measurable. Confidence: high because expert consensus is that interaction with white banana prawn is considered unlikely.
External impacts	Other fisheries: crab fishery, spanner crab fishery, line fishery, net fisheries	1	6	6	Population size	White banana prawn (*Penaeus merguiensis*)	1.2	2	2	2	Fishing occurs throughout the year by several other fisheries in the NPF managed region, however, they are unlikely to capture many commercial prawns due to gear type used. Population size likely to be affected before major changes in other sub-components due to the removal of individuals. White banana prawn is the most likely species to be affected by this activity. Intensity: minor as prawns rarely caught due to other trawl and non-trawl fisheries targeting other species in other habitats e.g. fish trawling over reefs. Consequence: minor as minimal impact on stocks. Confidence: high as catch data from other fisheries show that white banana prawn catch is very small.
	Aquaculture	1	3	3	Population size	White banana prawn (*Penaeus merguiensis*)	1.2	2	2	2	Three boat licenses exist for capturing *P. monodon* broodstock for aquaculture. Population size likely to be affected before major changes in other sub-components due to the removal of individuals. White banana prawn is the most likely species to be affected by this activity. Intensity: minor as fishing for this broodstock only occurs at a few resticted locations. Consequence: minor as minimal impact on white banana prawn stocks. Confidence: high as catch data exists from *P. monodon* broodstock collection.

DIRECT IMPACT OF FISHING	FISHING ACTIVITY	PRESENCE (1) ABSENCE (0)	SPATIAL SCALE OF HAZARD (1-6)	TEMPORAL SCALE OF HAZARD (1-6)	SUB-COMPONENT	UNIT OF ANALYSIS	OPERATIONAL OBJECTIVE (S2.1)	INTENSITY SCORE (1-6)	CONSEQUENCE SCORE (1-6)	CONFIDENCE SCORE (1-2)	RATIONALE
	Coastal development	1	3	6	Behaviour/ movement	White banana prawn (*Penaeus merguiensis*)	6.1	3	3	1	Coastal development occurs in small pockets surrounding the NPF. Behaviour and movement likely to be affected before major changes in other sub-components due to altered water/habitat quality. White banana prawn (which are coastal during its early lifestages) is the most likely species to be affected by this activity. Intensity: moderate as coastal development occurs in the vicinity of large waterways (including Weipa and Karumba) which have high numbers of white banana prawns. Consequence: moderate as coastal development may have a detectable impact on banana prawn behaviour/movement as a result of altered flow regimes and changes to water/habitat quality. Confidence: low as there is little data available to demonstrate the effects of coastal development on prawn behaviour/movement.
	Other extractive activities	1	4	6	Behaviour/ movement	White banana prawn (*Penaeus merguiensis*)	6.1	2	2	1	Exploration for oil, gas and petroleum is underway or proposed throughout NPF, particularly in the Arafura Sea. Behaviour and movement likely to be affected before major changes in other sub-components due to movement away from the exploratory activity e.g. drilling. White banana prawn is the most likely species to be affected by this activity. Intensity: minor as these activities occur in restricted locations. Consequence: minor as effect on prawn expected to be minimal as these activities don't occur in areas where white banana prawns are found. Confidence: low as data unavailable for effects of extractive activities on prawns.
	Other non extractive activities	1	6	6	Behaviour/ movement	White banana prawn (*Penaeus merguiensis*)	6.1	3	1	2	Shipping occurs throughout the year throughout the NPF. Behaviour and movement likely to be affected before major changes in other sub-components due an avoidance reaction. White banana prawn is the most likely species to be affected by this activity. Intensity: moderate as shipping occurs throughout the NPF and is concentrated in a number of ports e.g. Darwin, Groote, Weipa, Karumba. Consequence: negligible as

DIRECT IMPACT OF FISHING	FISHING ACTIVITY	PRESENCE (1) ABSENCE (0)	SPATIAL SCALE OF HAZARD (1-6)	TEMPORAL SCALE OF HAZARD (1-6)	SUB-COMPONENT	UNIT OF ANALYSIS	OPERATIONAL OBJECTIVE (S2.1)	INTENSITY SCORE (1-6)	CONSEQUENCE SCORE (1-6)	CONFIDENCE SCORE (1-2)	RATIONALE
											impact unlikely to be measurable. Confidence: high because expert consensus is that interaction with white banana prawn is considered unlikely.
	Other anthropogenic activities	1	6	6	Behaviour/ movement	White banana prawn (*Penaeus merguiensis*)	6.1	2	2	1	Recreational boating/fishing and tourism occurs throughout the year in the NPF area, but particularly inshore and near major towns/cities. Behaviour and movement likely to be affected before major changes in other sub-components due an avoidance reaction. White banana prawn is the most likely species to be affected by this activity. Intensity: minor as recreational activities occurs primarily in inshore areas and near major towns/cities. Consequence: minor as impact of recreational fishing probably minimal on target species populations. Confidence: low as data unavailable for effects of recreational fishing on white banana prawns.

Level 1 (SICA) Document L1.2 - Byproduct and Bycatch Component.

DIRECT IMPACT OF FISHING	FISHING ACTIVITY	PRESENCE (1) ABSENCE (0)	SPATIAL SCALE OF HAZARD (1-6)	TEMPORAL SCALE OF HAZARD (1-6)	SUB-COMPONENT	UNIT OF ANALYSIS	OPERATIONAL OBJECTIVE (S2.1)	INTENSITY SCORE (1-6)	CONSEQUENCE SCORE (1-6)	CONFIDENCE SCORE (1-2)	RATIONALE
Capture	Bait collection	0									
	Fishing	1	5	3	Population size	Australian blacktip shark (*Carcharhinus tilstoni*)	1.2	3	3	2	Fishing in the NPF has a 1.6% annual footprint on the 770,000 km^2 managed area (Pitcher et al. 2016). Population size likely to be affected before major changes in other sub-components due to removal of individuals. Australian blacktip sharks are the most likely species to be affected as they make most of the shark species caught in the NPF and sharks typically have low fecundity, slow growth rate and low trawl survivability. Intensity: moderate as although fishing has a severe impact, it is localized due to suitable habitat for trawling. Consequence: moderate as this may impact on the stock. Confidence: high as data shows this is the most caught shark in the NPF.
	Incidental behaviour	0									
Direct impact without capture	Bait collection	0									
	Fishing	1	5	3	Population size	Black jewfish (*Protonibea diacanthus*)	1.2	2	2	1	Fishing in the NPF has a 1.6% annual footprint on the 770,000 km^2 managed area (Pitcher et al. 2016). Population size likely to be affected before major changes in other sub-components due to removal of individuals. Black jewfish are the most likely species to be affected as they are large so can escape via the TED but would probably have a high mortality rate and there is already concern about their population status. Intensity: minor as it is expected that these interactions would occur only occasionally. Consequence: minor as this has a minimal impact on the stock. Confidence: low as it is unknown what their survivability is after escapement from the TED.

DIRECT IMPACT OF FISHING	FISHING ACTIVITY	PRESENCE (1) ABSENCE (0)	SPATIAL SCALE OF HAZARD (1-6)	TEMPORAL SCALE OF HAZARD (1-6)	SUB-COMPONENT	UNIT OF ANALYSIS	OPERATIONAL OBJECTIVE (S2.1)	INTENSITY SCORE (1-6)	CONSEQUENCE SCORE (1-6)	CONFIDENCE SCORE (1-2)	RATIONALE
	Incidental behaviour	0									
	Gear loss	1	1	1	Population size	Australian blacktip shark (*Carcharhinus tilstoni*)	1.2	2	1	2	Fishing in the NPF has a 1.6% annual footprint of the 770,000 km^2 managed area (Pitcher et al. 2016), yet these days gear loss rarely occurs (e.g. one large commercial company stated only 1 gear loss in the last 10 years). Population size likely to be affected before major changes in other sub-components due to entrapment of individuals. Australian blacktip sharks are the most likely species to be at risk as they make up most of shark species caught in the NPF and would be expected to be in the net if gear loss occurred. Intensity: minor as gear loss is rare and interaction of shark with gear remote. Consequence: negligible as impact unlikely to be measurable. Confidence: high as it is known that very little gear is lost.
	Anchoring/ mooring	1	1	3	Population size	Mud bug (*Thenus parindicus*)	1.2	1	2	1	Anchoring sometimes occurs throughout the banana prawn sub-fishery. Population size likely to be affected before major changes in other sub-components due to impact with the anchor. Mud bug (which are a byproduct of the banana prawn sub-fishery) are the most likely species to be at affected due to injury/death from impact with the anchor. Intensity: negligible as vessels don't often anchor and anchoring has a very small footprint. Consequence: minor as this would have a minimal impact on the stock. Confidence: low as it is unknown how often anchors come in contact with bugs.
	Navigation/ steaming	1	3	3	Population size	Australian blacktip shark (*Carcharhinus tilstoni*)	1.2	2	1	2	Navigation to and from fishing grounds and steaming between trawls can occur throughout the NPF managed areas and has the potential to cause collision with animals. Population size likely to be affected before major changes in other sub-components due to injury/death from collision. Australian blacktip sharks are the most likely species to be affected as they swim at the water surface. Intensity: negligible as

DIRECT IMPACT OF FISHING	FISHING ACTIVITY	PRESENCE (1) ABSENCE (0)	SPATIAL SCALE OF HAZARD (1-6)	TEMPORAL SCALE OF HAZARD (1-6)	SUB-COMPONENT	UNIT OF ANALYSIS	OPERATIONAL OBJECTIVE (S2.1)	INTENSITY SCORE (1-6)	CONSEQUENCE SCORE (1-6)	CONFIDENCE SCORE (1-2)	RATIONALE
											Australian blacktip sharks are highly mobile and able to move out of a vessel's path. Consequence: negligible as any impact is unlikely to be detectable. Confidence: high as expert consensus is that Australian blacktip sharks and vessels rarely collide.
Addition/ movement of biological material	Translocation of species	1	5	6	Population size	Saucer scallop (*Amusium pleuronectes*)	1.2	1	2	1	Translocation may occur throughout the NPF, through ballast water or hull fouling, gear or anchor entanglement, and has the potential to establish as the majority of fishing areas and ports used are of similar depths. The black-striped mussel (*Mytilopsis sallei*) is now eradicated (Summerson et al. 2013), but establishes precedence for translocation to occur in the NPF area. Population size likely to be affected before major changes in other sub-components, by introducing a foreign competitor or through transmission of disease, but also directly or indirectly through changing trophic linkages. No mitigating measures are currently in place. Saucer scallop (which are a byproduct of the banana prawn sub-fishery) are the most likely bycatch/byproduct species to be at risk as they could easily be out-competed by other introduced bivalves for food and habitat. Intensity: negligible at present as saucer scallop are currently not affected by introduced organisms. Consequence: minor as although there is the potential for impacts to significantly alter population size, the previously introduced pest was quickly eradicated. Confidence: low as it not known to what extent trawling in the NPF contributes to the spread of the species. No data exists to refute this risk.
	On board processing	0									
	Discarding catch	1	5	3	Behaviour/ movement	Australian blacktip shark	6.1	3	2	2	Discarding of bycatch occurs extensively throughout the fished region. Population size likely to be affected before major changes in other sub-

DIRECT IMPACT OF FISHING	FISHING ACTIVITY	PRESENCE (1) ABSENCE (0)	SPATIAL SCALE OF HAZARD (1-6)	TEMPORAL SCALE OF HAZARD (1-6)	SUB-COMPONENT	UNIT OF ANALYSIS	OPERATIONAL OBJECTIVE (S2.1)	INTENSITY SCORE (1-6)	CONSEQUENCE SCORE (1-6)	CONFIDENCE SCORE (1-2)	RATIONALE
						(*Carcharhinus tilstoni*)					components if scavengers and predators (e.g. sharks and trevally) are attracted due to the addition of discards. Australian blacktip sharks are the most likely bycatch/byproduct species to be at risk as they are in the area (regularly caught in NPF nets). Intensity: major as this occurs daily throughout the fishery, however, the ratio of bycatch to catch is substantially lower during the banana prawn sub-fishery as "marks" of prawns are targeted. Consequence: minor as these changes are likely to be short-lived. Confidence: high as the effects of discarding of bycatch is well documented in the NPF.
	Stock enhancement	0									
	Provisioning	0									
	Organic waste disposal	1	5	3	Behaviour/ movement	Australian blacktip shark (*Carcharhinus tilstoni*)	6.1	1	1	2	Fishing in the NPF has a 1.6% annual footprint of the 770,000 km^2 managed area (Pitcher et al. 2016), for ~3 months each year, so organic waste disposal is possible over this scale. Behaviour/movement likely to be affected before major changes in other sub-components as a result of the attraction (e.g. food scraps) or repulsion (e.g. raw sewage) of the organic waste. Australian blacktip shark are the most likely species to be at risk as they would be attracted or repelled from the above organic waste. Intensity: negligible as each disposal event wouldn't have a detectable change on behaviour/movement. Consequence: negligible as impact is unlikely to be detectable. Confidence: high because expert consensus is that general fishing waste disposal is unlikely to impact the behaviour/movement of sharks.
	Debris	0									
	Chemical pollution	0									

DIRECT IMPACT OF FISHING	FISHING ACTIVITY	PRESENCE (1) ABSENCE (0)	SPATIAL SCALE OF HAZARD (1-6)	TEMPORAL SCALE OF HAZARD (1-6)	SUB-COMPONENT	UNIT OF ANALYSIS	OPERATIONAL OBJECTIVE (S2.1)	INTENSITY SCORE (1-6)	CONSEQUENCE SCORE (1-6)	CONFIDENCE SCORE (1-2)	RATIONALE
Addition of non-biological material	Exhaust	1	5	3	Behaviour/ movement	Australian blacktip shark (*Carcharhinus tilstoni*)	6.1	1	1	2	Fishing vessels travel throughout the NPF for ~3 months each year so exhaust emissions possible over this scale. Behaviour/movement likely to be affected before major changes in other sub-components due to the deterrent nature of the exhaust emissions. Australian blacktip shark are the most likely bycatch/byproduct species to be affected as they are closest to the water surface where pollutants will first affect. Intensity: negligible because although the hazard could occur over a large range/scale, exhaust wouldn't have a detectable change on behaviour/movement. Consequence: negligible as the impact of exhaust emissions is unlikely to be detectable. Confidence: high because expert consensus is that exhaust was considered unlikely to impact the behaviour/movement of highly mobile species.
	Gear loss	1	1	1	Population size	Blue Swimmer Crab (*Portunus armatus*)	1.2	2	1	2	Fishing in the NPF has a 1.6% annual footprint of the 770,000 km^2 managed area (Pitcher et al. 2016), yet these days gear loss rarely occurs (e.g. one large commercial company stated only 1 gear loss in the last 10 years). Population size likely to be affected before major changes in other sub-components due to entrapment of individuals. Blue swimmer crabs (most commonly caught portunid crab) are the most likely bycatch/byproduct species to be at risk as their body structure causes them to become easily trapped in ghost nets. Intensity: minor as lost gear would rarely interact with crabs. Consequence: negligible as the impact is unlikely to be detectable. Confidence: high because it is known that very little gear is lost, so interaction with crabs is considered unlikely.
	Navigation/ steaming	1	5	3	Behaviour/ movement	Australian blacktip shark	6.1	2	1	2	Navigation to and from fishing grounds and steaming between trawls can occur throughout the NPF managed areas and has the potential to cause collision with animals. Population size likely to be affected before major changes in other sub-components due to injury/death from

DIRECT IMPACT OF FISHING	FISHING ACTIVITY	PRESENCE (1) ABSENCE (0)	SPATIAL SCALE OF HAZARD (1-6)	TEMPORAL SCALE OF HAZARD (1-6)	SUB-COMPONENT	UNIT OF ANALYSIS	OPERATIONAL OBJECTIVE (S2.1)	INTENSITY SCORE (1-6)	CONSEQUENCE SCORE (1-6)	CONFIDENCE SCORE (1-2)	RATIONALE
						(*Carcharhinus tilstoni*)					collision. Australian blacktip sharks are the most likely bycatch/byproduct species to be at risk as they swim at the water surface. Intensity: minor as Australian blacktip sharks are highly mobile and unlikely to be affected by the shipping which is localised. Consequence: negligible as any impact is unlikely to be detectable. Confidence: high as expert consensus is that Australian blacktip sharks and vessels rarely collide.
	Activity/presence on water	1	5	3	Behaviour/ movement	Australian blacktip shark (*Carcharhinus tilstoni*)	6.1	1	1	1	Fishing throughout the NPF managed area introduces noise and visual stimuli into the environment. Behaviour and movement likely to be affected before major changes in other sub-components due to the repellent nature of the noise and visual stimuli. Australian blacktip shark are the most likely bycatch/byproduct species to be affected as they swim at the water surface. Intensity: negligible as sharks are highly mobile and easily move away from vessels. Consequence: negligible as any impact is unlikely to be detectable. Confidence: low as it not known to what extent noise and visual stimuli from fishing has on sharks.
Disturb physical processes	Bait collection	0									
	Fishing	1	5	3	Population size	Stephenson's mantis shrimp (*Harpiosquilla stephensoni*)	1.2	3	2	1	Fishing in the NPF has a 1.6% annual footprint of the 770,000 km^2 managed area (Pitcher et al. 2016), for ~3 months each year, with the action of direct disturbance to the seafloor. Population size likely to be affected before major changes in other sub-components due to trawl gear disturbing the seafloor habitat of benthic organisms. Stephenson's mantis shrimp (larger shrimp usually found near banana schools) are the most likely bycatch/byproduct species to be affected as the ground-chain would disturb their burrows and remove their food (small fish/crustaceans) from the benthos. Intensity: moderate as although fishing has a severe impact, it is localized due to suitable habitat for

DIRECT IMPACT OF FISHING	FISHING ACTIVITY	PRESENCE (1) ABSENCE (0)	SPATIAL SCALE OF HAZARD (1-6)	TEMPORAL SCALE OF HAZARD (1-6)	SUB-COMPONENT	UNIT OF ANALYSIS	OPERATIONAL OBJECTIVE (S2.1)	INTENSITY SCORE (1-6)	CONSEQUENCE SCORE (1-6)	CONFIDENCE SCORE (1-2)	RATIONALE
											trawling. Consequence: minor as disturbance of sediment will have a minimal impact on stocks. Confidence low as no data available.
	Boat launching	0									
	Anchoring/ mooring	1	2	3	Population size	Stephenson's mantis shrimp (*Harpiosquilla stephensoni*)	1.2	1	1	2	Anchoring sometimes occurs throughout the banana prawn sub-fishery. Population size likely to be affected before major changes in other sub-components due to the anchor disturbing the seafloor. Stephenson's mantis shrimp (larger shrimp usually found near banana schools) are the most likely bycatch/byproduct species to be affected as the anchor would disturb their burrows. Intensity: negligible as vessels don't often anchor and anchoring has a very small footprint. Consequence: negligible as impact unlikely to be measurable. Confidence: high because expert consensus is that interaction with Stephenson's mantis shrimp is considered unlikely.
	Navigation/ steaming	1	5	3	Behaviour/ movement	Australian blacktip shark (*Carcharhinus tilstoni*)	6.1	2	1	1	Navigation to and from fishing grounds and steaming between trawls can occur throughout the NPF managed areas and introduces noise and visual stimuli into the environment. Behaviour and movement likely to be affected before major changes in other sub-components due to the repellent nature of the noise and visual stimuli. Australian blacktip shark are the most likely bycatch/byproduct species to be affected as they swim at the water surface. Intensity: minor as sharks are highly mobile and unlikely to be affected by the shipping which is localised. Consequence: negligible as any impact is unlikely to be detectable. Confidence: low as it not known to what extent navigation/steaming in the NPF has on sharks.
External impacts	Other fisheries: crab fishery, spanner crab	1	6	6	Population size	Australian blacktip shark	1.2	3	3	2	Fishing occurs throughout the year by several other fisheries in the NPF managed region. Population size likely to be affected before major changes in other sub-components due to removal of individuals.

DIRECT IMPACT OF FISHING	FISHING ACTIVITY	PRESENCE (1) ABSENCE (0)	SPATIAL SCALE OF HAZARD (1-6)	TEMPORAL SCALE OF HAZARD (1-6)	SUB-COMPONENT	UNIT OF ANALYSIS	OPERATIONAL OBJECTIVE (S2.1)	INTENSITY SCORE (1-6)	CONSEQUENCE SCORE (1-6)	CONFIDENCE SCORE (1-2)	RATIONALE
	fishery, line fishery, net fisheries					(*Carcharhinus tilstoni*)					Australian blacktip sharks (most commonly caught shark in the NPF) are the most likely species to be affected as they would also be captured in both gillnet and long-line fisheries. Intensity: moderate as although fishing has a severe impact, it is localized to fishing hotspots. Consequence: moderate as this has a measurable impact on the stock. Confidence: high as data shows sharks are caught in numerous fisheries.
	Aquaculture	1	3	3	Population size	Australian blacktip shark (*Carcharhinus tilstoni*)	1.2	2	2	2	Three boat licenses exist for capturing *P. monodon* broodstock for aquaculture. Population size likely to be affected before major changes in other sub-components due to the removal of individuals. Australian blacktip sharks (most commonly caught shark in the NPF) are the most likely species to be affected as they would also be captured in trawl net. Intensity: minor as fishing for this broodstock only occurs at a few resticted locations. Consequence: minor as minimal impact on stocks due to not much fishing in this aquaculture fishery. Confidence: high as bycatch from *P. monodon* broodstock collection would be similar to that from banana prawn sub-fishery.
	Coastal development	1	3	6	Behaviour/ movement	Chacunda gizzard shad (*Anodontostoma chacunda*)	6.1	2	3	1	Coastal development occurs in small pockets surrounding the NPF. Behaviour and movement likely to be affected before major changes in other sub-components due to altered water/habitat quality. Chacunda gizzard shad are the most likely species to be affected as they are pelagic, but their juvenile stage covers inshore/river systems feeding on diatoms, etc., that would be affected by high sedimentation/ smothering in the water. Intensity: minor as this would be in restricted locations (most coastal development is limited to large estuaries). Consequence: moderate as coastal development may have a detectable impact on these shad during their early lifecycle phase inshore. Confidence: low as there is little data available to demonstrate the effects of coastal development on shad behaviour/movement.

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	Other extractive activities	1	4	6	Behaviour/ movement	Indian pellona (*Pellona ditchela*)	6.1	2	2	1	Exploration for oil, gas and petroleum is underway or proposed throughout NPF, particularly in the Arafura Sea. Behaviour and movement likely to be affected before major changes in other sub-components due to the addition of structures (rigs) in the sea. Indian pellona is the most likely species to be affected as they would tend to school around the large structure feeding on components of the community that grows on these hard structures. Intensity: minor as these activities occur in restricted locations. Consequence: minor as this would have a minimal effect on the stock. Confidence: low as data unavailable for effects of extractive activities on these fish.
	Other non extractive activities	1	6	6	Behaviour/ movement	Australian blacktip shark (*Carcharhinus tilstoni*)	6.1	3	1	1	Shipping occurs throughout the year throughout the NPF. Behaviour and movement likely to be affected before major changes in other sub-components due to an avoidance reaction. Australian blacktip shark are the most likely species to be affected as they swim at the water surface. Intensity: moderate as shipping occurs throughout the NPF and is concentrated in a number of ports e.g. Darwin, Groote, Weipa, Karumba. Consequence: negligible as any impact is unlikely to be detectable. Confidence: low as it not known to what extent non-NPF shipping has on sharks.
	Other anthropogenic activities	1	6	6	Population size	Golden snapper (*Lutjanus johnii*)	1.2	2	2	1	Recreational boating/fishing and tourism occurs throughout the year in the NPF, but particularly inshore and near major towns/cities. Behaviour and movement likely to be affected before major changes in other sub-components due an avoidance reaction. Golden snapper are the most likely species to be affected as they are a popular target fish of recreational fishers and are also caught in high numbers in the NPF. Intensity: minor as recreational activities occurs primarily in inshore areas and near major towns/cities. Consequence: minor as recreational

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											fishing probably has a minimal impact on the stock. Confidence: low as data unavailable for numbers of fish caught from recreational activities.

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DIRECT IMPACT OF FISHING	FISHING ACTIVITY	PRESENCE (1) ABSENCE (0)	SPATIAL SCALE OF HAZARD (1-6)	TEMPORAL SCALE OF HAZARD (1-6)	SUB-COMPONENT	UNIT OF ANALYSIS	OPERATIONAL OBJECTIVE (S2.1)	INTENSITY SCORE (1-6)	CONSEQUENCE SCORE (1-6)	CONFIDENCE SCORE (1-2)	RATIONALE
Capture	Bait collection	0									
	Fishing	1	5	3	Population size	Freshwater sawfish (*Pristis pristis*) and green sawfish (*P. zijsron*)	1.2	3	3	1	Fishing in the NPF has a 1.6% annual footprint on the 770,000 km^2 managed area (Pitcher et al. 2016). Population size likely to be affected before major changes in other sub-components due to removal of individuals. Both the green and freshwater sawfish are the most likely vulnerable species as their rostra are likely to interact with fishing trawl operations and escapement rates of sawfish from trawl nets through TED openings are currently unknown. Also, (i) population status of each species is unknown and (ii) there is either no or little information on any trends based on abundances indices (e.g., catch-per-unit-effort) within this assessment period. Intensity: moderate as although fishing has a severe

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											impact, it is localized due to suitable habitat for trawling. Consequence: moderate as population of green and freshwater sawfish are already relatively low taking only few will still have an impact on stocks. Confidence: low, stock status of these species is uncertain.
	Incidental behaviour	0									
Direct impact without capture	Bait collection	0									
	Fishing	1	5	3	Population size	Olive ridley turtle (*Lepidochelys olivacea*)	1.2	3	3	1	Fishing in the NPF has a 1.6% annual footprint on the 770,000 km^2 managed area (Pitcher et al. 2016). Population size likely to be affected before major changes in other sub-components. Population size likely to be affected before major changes in other sub-components due to removal of individuals. Olive ridley turtles are the most likely protected species to be at risk as they have the greatest risk of extinction for marine turtle stocks in the Gulf of Carpentaria region (C. Limpus pers. comm.). Western Cape York Peninsula olive ridley genetic stock nesting population is endemic to Queensland for breeding and has currently only a few hundred individuals annually. They are approaching zero recruitment of new adults annually into the breeding population (C. Limpus pers. comm.). Intensity: moderate as olive ridley turtles are encounter on a larger spatial scale. Consequence: moderate as the loss of only tens of adult females annually would represent a serious impact. Confidence: low as there is no data available to show the number or condition of turtles that escape the TED.
	Incidental behaviour	0									
	Gear loss	1	1	1	Population size	Freshwater sawfish (*Pristis pristis*) and	1.2	2	1	2	Fishing occurs in 1.6% annual footprint 770,000 km^2 NPF managed area for ~ three months each year, yet these days gear loss rarely occurs (e.g. one large commercial company stated only 1 gear loss in the last 10 years). Population size likely to be affected before major changes in other sub-components due to

DIRECT IMPACT OF FISHING	FISHING ACTIVITY	PRESENCE (1) ABSENCE (0)	SPATIAL SCALE OF HAZARD (1-6)	TEMPORAL SCALE OF HAZARD (1-6)	SUB-COMPONENT	UNIT OF ANALYSIS	OPERATIONAL OBJECTIVE (S2.1)	INTENSITY SCORE (1-6)	CONSEQUENCE SCORE (1-6)	CONFIDENCE SCORE (1-2)	RATIONALE
						green sawfish (*P. zijsron*)					removal of individuals. Both the green and freshwater sawfish are most likely protected species to be affected from lost gear as they are benthic and their rostra easily entangle in net mesh. Intensity: minor as gear loss is rare and interaction of sawfish with gear remote. Consequence: minor as gear loss unlikely to contribute to further population decline. Confidence: high as it is known that very little gear is lost, and interaction with sawfish is considered unlikely.
	Anchoring/mooring	1	1	3	Population size	Olive ridley turtle (*Lepidochelys olivacea*)	1.2	1	2	2	Fishing in the NPF has a 1.6% annual footprint on the 770,000 km^2 managed area (Pitcher et al. 2016). Population size likely to be affected before major changes in other sub-components. Olive ridley turtles are the most likely protected species to be affected of interacting with the anchor or chain. Intensity: negligible as turtles unlikely to interact with anchor. Consequence: minor as anchoring is unlikely to have a detectable effect on the populations. Confidence: high as expert consensus is that it is very unlikely that turtles would interact with the anchor chain/rope.
	Navigation/steaming	1	3	3	Population size	Olive ridley turtle (*Lepidochelys olivacea*)	1.2	2	2	2	Navigation to and from fishing grounds and steaming between trawls can occur throughout the NPF managed areas and has the potential to cause collision with animals. Population size likely to be affected before major changes in other sub-components due to injury/death from collision. Olive ridley turtles are the most likely protected species to be affected as they are slow moving, spend time at the surface (like other species), yet their stocks are already severely depleted and need population recovery. Intensity: minor as this occurs rarely. Consequence: minor as there is minimal impact on stock structure. Confidence: low as it is unknown the effect shipping has on this species; data is too deficient to assess.
Addition/ movement of biological material	Translocation of species	1	5	6	Population size	Olive ridley turtle (*Lepidochelys olivacea*)	1.2	1	2	1	Translocation may occur throughout the NPF, through ballast water or hull fouling, gear or anchor entanglement, and has the potential to establish as the majority of fishing areas and ports used are of similar depths. The black-striped mussel (*Mytilopsis sallei*) is now eradicated (Summerson et al. 2013), but establishes precedence for translocation to occur in the NPF area. Population size likely to be affected before major changes in other sub-components, by

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											introducing a foreign competitor or through transmission of disease, but also directly or indirectly through changing trophic linkages. Olive ridley turtles are the most likely protected species to be at risk as the introduction of marine pests that may affect the feeding grounds of this species. Translocated species most likely to affect compromised habitats in terms of structure and function, by altering pelagic and sediment processes, and displacing species. Intensity: negligible at present as olive ridley turtles are currently not affected by introduced organisms. Consequence: minor as although there is the potential for impacts to significantly alter population size, the previously introduced pest was quickly eradicated. Confidence: low as it not known to what extent trawling in the NPF contributes to the spread of the species. No data exists to refute this risk.
	On board processing	0									
	Discarding catch	1	5	3	Behaviour /movement	Crested tern (*Thalasseus bergii*)	6.1	3	2	2	Discarding is common after each shot throughout the fishery. Behaviour and movement like to be affected before major changes in other sub-components due to foraging for food. Crested tern are the most likely protected species to be affected as their primary food source (small fish) make up the majority of the discarded bycatch. Intensity: major as this occurs daily throughout the fishery with a substantial amount of bycatch being discarded due to the "line trawling" that occurs during the sub-fishery. Consequence: minor as these changes are likely to be short-lived. Confidence: high as scavenging by terns behind trawlers is common and well documented.
	Stock enhancement	0									
	Provisioning	0									
	Organic waste disposal	1	5	3	Behaviour /movement	Crested tern (*Thalasseus bergii*)	6.1	1	1	2	Fishing in the NPF has a 1.6% annual footprint on the 770,000 km^2 managed area (Pitcher et al. 2016). Behaviour/movement likely to be affected before major changes in other sub-components as a result of the attraction (e.g. food scraps)

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											or repulsion (e.g. raw sewage) of the organic waste. Crested tern are the most likely protected species to be affected. Intensity: negligible as each disposal event wouldn't have a detectable change on behaviour/movement. Consequence: negligible as impact is unlikely to be detectable. Confidence: high because expert consensus is that general fishing waste disposal is unlikely to impact the behaviour/movement of birds.
Addition of non-biological material	Debris	0									
	Chemical pollution	0									
	Exhaust	1	5	3	Behaviour /movement	Crested tern (*Thalasseus bergii*)	6.1	1	1	1	Fishing occurs throughout the NPF for ~ three months each year so exhaust emissions occurs over this scale. Behaviour and movement like to be affected before major changes in other sub-components due to inhalation of exhaust fumes. Exhaust poses greatest potential risk for the behaviour/movement of crested terns as emissions and pollutants are initially in the atmosphere which is where the crested tern population spend most of their time. Intensity: negligible because although the hazard could occur over a large range/scale, exhaust considered to only impact a small area. Consequence: negligible as exhaust is unlikely to have a significant impact on the population's movement and behaviour. Confidence: low as the effects of exhaust on crested terns is unknown.
	Gear loss	1	1	1	Population size	Freshwater sawfish (*Pristis pristis*) and green sawfish (*P. zijsron*)	1.2	2	2	2	Fishing in the NPF has a 1.6% annual footprint on the 770,000 km^2 managed area (Pitcher et al. 2016), however gear loss is rare. Population size likely to be affected before major changes in other sub-components. Both the green and freshwater sawfish are the most likely protected species to be affected as they are benthic and their rostra easily entangle in net mesh. Also nets may wash up near shore in nursery grounds. Intensity: minor as gear loss is rare and interaction of sawfish with gear remote. Consequence: minor as gear loss unlikely to contribute to further population decline. Confidence: high as it is known that very little gear is lost, and interaction with sawfish is considered unlikely.

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	Navigation/steaming	1	5	3	Behaviour /movement	Bottlenose dolphin (*Tursiops truncatus*)	6.1	2	1	2	Navigation to and from fishing grounds and steaming between trawls can occur throughout the NPF managed areas and introduces noise and visual stimuli into the environment. Behaviour and movement likely to be affected before major changes in other sub-components due to the introduction of the noise and sonar. Dolphins are the most likely protected species to be affected as they are attracted to the sonic signals and noise emitted from the vessels. Intensity: minor as this occurs in restricted locations where fishing occurs. Consequence: negligible as any impact is unlikely to be detectable. Confidence: high as data exists which supports the theory that dolphins are attracted to vessels.
	Activity/presence on water	1	5	3	Behaviour /movement	Bottlenose dolphin (*Tursiops truncatus*)	6.1	2	1	2	Fishing throughout the NPF managed area introduces noise and visual stimuli into the environment. Behaviour and movement likely to be affected before major changes in other sub-components due to the introduction of the noise and sonar. Dolphins are the most likely protected species to be affected as they are attracted to the sonic signals and noise emitted from the vessels. Intensity: minor as this occurs in restricted locations where fishing occurs. Consequence: negligible as any impact is unlikely to be detectable. Confidence: high as data exists which supports the theory that dolphins are attracted to vessels.
Disturb physical processes	Bait collection	0									
	Fishing	1	5	3	Behaviour /movement	Freshwater sawfish (*Pristis pristis*) and green sawfish (*P. zijsron*)	6.1	3	2	1	Fishing in the NPF has a 1.6% annual footprint of the 770,000 km^2 managed area (Pitcher et al. 2016), for ~ three months each year, with the action of direct disturbance to the seafloor. Behaviour and movement likely to be affected before major changes in other sub-components due to trawl gear disturbing the seafloor habitat of benthic organisms. Both the green and freshwater sawfish are the most likely protected species to be affected as trawling may disturb sediments and prevent sawfish from feeding. Intensity: moderate as sediment disturbance occurs regularly. Consequence: minor as disturbance of sediment causes minimal

DIRECT IMPACT OF FISHING	FISHING ACTIVITY	PRESENCE (1) ABSENCE (0)	SPATIAL SCALE OF HAZARD (1-6)	TEMPORAL SCALE OF HAZARD (1-6)	SUB-COMPONENT	UNIT OF ANALYSIS	OPERATIONAL OBJECTIVE (S2.1)	INTENSITY SCORE (1-6)	CONSEQUENCE SCORE (1-6)	CONFIDENCE SCORE (1-2)	RATIONALE
											impact on sawfish behaviour/movement. Confidence: low since no data are available.
	Boat launching	0									
	Anchoring/mooring	1	2	3	Behaviour /movement	Freshwater sawfish (*Pristis pristis*) and green sawfish (*P. zijsron*)	6.1	1	1	1	Anchoring sometimes occurs throughout the banana prawn sub-fishery. Behaviour and movement likely to be affected before major changes in other sub-components due to the anchor disturbing the seafloor. Both the green and freshwater sawfish are the most likely protected species to be affected as anchoring may disturb sediments and prevent sawfish from feeding. Intensity: negligible as anchoring doesn't regularly occur and is only in shallower waters where their feeding habitat occurs. Consequence: negligible as disturbance of sediment causes undetectable impact on sawfish behaviour/movement. Confidence: low since no data are available.
	Navigation/steaming	1	5	3	Behaviour /movement	Spectacled sea snake (*Disteira kingii*) and large-headed sea snake (*Hydrophis pacificus*)	6.1	2	1	1	Navigation to and from fishing grounds and steaming between trawls can occur throughout the NPF managed areas and creates turbulent action from the propellers. Behaviour and movement likely to be affected before major changes in other sub-components due to the repellent nature of this turbulence. Both the spectacled and large-headed sea snakes are the most likely protected species to be affected as turbulence from the boat will move/displace these relatively light sea snake that swim at the surface as they travel. Intensity: minor as it is unlikely that turbulence would have a detectable change on behaviour/movement. Consequence: negligible as any impact is unlikely to be detectable. Confidence: low as it not known to what extent turbulence affects sea snakes.
External impacts	Other fisheries: crab fishery, spanner crab fishery, line fishery, net fisheries	1	6	6	Population size	Freshwater sawfish (*Pristis pristis*) and green sawfish (*P. zijsron*)	1.2	4	4	2	Fishing occurs throughout the year by several other fisheries in the NPF managed region. Population size most likely to be affected before major changes in other sub-components due to removal of individuals. Freshwater and green sawfish most likely to be affected as their rostra get entangled in gillnets. Intensity: major as sawfish commonly caught in gillnet fisheries operation year-round.

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											Consequence: major as sawfish populations declining and continual catches may further deplete the population in the NPF region. Confidence: high as catch data from other fisheries show high catch of sawfish.
	Aquaculture	1	3	3	Population size	Freshwater sawfish (*Pristis pristis*) and green sawfish (*P. zijsron*)	1.2	2	4	2	Three boat licenses exist for capturing *P. monodon* broodstock for aquaculture. Population size likely to be affected before major changes in other sub-components due to the removal of individuals. Freshwater and green sawfish are the most likely protected species to be affected as they would also be captured in trawl net. Intensity: minor as fishing for this broodstock only occurs at a few restricted locations. Consequence: major as high impact on stocks due a large number of sawfish being caught when trawling for broodstock. Confidence: high as sawfish catch data exists from *P. monodon* broodstock collection.
	Coastal development	1	3	6	Behaviour /movement	Freshwater sawfish (*Pristis pristis*) and green sawfish (*P. zijsron*)	6.1	3	3	1	Coastal development occurs in small pockets surrounding the NPF. Behaviour and movement likely to be affected before major changes in other sub-components due to altered water/habitat quality. Both the green and freshwater sawfish are the most likely species to be affected as their habitats are in shallower waters and they may move in response to altered turbidity/habitat quality. Intensity: moderate as coastal development occurs in the vicinity of large waterways (including Weipa and Karumba) which have high numbers of sawfish. Consequence: moderate as coastal development may change sedimentation regimes which may directly affect sawfish. Confidence: low as there is little data available to demonstrate the effects of coastal development on sawfish.
	Other extractive activities	1	4	6	Behaviour /movement	Bottlenose dolphin (*Tursiops truncatus*)	6.1	2	1	1	Exploration for minerals is underway or proposed within NPF. Most likely to affect behaviour/movement before major changes in other sub-components. This is most likely to affect behaviour/movement of dolphins as they are sensitive to noise from drilling and seismic testing. Intensity: scored as minor as exploration activity occurs at a very few restricted areas. Consequence: scored as negligible

DIRECT IMPACT OF FISHING	FISHING ACTIVITY	PRESENCE (1) ABSENCE (0)	SPATIAL SCALE OF HAZARD (1-6)	TEMPORAL SCALE OF HAZARD (1-6)	SUB-COMPONENT	UNIT OF ANALYSIS	OPERATIONAL OBJECTIVE (S2.1)	INTENSITY SCORE (1-6)	CONSEQUENCE SCORE (1-6)	CONFIDENCE SCORE (1-2)	RATIONALE
											as effect on behaviour expected to be undetectable at this scale. Confidence: is low as effects are not documented in this region.
	Other non extractive activities	1	6	6	Population size	Olive ridley turtle (*Lepidochelys olivacea*)	1.2	3	3	2	Shipping occurs year-round throughout the NPF. Population size likely to be affected before major changes in other sub-components. This is mainly due to collision with ships as turtles are slow moving. Olive Ridley turtles are the most likely protecetd species to be at risk as they have the greatest risk of extinction for marine turtle stocks in the Gulf of Carpentaria region (C. Limpus pers. comm.). Western Cape York Peninsula olive ridley genetic stock nesting population is endemic to Queensland for breeding and has currently only a few hundred individuals annually. They are approaching zero recruitment of new adults annually into the breeding population (C. Limpus pers. comm.). Intensity: moderate as activity occurs throughout the NPF. Consequence: moderate as the loss of only tens of adult females annually would represent a serious impact. Confidence: high as turtle experts agree this species is extremely vulnerable.
	Other anthropogenic activities	1	6	6	Population size	Olive ridley turtle (*Lepidochelys olivacea*)	1.2	2	3	2	Recreational boating/fishing and tourism occurs throughout the year in the NPF, but particularly inshore and near major towns/cities. Population size likely to be affected before major changes in other sub-components due to boat strikes. Olive Ridley turtles are the most likely species to be affected as they have the greatest risk of extinction for marine turtle stocks in the Gulf of Carpentaria region (C. Limpus pers. comm.). Western Cape York Peninsula olive ridley genetic stock nesting population is endemic to Queensland for breeding and has currently only a few hundred individuals annually. They are approaching zero recruitment of new adults annually into the breeding population (C. Limpus pers. comm.). Intensity: moderate as activity occurs throughout the NPF and is concentrated in a number of ports e.g. Darwin, Groote, Weipa, Karumba. Consequence: moderate as the loss of only tens of adult females annually would represent a serious impact. Confidence: high, as turtle experts agree this species is extremely vulnerable.

Level 1 (SICA) Document L1.4 - Habitat Component (demersal)

DIRECT IMPACT OF FISHING	FISHING ACTIVITY	PRESENCE (1) ABSENCE (0)	SPATIAL SCALE OF HAZARD (1-6)	TEMPORAL SCALE OF HAZARD (1-6)	SUB-COMPONENT	UNIT OF ANALYSIS	OPERATIONAL OBJECTIVE (S2.1)	INTENSITY SCORE (1-6)	CONSEQUENCE SCORE (1-6)	CONFIDENCE SCORE (1-2)	RATIONALE
Capture	Bait collection	0									
	Fishing	1	5	3	Habitat structure and function	Habitat–forming benthos: bryozoans, corals, sponges, gorgonians, anemones, and ascidians (region 2: assemblage 5)	5.1	3	3	1	Fishing occurs over 1.6% of the 770,000 km² NPF managed area for each year (late March to ~mid June), in waters generally <35 m deep. Fishing localized and highly selective, targeting aggregations of banana prawns, fishing activity occurs 24 hrs. Net sits up higher in the water than when targeting tiger prawns, however gear still operates demersally. Gear bottom time and footprint less than longer shots as in tiger prawns targeting. Intensity: moderate - trawls short, shots (0.5 -1 hour) due to easier targeting of 'marks'. Consequence: moderate. Gear will damage and potentially remove erect, rugose and inflexible octocorals associated with soft muddy substratum. Regeneration times of fauna will vary between species, however in coastal margin depths (0-25m); can be expected to be reasonably rapid as fauna are likely to be well adapted to frequent and considerable disturbance regimes (e.g. strong currents, runoff, cyclones). More structurally complex forms/ communities may take > 1 year to recover. Confidence: low, requires data on resilience and recovery times of mud-based habitats.
	Incidental behaviour	0									
Direct impact without capture	Bait collection	0									
	Fishing	1	5	3	Habitat structure and function	Habitat–forming benthos: bryozoans, corals, sponges, gorgonians, anemones, and	5.1	3	3	1	Octocorals and hexacorals which survive passing of a prawn trawl shot, due to their apparent flexibility or strong subsurface attachment, are likely to sustain some degree of damage to contacted polyps. Sponges, bryozoans and ascidians may be detatched from the seafloor completely. Intensity: moderate - shots short and localised (0.5 -1 hour)

DIRECT IMPACT OF FISHING	FISHING ACTIVITY	PRESENCE (1) ABSENCE (0)	SPATIAL SCALE OF HAZARD (1-6)	TEMPORAL SCALE OF HAZARD (1-6)	SUB-COMPONENT	UNIT OF ANALYSIS	OPERATIONAL OBJECTIVE (S2.1)	INTENSITY SCORE (1-6)	CONSEQUENCE SCORE (1-6)	CONFIDENCE SCORE (1-2)	RATIONALE
						ascidians (region 2: assemblage 5)					due to easier targeting of 'marks', decreases potential contact time with fauna. Consequence: moderate. Post encounter fate of fauna unknown, regeneration times of damaged tissues will vary between species, however in coastal margin depths (0-25m), can be expected to be reasonably rapid as fauna are likely to be well adapted to frequent and considerable disturbance regimes (e.g. strong currents, runoff, cyclones). More structurally complex forms/ communities may take > 1 year to recover. Confidence: low, requires data on resilience and recovery times of mud-based habitats.
	Incidental behaviour	0									
	Gear loss	1	1	1	Habitat structure and function	Habitat–forming benthos: bryozoans, corals, sponges, gorgonians, anemones, and ascidians (region 2: assemblage 5)	5.1	2	1	2	Fishing occurs in 1.6% of the 770,000 km2 NPF managed area each year. Gear loss is rare. Trawling often over relatively muddy sediments which are likely to be interspersed with patches of biogenic encrusted/ coral outcrops but snagging unlikely if terrain known and hard patches avoided. Intensity: minor as gear loss is rare. Consequence: negligible. Gear likely to be retrievable in these depths. Lost gear may change habitat structure by virtue of creating new structure, which remains to eventually become habitat, impact unlikely to be measurable. Confidence: high as it is known that very little gear is lost.
	Anchoring/mooring	1	1	3	Habitat structure and function	Habitat–forming benthos: bryozoans, corals, sponges, gorgonians, anemones, and ascidians (region 2: assemblage 5)	5.1	1	2	1	Anchoring occurs occasionally throughout the fishery, over a 6 week period, mainly in <25 m depths. Anchoring may occur on sandy substratum or coral reefs. Attached/ sessile fauna may be damaged by physical contact with anchor, during anchoring and retrieval. Intensity: negligible across scale of fishery. Consequence: minor over scale of fishery, considered to affect only a very small percentage of the area of the habitat overall, and in very localised locations. Confidence: low as unknown effect on NPF habitat caused by anchoring/ mooring.

DIRECT IMPACT OF FISHING	FISHING ACTIVITY	PRESENCE (1) ABSENCE (0)	SPATIAL SCALE OF HAZARD (1-6)	TEMPORAL SCALE OF HAZARD (1-6)	SUB-COMPONENT	UNIT OF ANALYSIS	OPERATIONAL OBJECTIVE (S2.1)	INTENSITY SCORE (1-6)	CONSEQUENCE SCORE (1-6)	CONFIDENCE SCORE (1-2)	RATIONALE
	Navigation/steaming	1	3	3	Water quality	Northern Pelagic Coastal (Gulf)	1.1	1	1	2	Navigation/ steaming associated with fishing activity occurs in 1.6% of the 770,000 km^2 NPF managed area each year. Navigation/steaming considered to influence water quality by disrupting the water column. Intensity: Negligible, considered unlikely that there would be detectable impacts on pelagic habitat water quality. Consequence: therefore negligible. Confidence: high because negative interactions between Navigation/steaming and pelagic habitat were considered unlikely to be detectable.
Addition/ movement of biological material	Translocation of species	1	5	6	Habitat structure and function	Habitat–forming benthos: bryozoans, corals, sponges, gorgonians, anemones, and ascidians (region 2: assemblage 5)	5.1	1	2	1	Translocation of species may occur throughout the NPF, through ballast water or hull fouling, and more likely to establish in shallower waters. Three species of introduced marine organisms are known to NPF; *Megabalanus tintinnabulum* (barnacle), *Aeolidiella indica* (nudibranch), and *Caulerpa taxifolia* (algae). The bivalve, black-striped mussel, currently eradicated from Darwin harbour, this species remains a potentially serious threat. Translocated species most likely to affect compromised habitats in terms of structure and function, by altering pelagic and sediment processes, and displacing species. Intensity: considered negligible at present. Consequence: minor as although there is the potential for impacts to significantly alter habitat structure and function, the previously introduced pest was quickly eradicated. Confidence: low as it not known to what extent trawling in the NPF contributes to the spread of the species.
	On board processing	0									
	Discarding catch	1	5	3	Substrate quality	Habitat–forming benthos: bryozoans, corals, sponges, gorgonians,	3.1	3	2	2	Discarding is common after each shot throughout the fishery. Hard bodied organisms discarded in considerable volumes in a single dump, may well sink to the benthos and accumulate in shallow depths, < 20% noted to be consumed by scavengers. If accumulate over fine sediments,

DIRECT IMPACT OF FISHING	FISHING ACTIVITY	PRESENCE (1) ABSENCE (0)	SPATIAL SCALE OF HAZARD (1-6)	TEMPORAL SCALE OF HAZARD (1-6)	SUB-COMPONENT	UNIT OF ANALYSIS	OPERATIONAL OBJECTIVE (S2.1)	INTENSITY SCORE (1-6)	CONSEQUENCE SCORE (1-6)	CONFIDENCE SCORE (1-2)	RATIONALE
						anemones, and ascidians (region 2: assemblage 5)					altering substrate quality via changed biogeochemical processes and sediment ecology. Habitat ecology will be modified by the attraction of scavengers and predators. Intensity: moderate as high volumes of bycatch occur extensively, but not as high as the tiger fishery. Consequence: minor as fishery discards high volumes of diverse bycatch in localised accumulations which may take long periods to breakdown. Confidence: high. Australian based Refs on fate of discards include: Wassenberg and Hill (1990), Harris and Poiner (1990), Hill and Wassenberg (1990).
	Stock enhancement	0									
	Provisioning	0									
	Organic waste disposal	1	5	3	Water quality	Northern Pelagic Coastal (Gulf)	1.1	1	1	2	Discharge of organic waste (e.g. uncontaminated food waste) likely to occur daily although relatively small amounts. Intensity: negligible over area. Consequence: negligible, volume likely to be small and quickly dispersed through the water column. Confidence: high, localised short term increases in nutrient not expected to adversely affect water column.
Addition of non-biological material	Debris	0									
	Chemical pollution	0									
	Exhaust	1	5	3	Air quality	Northern Pelagic Coastal (Gulf)	2.1	1	1	1	Fishing occurs throughout the NPF for about 10 weeks each year so chemical pollution from exhaust emissions possible over this scale. Chemical pollution poses greatest potential threat to the water quality of the northern pelagic coastal province habitats (Gulf). Intensity: negligible because although the hazard could occur over a large range/scale, pollution considered to only impact a small area. Consequence: negligible as the effects of chemical pollution are likely to be rapidly undetectable if volume small and affect surface conditions

DIRECT IMPACT OF FISHING	FISHING ACTIVITY	PRESENCE (1) ABSENCE (0)	SPATIAL SCALE OF HAZARD (1-6)	TEMPORAL SCALE OF HAZARD (1-6)	SUB-COMPONENT	UNIT OF ANALYSIS	OPERATIONAL OBJECTIVE (S2.1)	INTENSITY SCORE (1-6)	CONSEQUENCE SCORE (1-6)	CONFIDENCE SCORE (1-2)	RATIONALE
											briefly until winds, wave action dissipates chemical pollution. Confidence: low as effects of the exhaust is unknown.
	Gear loss	1	1	1	Habitat structure and function	Habitat–forming benthos: bryozoans, corals, sponges, gorgonians, anemones, and ascidians (region 2: assemblage 5)	5.1	2	1	2	Gear loss is rare. Retrieval is usually attempted and possible in shallow depths. Lost gear may change habitat structure by virtue of creating new structure, which remains to eventually become habitat. Intensity: minor as gear loss is rare across the spatial scale of the fishery, therefore alteration of habitat structure from lost gear minimal. Consequence: negligible, impact unlikely to be measurable. Confidence: high, known that very little gear is lost.
	Navigation/ steaming	1	5	3	Water quality	Habitat–forming benthos: bryozoans, corals, sponges, gorgonians, anemones, and ascidians (region 2: assemblage 5)	1.1	2	1	1	Navigation to and from fishing grounds and steaming between trawls can occur throughout the NPF managed areas and introduces noise and visual stimuli into the environment, affecting water quality. Intensity: minor as this occurs in restricted locations where fishing occurs. Consequence: negligible as any impact is unlikely to be detectable. Confidence: low as effect on pelagic habitats of noise and visual stimuli not known.
	Activity/ presence on water	1	5	3	Water quality	Northern Pelagic Coastal (Gulf)	1.1	1	1	1	Fishing occurs throughout the fishery and birds and seals turtles may be attracted to fishing operations. No preceivable impact on the pelagic environment (nor on demersal or air habitat). Intensity: negligible because it occurs over a large range but detection of impact unlikely. Consequence: negligible. Confidence: low as effect on pelagic habitats of noise and visual stimuli not known.
Disturb physical processes	Bait collection	0									
	Fishing	1	5	3	Substrate quality	Habitat–forming benthos: bryozoans, corals, sponges,	3.1	3	2	1	Most vulnerable habitats in assemblage 2 from Pitcher et al. (2016) (region 2: assemblage 5 from Pitcher et al. (2018)) were chosen as potentially impacted where highest levels of effort although there is no

DIRECT IMPACT OF FISHING	FISHING ACTIVITY	PRESENCE (1) ABSENCE (0)	SPATIAL SCALE OF HAZARD (1-6)	TEMPORAL SCALE OF HAZARD (1-6)	SUB-COMPONENT	UNIT OF ANALYSIS	OPERATIONAL OBJECTIVE (S2.1)	INTENSITY SCORE (1-6)	CONSEQUENCE SCORE (1-6)	CONFIDENCE SCORE (1-2)	RATIONALE
						gorgonians, anemones, and ascidians (region 2: assemblage 5)					data that shows actual impact. Trawls are deployed over sandy/mud sediments which may support large/tall erect sponges and other suspension feeding sessile invertebrates in patches. Trawling may cause suspension of fine sediment layers which settle out on filter feeding organisms smothering ability to function normally, in a way that is greater than expected from wave/ current action alone. Intensity: moderate. Consequence: minor as trawl considered to have little direct impact on seafloor. Confidence: high, however, the area fished is a highly dynamic zone, much of its fauna is adapted to mobile sediments from natural disturbance, but fishing may occur at greater frequency than these natural events.
	Boat launching	0									
	Anchoring/mooring	1			Habitat structure and function	Habitat–forming benthos: bryozoans, corals, sponges, gorgonians, anemones, and ascidians (region 2: assemblage 5)	5.1	1	1	1	Anchoring sometimes occurs throughout the banana prawn sub-fishery. Physical contact with anchor may disturb substratum in the process and damage hard, benthic organisms in a more persistent way, particularly in frequently used sites. Risk of sediment suspension low as likely to anchor on 'hard' structures or coarse sands. Intensity: negligible as anchoring doesn't regularly occur. Consequence: negligible as disturbance of sediment unlikely. Confidence: low since no data are available.
	Navigation/steaming	1	5	3	Water quality	Northern Pelagic Coastal (Gulf)	1.1	2	1	1	Navigation/steaming associated with searching for banana prawns in the NPF occurs over ~6 weeks each year. Intensity: minor as activity occurs over a large range but detection of impact is rare. Consequence: negligible. Water quality altered by turbulence unlikely to sustain measurable or persistent change. Stimuli cease with cessation of activities. Confidence: low, effects of water column disturbance on pelagic habitats not known.

DIRECT IMPACT OF FISHING	FISHING ACTIVITY	PRESENCE (1) ABSENCE (0)	SPATIAL SCALE OF HAZARD (1-6)	TEMPORAL SCALE OF HAZARD (1-6)	SUB-COMPONENT	UNIT OF ANALYSIS	OPERATIONAL OBJECTIVE (S2.1)	INTENSITY SCORE (1-6)	CONSEQUENCE SCORE (1-6)	CONFIDENCE SCORE (1-2)	RATIONALE
External Impacts	Other fisheries: crab fishery, spanner crab fishery, line fishery, net fisheries	1	6	6	Habitat type, structure and function	Habitat–forming benthos: bryozoans, corals, sponges, gorgonians, anemones, and ascidians (region 2: assemblage 5)	4.1, 5.1	3	3	1	Fishing occurs throughout the year by several other fisheries in the NPF managed region. Intensity: moderate for benthic habitat structure and function across the spatial scale of the NPF, as many other methods interact to varying degrees with substratum and faunal communities. Consequence: moderate as both hard and soft grounds are targeted, degree of habitat impact not quantified, nor enough known about habitat potential to recover given frequent anthropogenic disturbance. Cumulative effects on habitat structure and function are a concern for all habitats, particularly those which may possess long-lived, fragile and endemic species. Confidence: low, requires data on cumulative effects in NPF.
	Aquaculture	1	3	3	Water quality, substrate quality	Habitat–forming benthos: bryozoans, corals, sponges, gorgonians, anemones, and ascidians (region 2: assemblage 5)	1.1, 3.1	2	2	1	Three boat licenses exist for capturing *P. monodon* broodstock for aquaculture. Water and substrate quality likely to be affected before major changes in other sub-components Intensity: minor as fishing for this broodstock only occurs at a few restricted locations. Consequence: minor as minimal impact on the habitat as relatively little fishing occurs. Confidence: low since no data available.
	Coastal development	1	3	6	Water quality, substrate quality	Habitat–forming benthos: bryozoans, corals, sponges, gorgonians, anemones, and ascidians (region 2: assemblage 5; region 2: assemblage 6, region 1: assemblage	1.1, 3.1	3	3	2	Coastal development occurs in small pockets surrounding the NPF. Most likely to affect coastal margin mangrove and seagrass habitats. Habitat structure and function most at risk of modification through indirect effects of coastal development, altered runoff and coastal sedimentation regimes, fragmentation of habitat, modified biogeochemical processes due to high nutrient loads, introduced species associated with port/ tourism/traditional/ O and G activities (Hill and Haywood, 2002). Intensity: moderate as coastal development may have severe, concentrated effects on crucial seafloor habitats occurring close to development e.g. mangroves, estuarine, seagrass, fringing reef

DIRECT IMPACT OF FISHING	FISHING ACTIVITY	PRESENCE (1) ABSENCE (0)	SPATIAL SCALE OF HAZARD (1-6)	TEMPORAL SCALE OF HAZARD (1-6)	SUB-COMPONENT	UNIT OF ANALYSIS	OPERATIONAL OBJECTIVE (S2.1)	INTENSITY SCORE (1-6)	CONSEQUENCE SCORE (1-6)	CONFIDENCE SCORE (1-2)	RATIONALE
						5, region 1: assemblage 6)					communities. Consequence: moderate as coastal development may fragment crucial habitats, which may take many years to recover. Confidence: high as data exists that demonstrates the effects of coastal development on shallow tropical, coastal zones.
	Other extractive activities	1	4	6	Substrate quality	Habitat–forming benthos: bryozoans, corals, sponges, gorgonians, anemones, and ascidians (region 2: assemblage 5; region 2: assemblage 6, region 1: assemblage 5, region 1: assemblage 6)	3.1	2	2	1	Exploration for oil, gas and petroleum is underway or proposed throughout NPF, particularly in the Arafura Sea. Most likely to affect rare benthic habitat types influenced directly by exploratory activities. Areal extent may be affected by exploratory activity e.g. drilling, habitats not well described for this region, and surrogates may not identify important habitats of restricted distributions. Intensity: minor as these activities occur in restricted locations. Consequence: minor as effects on rare habitat distribution expected to be minimal at this stage of development. Confidence: low as data unavailable for effects of extractive activities on these habitats.
	Other non extractive activities	1	6	6	Water quality	Northern Coastal Gulf (pelagic)	1.1	3	2	1	Shipping occurs throughout the year throughout the NPF. Greatest threat to pelagic habitat function is water quality due to introduction of tubulence from vessels. Intensity: moderate as shipping occurs throughout the NPF and is concentrated in a number of ports e.g. Darwin, Groote, Weipa, Karumba. Consequence: minor as effects on water quality are expected to be minimal. Confidence: low as data are unavailable for effect of shippping on water quality in NPF.
	Other anthropogenic activities	1	6	6	Water quality, substrate quality, habitat types, structure and function	Habitat–forming benthos: bryozoans, corals, sponges, gorgonians, anemones, and ascidians (region 2: assemblage 5; region	1.1, 3.1, 4.1, 5.1	2	2	1	Recreational boating/fishing and tourism occurs throughout the year in the NPF, but particularly inshore and near major towns/cities. Greatest threats to water quality, substrate quality, habitat types, structure and function as it includes boat launching, recreational fishing, diving, etc. that has effect from the water surface to the seafloor. Intensity: minor as these activities occur in restricted locations. Consequence: minor as

DIRECT IMPACT OF FISHING	FISHING ACTIVITY	PRESENCE (1) ABSENCE (0)	SPATIAL SCALE OF HAZARD (1-6)	TEMPORAL SCALE OF HAZARD (1-6)	SUB-COMPONENT	UNIT OF ANALYSIS	OPERATIONAL OBJECTIVE (S2.1)	INTENSITY SCORE (1-6)	CONSEQUENCE SCORE (1-6)	CONFIDENCE SCORE (1-2)	RATIONALE
						2: assemblage 6, region 1: assemblage 5, region 1: assemblage 6)					effects on habitat expected to be minimal. Confidence: low as data are unavailable for effects of these activities on habitats.

Level 1 (SICA) Document L1.5 - Community Component.

DIRECT IMPACT OF FISHING	FISHING ACTIVITY	PRESENCE (1) ABSENCE (0)	SPATIAL SCALE OF HAZARD (1-6)	TEMPORAL SCALE OF HAZARD (1-6)	SUB-COMPONENT	UNIT OF ANALYSIS	OPERATIONAL OBJECTIVE (S2.1)	INTENSITY SCORE (1-6)	CONSEQUENCE SCORE (1-6)	CONFIDENCE SCORE (1-2)	RATIONALE
Capture	Bait collection	0									
	Fishing	1	5	3	Species composition	Timor Transition inner shelf: Cape York	1.1	3	2	2	Fishing occurs in 1.6% of the 770,000 km^2 (Pitcher et al. 2016) for about three months annually (~ late March - mid June) - most catch (~60%) concentrated in the Timor Transition inner shelf which lies in the Gulf of Carpentaria (eastern; Cape York). Species composition likely to be affected before major changes in other sub-components. Banana prawns are the primary target and diverse taxonomically, therefore species compositon might be affected overall. Intensity: moderate as fishing shots are short (~ 1 hour), often localized due to suitable habitat and prawn aggregations. Consequence: minor; at current effort level (see scoping section) unable to detect differences in species composition or relative abundances of bycatch species. Localised targetting spatially and temporally, non-targetting of byproduct/bycatch occurs. Confidence: high as data are available, but estimate of sustainable byproduct/bycatch levels are required.
	Incidental behaviour	0									
Direct impact without capture	Bait collection	0									
	Fishing	1	5	3	Species composition	Timor Transition inner shelf: Cape York	1.1	3	2	1	Fishing occurs in 1.6% of the 770,000 km^2 for about three months annually. Species composition likely to be affected before major changes in other sub-components. Intensity: moderate, as this activity occurs over a broader spatial scale. Consequence: minor, since it is likely to have minimal impact on the community structure. Confidence: low as data are unavailable for direct impacts without capture.
	Incidental behaviour	0									

DIRECT IMPACT OF FISHING	FISHING ACTIVITY	PRESENCE (1) ABSENCE (0)	SPATIAL SCALE OF HAZARD (1-6)	TEMPORAL SCALE OF HAZARD (1-6)	SUB-COMPONENT	UNIT OF ANALYSIS	OPERATIONAL OBJECTIVE (S2.1)	INTENSITY SCORE (1-6)	CONSEQUENCE SCORE (1-6)	CONFIDENCE SCORE (1-2)	RATIONALE
	Gear loss	1	1	1	Species composition	Timor Transition inner shelf: Cape York	1.1	2	2	2	Fishing occurs in 1.6% of the 770,000 km^2 for ~three months each year. Gear loss is rare. Species composition likely to be affected before major changes in other sub-components. Benthic species most likely to be affected due to entanglement, smothering or habitat alteration. Intensity: minor, as gear loss is rare (estimated ~less than 5 occurrences per year). Consequence: minor, as impact would affect very small area and any effect on community due to gear loss is immeasurable. Confidence high as it is known that very little gear is lost.
	Anchoring/mooring	1	1	3	Distribution of the community	Timor Transition inner shelf: Cape York	3.1	1	1	2	Anchoring occurs sometime in the banana prawn sub-fishery. Some sedentary fish may be disturbed by presence of vessel in very shallow waters and distributions may be disrupted briefly. Anchoring occurs on reefs, where banana prawns are not abundant. Intensity: negligible, as as the likelihood of detection is negligible. Consequence: negligible. Confidence: high as it's very unlikely for community to be negatively affected by anchoring/mooring.
	Navigation/steaming	1	3	3	Distribution of the community	Timor Transition inner shelf: Cape York	3.1	2	1	2	Navigation/steaming occurs throughout the entire season in the NPF. Most likely to interact with distribution of the Timor transition inner shelf (eastern Gulf-Cape York) community where most fishing effort occurs. Intensity: minor, as this activity occurs over restricted locations where fishing occurs. Consequence: negligible, as impact likely to be undetectable on the distribution of the community. Confidence: high, as it is unlikely for a strong interaction to occur between navigation/steaming and the community.
Addition/ movement of biological material	Translocation of species	1	5	6	Species composition	Timor Transition inner shelf: Cape York, Arafura	1.1	1	2	1	Translocation of species may occur throughout the NPF, as larvae through ballast water or as adults via hull fouling, gear or anchor entanglement, and has the potential to establish as the majority of fishing areas and ports used are of similar depths. Three species of introduced marine organisms have the potential to in the NPF - *Perna viridis* (mussel), *Crepidula fornicata*

DIRECT IMPACT OF FISHING	FISHING ACTIVITY	PRESENCE (1) ABSENCE (0)	SPATIAL SCALE OF HAZARD (1-6)	TEMPORAL SCALE OF HAZARD (1-6)	SUB-COMPONENT	UNIT OF ANALYSIS	OPERATIONAL OBJECTIVE (S2.1)	INTENSITY SCORE (1-6)	CONSEQUENCE SCORE (1-6)	CONFIDENCE SCORE (1-2)	RATIONALE
											(limpet) and *Mytilopsis sallei* (black-striped mussel) and establish precedence for translocation to occur in the NPF area. A massive infestation of the latter species, black-striped mussel was discovered in Cullen Bay Marina (Darwin) in March 1999 and rapidly eradicated (Summerson et al. 2013). Translocation most likely to change the species composition and trophic structure of the community, possibly by introducing a foreign competitor or through transmission of disease, but also directly or indirectly through changing trophic linkages. No mitigating measures are currently in place. Intensity: negligible at present. Consequence: minor as while there is the potential to alter the species composition and potentially trophic structure of the community (based on its incursion in 1999 of black-striped mussel), it was quickly eradicated. Confidence: low as there are no data to show the spread of the species and the likely impact on species composition of this community. Also, there is no data exists to refute the NPF risk.
	On board processing	0									
	Discarding catch	1	5	3	Distribution of the community	Timor Transition inner shelf: Groote	3.1	3	2	2	Discarding is common after each shot throughout the NPF fishery. Most likely to affect distribution of community if scavengers and predators (e.g. sharks and trevally) are attracted to discard site. Intensity: moderate, as discarding occurs. Consequence: minor as the fishery discards diverse bycatch but it is localised and discarded proportion is lower relative to targeted prawn aggregations. Discarding may cause more permanent changes in population size of scavenger species. Confidence: high as available discard estimates (AFMA data).
	Stock enhancement	0									
	Provisioning	0									

DIRECT IMPACT OF FISHING	FISHING ACTIVITY	PRESENCE (1) ABSENCE (0)	SPATIAL SCALE OF HAZARD (1-6)	TEMPORAL SCALE OF HAZARD (1-6)	SUB-COMPONENT	UNIT OF ANALYSIS	OPERATIONAL OBJECTIVE (S2.1)	INTENSITY SCORE (1-6)	CONSEQUENCE SCORE (1-6)	CONFIDENCE SCORE (1-2)	RATIONALE
	Organic waste disposal	1	5	3	Distribution of the community	Northern Coastal Gulf (pelagic)	3.1	1	1	2	Fishing occurs in 1.6% of the 770,000 km^2 for ~three months annually, so organic waste disposal is possible over this scale. Disposal of organic waste poses greatest potential risk for distribution of Northern Coastal Arafura pelagic community resulting in either attraction (e.g. food scraps) or repulsion (e.g. raw sewage). Intensity: negligible each disposal event probably only affects a small (< 1 nm) area. Consequence: negligible as it's unlikely to be detectable nor persistent. Confidence: high because consensus among experts is that general fishing waste disposal was unlikely to impact the distrubtion of the community.
Addition of non-biological material	Debris	0									
	Chemical pollution	0									
	Exhaust	1	5	3	Distribution of the community	Northern Coastal Gulf (pelagic)	3.1	1	1	2	Fishing occurs in 1.6% of the 770,000 km^2 for ~ three months annually, so exhaust emissions possible over this scale. Exhaust emissions poses greatest potential risk for the distribution of this community by affecting the distribution of birds in the vicinity of vessels. Intensity: negligible because although the hazard could occur over a large range/scale, exhaust considered to only impact a small area. Consequence: negligible as the effects of exhaust emissions is unlikely to be detectable. Confidence: high because consensus among experts is that exhaust was considered unlikely to impact the distribution of community.
	Gear loss	1	1	1	Distribution of the community	Timor Transition inner shelf: Cape York	3.1	2	1	2	Fishing occurs in 1.6% of the 770,000 km^2 for ~ three months annually. Gear loss is rare (approximately less than five occurrences per year). Lost gear most likely to affect distribution of community by altering habitat and dependent species. Intensity: minor because lost gear is rare. Consequence: negligible as the impact is unlikely to be detectable. Confidence: high because it is known that very little gear is lost.

DIRECT IMPACT OF FISHING	FISHING ACTIVITY	PRESENCE (1) ABSENCE (0)	SPATIAL SCALE OF HAZARD (1-6)	TEMPORAL SCALE OF HAZARD (1-6)	SUB-COMPONENT	UNIT OF ANALYSIS	OPERATIONAL OBJECTIVE (S2.1)	INTENSITY SCORE (1-6)	CONSEQUENCE SCORE (1-6)	CONFIDENCE SCORE (1-2)	RATIONALE
	Navigation/steaming	1	5	3	Distribution of the community	Timor Transition inner shelf: Cape York	3.1	2	1	2	Navigation/steaming occurs throughout the NPF for ~ three months annually and introduces noise from vessel engine and echo sounding during fish finding/trawling. Navigation/steaming expected to pose greatest potential risk for the distribution of community which may alter distribution of community members which are most likely impacted. Intensity: minor, as this activity occurs over restricted locations where fishing occurs. Consequence: negligible since impacts unlikely to be measurable. Confidence: high because consensus among experts is that the addition of non-biological material due to navigation/steaming is unlikely to impact upon the behaviour/movement of demersal prawns and thus distribution of community.
	Activity/presence on water	1	5	3	Distribution of the community	Timor Transition inner shelf: Cape York	3.1	1	1	1	Activity/presence on water occurs throughout the NPF for ~ three months annually. Activity/presence considered most likely to affect function group composition by changing the behaviour and distribution of marine repiles (e.g., turtles), teleosts (e.g., sea snakes) due to avoidance reaction. Intensity: negligible; impact unlikely to be detectable. Consequence: negligible, since any change the community distribution would be undetectable against background variation except during fishing operations. Confidence: low because the effects of activity/presence on water is unknown.
Disturb physical processes	Bait collection	0									
	Fishing	1	5	3	Distribution of the community	Timor Transition inner shelf: Cape York	3.1	3	2	1	Disturbance of physical processes may occur throughout the NPF for ~ three months annually, which is most likely to affect distribution of community. Benthic species most likely to be affected since trawling may disturb sediments. Intensity: moderate as sediment disturbance may occur regularly. Consequence: minor as disturbance of sediment not likely to affect distribution. Confidence: low as no data are available.
	Boat launching	0									

DIRECT IMPACT OF FISHING	FISHING ACTIVITY	PRESENCE (1) ABSENCE (0)	SPATIAL SCALE OF HAZARD (1-6)	TEMPORAL SCALE OF HAZARD (1-6)	SUB-COMPONENT	UNIT OF ANALYSIS	OPERATIONAL OBJECTIVE (S2.1)	INTENSITY SCORE (1-6)	CONSEQUENCE SCORE (1-6)	CONFIDENCE SCORE (1-2)	RATIONALE
	Anchoring/ mooring	1	2	3	Distribution of community	Timor Transition inner shelf: Cape York	3.1	1	2	1	Fishing occurs for about three months annually. Anchoring occurs sometimes in this sub-fisahery. Distribution of community most likely to be affected as anchoring occurs on reefs where damage to habitat may result in alteration of species distributions. Also, some sedentary fish may be disturbed by anchor disturbance of sediments smothering some community components. Intensity: negligible, occurs in a few restricted locations and vessels only anchor during the day or night when they are not fishing and anchoring has a very small footprint. Consequence: minor, as minimal impact on distribution of community. Confidence low, as data deficient.
	Navigation/steaming	1	5	3	Bio- and geo-chemical cycles	Timor Transition inner shelf: Cape York	5.1	2	1	1	Navigation/steaming occurs throughout the NPF for about three months annually. Possible impact on bio- and geo-chemical cycles of pelagic waters by disturbing mixed layer via surface turbulence. Pelagic species most likely to be affected. Intensity: negligible as unlikely to be detectable. Consequence: negligible as impact unlikely to be detectable. Confidence: low, as effects unknown.
External Impacts	Other fisheries: crab fishery, spanner crab fishery, line fishery, net fisheries	1	6	6	Species composition	Timor Transition inner shelf: Cape York	1.1	2	2	2	Fishing occurs throughout the year by other fisheries in the NPF managed region. Other fisheries which catch a diverse range of species most likely to affect species composition of different communities. Intensity: minor, as other trawl and non-trawl fisheries target other species in other habitats e.g. fish trawling over reefs or catch prawns in low numbers (e.g. recreational fisheries). Consequence: minor, as diverse range of species captured. Confidence: high, catch data from other fisheries are recorded.
	Aquaculture	1	3	3	Trophic/size structure	Timor inner shelf	4.1	3	3	1	Three boat licenses exist for capturing *P. monodon* broodstock for aquaculture. Broodstock are currently captured around Tiwi Islands, Darwin and in the JBG. Removal of spawners could affect the size structure of this community as large spawners are removed from these locations. Intensity: moderate, as perceived to be localized but severe. Consequence: moderate,

DIRECT IMPACT OF FISHING	FISHING ACTIVITY	PRESENCE (1) ABSENCE (0)	SPATIAL SCALE OF HAZARD (1-6)	TEMPORAL SCALE OF HAZARD (1-6)	SUB-COMPONENT	UNIT OF ANALYSIS	OPERATIONAL OBJECTIVE (S2.1)	INTENSITY SCORE (1-6)	CONSEQUENCE SCORE (1-6)	CONFIDENCE SCORE (1-2)	RATIONALE
											as currently impact on the size structure of this community is possible. Confidence: low, as no data available on the removal of large spawners of this species on the size structure of this community.
	Coastal development	1	3	6	Species composition	Northern Coastal Gulf (pelagic)	1.1	3	3	1	Coastal development occurs in small pockets surrounding the NPF, in the vicinity of large waterways (Darwin, Weipa, Karumba, McArthur River). Intensity: moderate at both broader coastal development and localized centres. Coastal development occurs in the vicinity of these large waterways most likely to affect bio/geochemical cycles from sewage outfalls or other run-off (from agricultural development and extraction of water for irrigation may which may alter water flows) affecting water/habitat quality. An increasing effect of port development for mineral shipment affecting coastal nursery habitats of target and byproduct species, as well as the offshore demersal and pelagic community. Consequence: moderate - moderate impact on species composition of community. Confidence: low as there are little data available to demonstrate the effects of coastal development.
	Other extractive activities	1	4	6	Distribution of the community	Timor Transition inner shelf: Cape York; Northern Coastal Gulf (pelagic)	3.1	3	2	1	Exploration for oil, gas, diamonds and gold is underway or proposed throughout NPF, particularly in the Arafura Sea. Also, manganese strip mining occurs in Groote Eylandt. Most likely to affect distribution of community by exploratory activity e.g. drilling; port development for mineral shipment affecting coastal nursery habitats of target and byproduct species, as well as the offshore demersal and pelagic community. Intensity: moderate as exploration activity probably occurs at a broad spatial scale. Consequence: minor as effect localised and changes to the distribution of the communities likely to be undetectable. Confidence: low, as effects are unknown.
	Other non-extractive activities	1	6	6	Distribution of the community	Northern Coastal Gulf (pelagic)	3.1	3	2	1	Commercial shipping occurs throughout the year throughout the NPF. Greatest potential risk for the distribution of community as a result of avoidance reaction. Intensity: moderate as shipping occurs throughout the NPF and is concentrated in a number of ports e.g. Darwin, Groote, Weipa,

DIRECT IMPACT OF FISHING	FISHING ACTIVITY	PRESENCE (1) ABSENCE (0)	SPATIAL SCALE OF HAZARD (1-6)	TEMPORAL SCALE OF HAZARD (1-6)	SUB-COMPONENT	UNIT OF ANALYSIS	OPERATIONAL OBJECTIVE (S2.1)	INTENSITY SCORE (1-6)	CONSEQUENCE SCORE (1-6)	CONFIDENCE SCORE (1-2)	RATIONALE
											Karumba, McArthur River. Consequence: minor as impact of shipping probably minimal on distribution of the community, but there is the possibility that pelagic aggregations of banana prawns may be affected. Confidence: low since the impact of shipping on distribution is unknown.
	Other anthropogenic activities	1	6	6	Distribution of the community	Northern Coastal Gulf (pelagic)	3.1	2	2	1	Communities may be disturbed by recreational boating/fishing and tourism (e.g. diving) throughout the year throughout the NPF along major towns and cities. Greatest potential risk for the distribution of community resulting from avoidance reaction. Intensity: minor, unlikely to detect direct and indirect impacts on pelagic or demersal communities at the scale of the activities, concentrated along a number of ports e.g. Darwin, Groote, Weipa, Karumba. Consequence: minor as long-term effects on distribution of communty is minimal, but there is the possibility that pelagic aggregations of banana prawns may be affected. Confidence: low, since the effects of these activities on distribution of species is unknown.

2.3.11 Summary of SICA results

Table 2.21. Level 1 (SICA) Document L1.6. Summary table of consequence scores for all activity/component combinations. Those that scored ≥3 are highlighted blue and bolded if high confidence. * existing stock assessment –assessment not required. Note: external hazards are not considered at Level 2.

DIRECT IMPACT	ACTIVITY	KEY/SECONDARY COMMERCIAL SPECIES	BYPRODUCT AND BYCATCH SPECIES	PROTECTED SPECIES	HABITATS	COMMUNITIES
Capture	Bait collection	0	0	0	0	0
	Fishing	**2**	**3**	3	3	2
	Incidental behaviour	0	0	0	0	0
Direct impact without capture	Bait collection	0	0	0	0	0
	Fishing	1	2	3	3	2
	Incidental behaviour	0	0	0	0	0
	Gear loss	**1**	**1**	**1**	1	2
	Anchoring/mooring	**1**	2	**2**	2	1
	Navigation/steaming	**1**	**1**	**2**	1	1
Addition/ movement of biological material	Translocation of species	2	2	2	2	2
	On board processing	0	0	0	0	0
	Discarding catch	**1**	**2**	**2**	2	2
	Stock enhancement	0	0	0	0	0
	Provisioning	0	0	0	0	0
	Organic waste disposal	**1**	**1**	**1**	1	1
Addition of non-biological material	Debris	0	0	0	0	0
	Chemical pollution	0	0	0	0	0
	Exhaust	**1**	**1**	1	1	1
	Gear loss	**1**	**1**	**2**	1	1
	Navigation/steaming	**1**	1	**1**	1	1
	Activity/presence on water	**1**	1	**1**	1	1
Disturb physical processes	Bait collection	0	0	0	0	0
	Fishing	2	2	2	2	2
	Boat launching	0	0	0	0	0
	Anchoring/mooring	**1**	**1**	1	1	2
	Navigation/steaming	**1**	1	1	1	1
External impacts	Other fisheries	**2**	**3**	**4**	3	2
	Aquaculture	**2**	**2**	**4**	2	3
	Coastal development	3	3	3	3	3
	Other extractive activities	2	2	1	2	2
	Other non-extractive activities	**1**	1	**3**	2	2
	Other anthropogenic activities	2	2	**3**	2	2

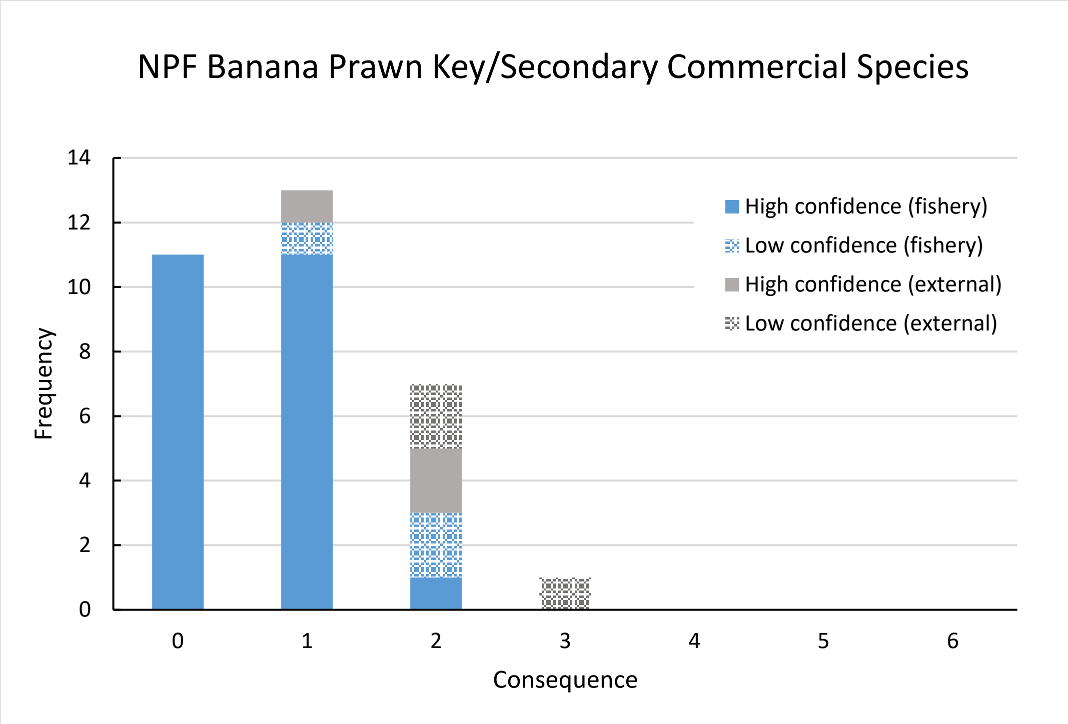

Figure 2.5. Key/secondary commercial species: Frequency of consequence score by high and low confidence.

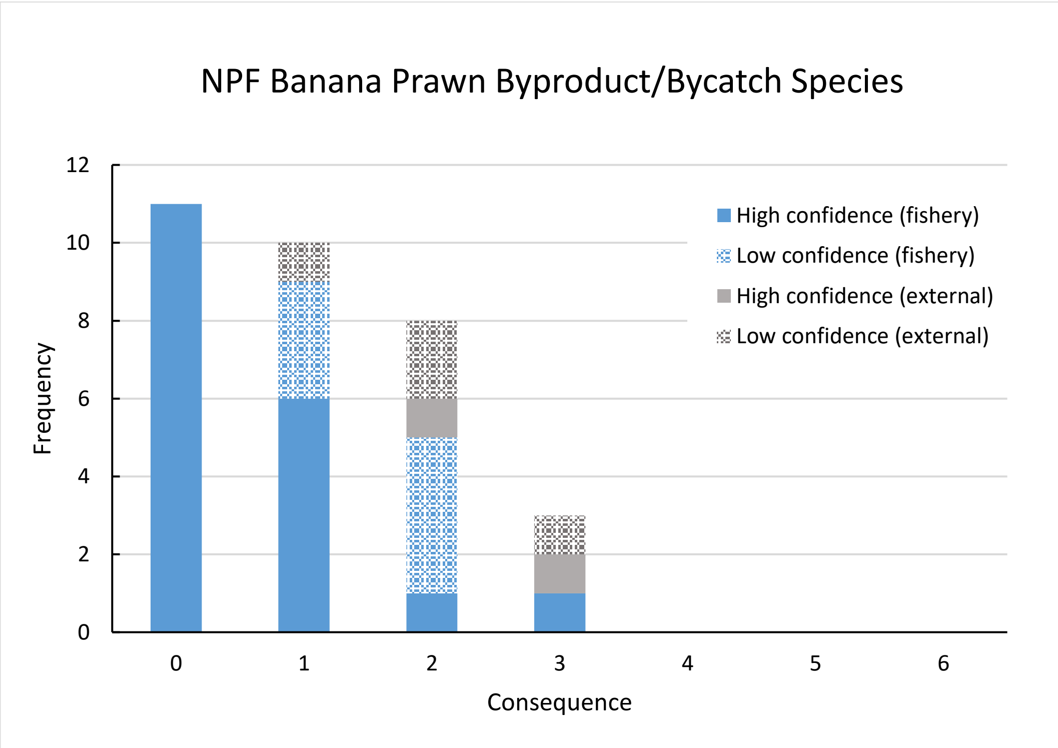

Figure 2.6. Byproduct and bycatch species: Frequency of consequence score by high and low confidence.

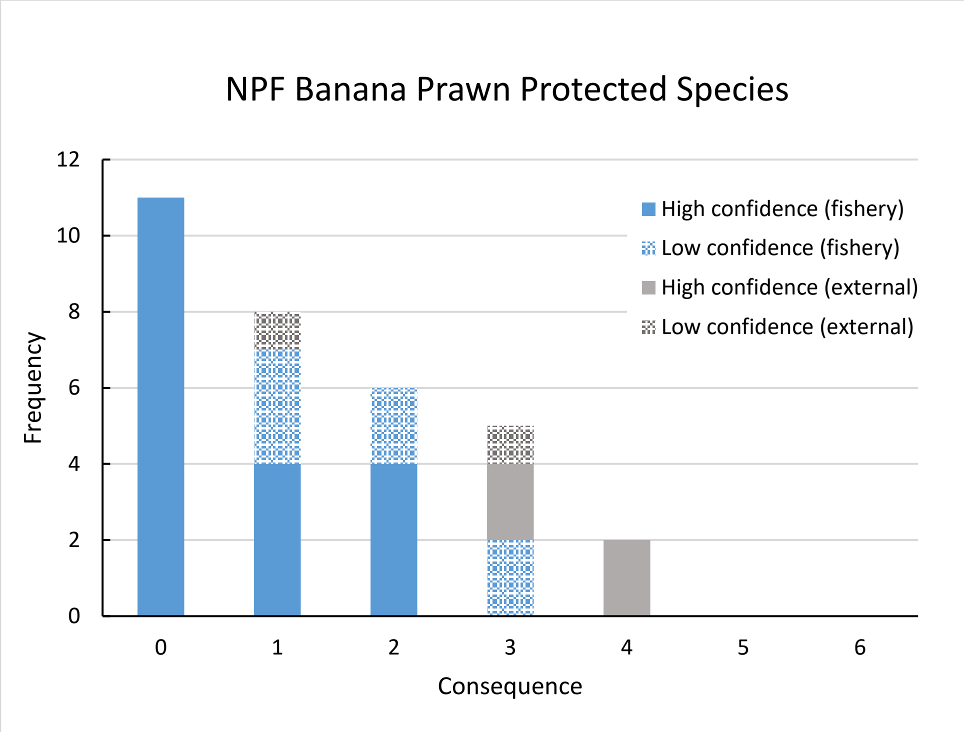

Figure 2.7. Protected species: Frequency of consequence score by high and low confidence.

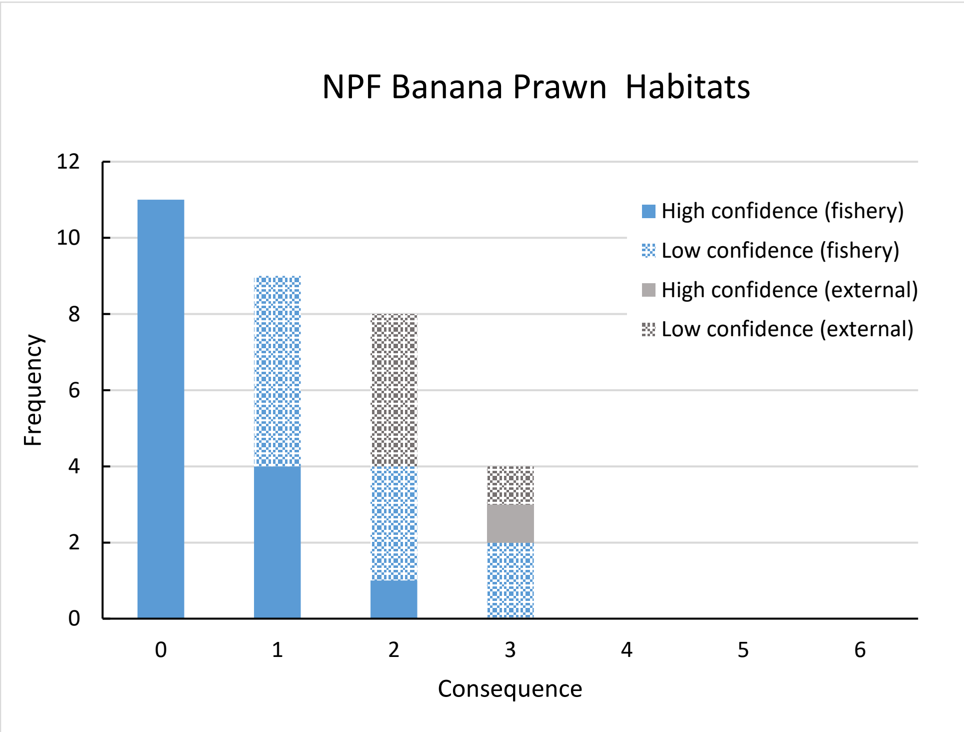

Figure 2.8. Habitat: Frequency of consequence score by high and low confidence.

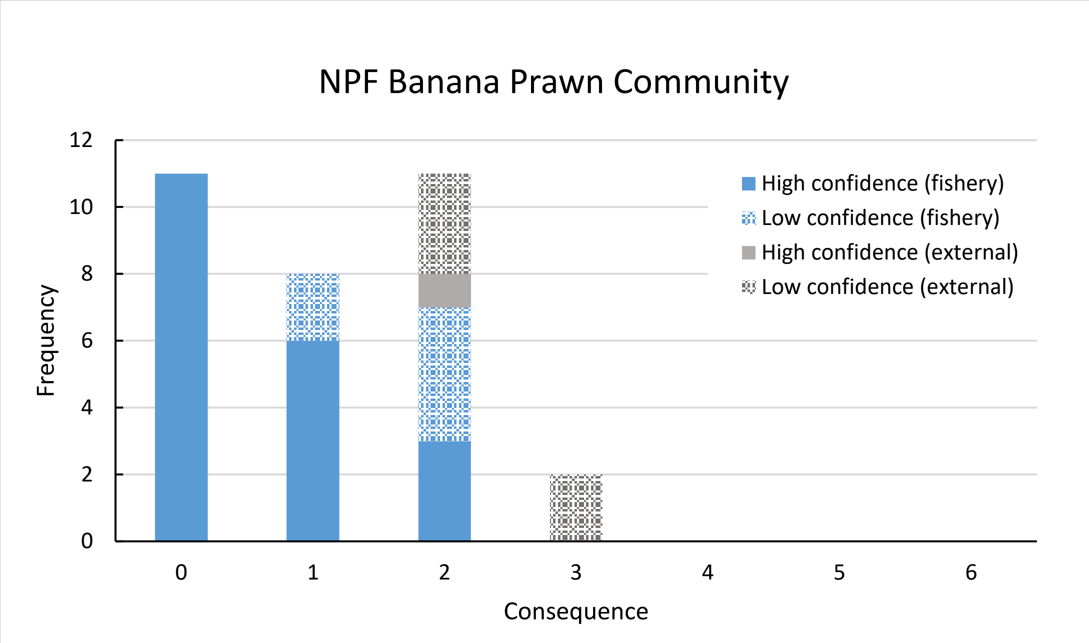

Figure 2.9. Communities: Frequency of consequence score by high and low confidence.

2.3.12 Evaluation/discussion of Level 1

Two ecological components were eliminated at Level 1 (i.e. no components with risk scores of 3 – moderate – or above).

Most hazards (fishing activities) were eliminated at Level 1 (i.e. no components with risk scores of 3 – moderate – or above). Those that remained were:

- Fishing (capture impacts on three ecological components)
- Fishing (non-capture impacts on two ecological components)
- External hazards from other fisheries (on three components)

As a result of direct capture by fishing, the most vulnerable bycatch species Australian blacktip shark (*Carcharhinus tilstoni*) was assessed at moderate risk largely due to the fact that they make up most of shark species caught in the NPF and sharks typically have low fecundity, slow growth rate and low trawl survivability.

As a result of direct capture by fishing, the most vulnerable protected species, the green and freshwater sawfish (*Pristis zijsron* and *Pristis pristis*) as they appear to have a high entanglement rate in trawl nets and escapement rates of sawfish from trawl nets through TED openings are currently unknown.

As a result of direct impact of non-capture by fishing, the most vulnerable protected species, the Olive Ridley turtle (*Lepidochelys olivacea*) as they have the greatest risk of extinction for marine turtle stocks in the Gulf of Carpentaria region (C. Limpus pers. comm.).

The impact of fishing represented a major risk to habitats (region 2: assemblage 5) largely due to the concentration of effort at depths where highly vulnerable fauna occur i.e., encounter with heavier demersal trawl gears will result in removal and damage of erect, rugose and inflexible octocorals associated with soft, muddy substrata.

Significant external hazards included other fisheries in the region on three components (byproduct/bycatch; protected; habitats). External fisheries and aquaculture were rated at major risk (score 4) on protected species.

2.3.13 Components to be examined at Level 2

As a result of the preliminary SICA analysis, the species components that are to be examined at Level 2 are those with any consequence scores of 3 or above. These components are:

- Byproduct/bycatch
- Protected species

A Level 2 analysis for Habitats was not conducted in this report, as it was outside the project scope.

2.4 Level 2 Productivity and Susceptibility Analysis (PSA)

When the risk of an activity at Level 1 (SICA) on a component is moderate or higher and no planned management interventions that would remove this risk are identified, an assessment is required at Level 2. The PSA approach is a method of assessment which allows all units within any of the ecological components to be effectively and comprehensively screened for risk. The units of analysis are the complete set of species habitats or communities identified at the scoping stage. The PSA results in sections 2.4.2 and 2.4.3 of this report measure risk of direct impacts of fishing only. Future iterations of the methodology will include PSAs modified to measure the risk due to other activities, such as gear loss.

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. It is important to note that the PSA analysis essentially measures potential for risk, hereafter denoted as "risk". A measure of absolute risk requires some direct measure of abundance or mortality rate for the unit in question, and this information is generally lacking at Level 2.

The PSA approach examines attributes of each unit that contribute to or reflect its productivity or susceptibility to provide a relative measure of risk to the unit. The following section describes how this approach is applied to the different components in the analysis. Full details of the methods are described in Hobday et al. (2007).

Species

The following Table outlines the seven attributes that are averaged to measure productivity, and the four aspects that are multiplied to measure susceptibility for all the species components.

Table 2.22. Attributes that measure productivity and suscepability.

	ATTRIBUTE
Productivity	Average age at maturity
	Average size at maturity
	Average maximum age
	Average maximum size
	Fecundity
	Reproductive strategy
	Trophic level
Susceptibility	Availability considers overlap of fishing effort with a species distribution
	Encounterability considers the likelihood that a species will encounter fishing gear that is deployed within the geographic range of that species (based on two attributes: adult habitat and bathymetry)

	ATTRIBUTE
	Selectivity considers the potential of the gear to capture or retain species
	Post capture mortality considers the condition and subsequent survival of a species that is captured and released (or discarded)

The productivity attributes for each species are based on data from the literature or from data sources such as FishBase. The four aspects of susceptibility are calculated in the following way:

Availability considers overlap of effort with species distribution. For species without distribution maps, availability is scored based on broad geographic distribution (global, southern hemisphere, Australian endemic). Where more detailed distribution maps are available (e.g. from BIOREG data or DEH protected species maps), availability is scored as the overlap between fishing effort and the portion of the species range that lies within the broader geographical spread of the fishery. Overrides can occur where direct data from independent observer programs are available.

Encounterability is the likelihood that a species will encounter fishing gear deployed within its range. Encounterability is scored using habitat information from FishBase, modified by bathymetric information. Higher risk corresponds to the gear being deployed at the core depth range of the species. Overrides are based on mitigation measures and fishery independent observer data.

For species that do encounter gear, **selectivity** is a measure of the likelihood that the species will be caught by the gear. Factors affecting selectivity will be gear and species dependent, but body size in relation to gear size is an important attribute for this aspect. Overrides can be based on body shape, swimming speed and independent observer data.

For species that are caught by the gear, **post capture mortality** measures the survival probability of the species. Obviously, for species that are retained, survival will be zero. Species that are discarded may or may not survive. This aspect is mainly scored using independent filed observations or expert knowledge.

Overall susceptibility scores for species are a product of the four aspects outlined above. This means that susceptibility scores will be substantially reduced if any one of the four aspects is considered to be low risk. However, the default assumption in the absence of verifiable supporting data is that all aspects are high risk.

Habitats

As with species, PSA methods for habitats are based around a set of attributes that measure productivity and susceptibility. Productivity attributes include speed of regeneration of fauna, and likelihood of natural disturbance. The susceptibility attributes for habitats are described in the following Table.

Table 2.23. Description of susceptibility attributes for habitats.

ASPECT	ATTRIBUTE	CONCEPT	RATIONALE
Susceptability			
Availability	General depth range (Biome)	Spatial overlap of subfishery with habitat defined at biomic scale	Habitat occurs within the management area
Encounterability	Depth zone and feature type	Habitat encountered at the depth and location at which fishing activity occurs	Fishing takes place where habitat occurs
	Ruggedness (fractal dimension of substratum and seabed slope)	Relief, rugosity, hardness and seabed slope influence accessibility to different sub-fisheries	Rugged substratum is less accessible to mobile gears. Steeply sloping seabed is less accessible to mobile gears
	Level of disturbance	Gear footprint and intensity of encounters	Degree of impact is determined by the frequency and intensity of encounters (includes size, weight, and mobility of individual gears)
Selectivity	Removability/ mortality of fauna/ flora	Removal/mortality of structure forming epifauna/ flora (inc. bioturbating infauna)	Erect, large, rugose, inflexible, delicate epifauna and flora, and large or delicate and shallow burrowing infauna (at depths impacted by mobile gears) are preferentially removed or damaged.
	Areal extent	How much of each habitat is present	Effective degree of impact greater in rarer habitats: rarer habitats may maintain rarer species.
	Removability of substratum	Certain size classes can be removed	Intermediate sized clasts (~6 cm to 3 m) that form attachment sites for sessile fauna can be permanently removed
	Substratum hardness	Composition of substrata	Harder substratum is intrinsically more resistant
	Seabed slope	Mobility of substrata once dislodged; generally higher levels of structural fauna	Gravity or latent energy transfer assists movement of habitat structures, eg turbidity flows, larger clasts. Greater density of filter feeding animals found where currents move up and down slopes.
Productivity			
	Regeneration of fauna	Accumulation/recovery of fauna	Fauna have different intrinsic growth and reproductive rates which are also variable in different conditions of temperature, nutrients, productivity.
	Natural disturbance	Level of natural disturbance affects intrinsic ability to recover	Frequently disturbed communities adapted to recover from disturbance

Communities

There are seven steps for the PSA undertaken for each component brought forward from Level 1 analysis (see Hobday et al. 2006 for full details).

- Step 1. Identify the units excluded from analysis and document the reason for exclusion
- Step 2. Score units for productivity
- Step 3. Score units for susceptibility
- Step 4. Plot individual units of analysis onto a PSA Plot
- Step 5. Ranking of overall risk of each unit
- Step 6. Evaluation of the PSA analysis
- Step 7. Decision rules to move from Level 2 to Level 3

2.4.1 Units excluded from analysis (Step 1)

Table 2.24. Species/species groups/taxa excluded from the PSA and SAFE because they were either not identified at the species level, not interacted in the fishery or outside the fishery's jurisdictional boundary. No obs/ints: No observations or interactions. These entries have been excluded from the protected species list since the last ERA assessment because they have not been observed within the fishery and/or occur outside the depth range of the fishery. AFMA Log: AFMA Logbook data; AFMA Obs: AFMA Observer data

ROLE IN FISHERY	TAXA	FAMILY NAME	SCIENTIFIC NAME	COMMON NAME	CAAB CODE	RATIONALE
BC	Teleost		Teleosts - undifferentiated	Finfish	37999998	AFMA Obs. Insufficient taxonomic resolution
BC	Miscellaneous		Large Benthic Items	Benthos	99000001	AFMA Obs. Insufficient taxonomic resolution
BC	Miscellaneous		Rubble and Rocks	Substrate or rocks	99000002	AFMA Obs. Insufficient taxonomic resolution
BC	Miscellaneous		Shells	Shells	23999999	AFMA Obs. Insufficient taxonomic resolution
BC	Miscellaneous		Unknown - other	Unknown or other	99999999	AFMA Obs. Insufficient taxonomic resolution
BC	Benthos	Spongiidae	Spongiidae - undifferentiated	Spongiid sponges	10114000	AFMA Obs. Insufficient taxonomic resolution
BC	Benthos		Subclass Octocorallia - undifferentiated	Octocorals - soft corals	11169000	AFMA Obs. Insufficient taxonomic resolution
BC	Benthos		Order Alcyonacea - undifferentiated	Octocorals and gorgonians	11173000	AFMA Obs. Insufficient taxonomic resolution
BC	Benthos		Coralliidae - undifferentiated	Precious corals	11183000	AFMA Obs. Insufficient taxonomic resolution
BC	Benthos		Order Scleractinia - undifferentiated	Stony corals	11290000	AFMA Obs. Insufficient taxonomic resolution
BC	Invertebrate		Phylum Mollusca - undifferentiated	Molluscs	23000000	AFMA Obs. Insufficient taxonomic resolution
BC	Invertebrate		Class Scyphozoa - undifferentiated	Jellyfishes	11120000	AFMA Obs. Insufficient taxonomic resolution
BC	Invertebrate	Pectinidae	Pectinidae - undifferentiated	Scallops	23270000	AFMA Log, Obs. Apportioned to existing scallops in list

ROLE IN FISHERY	TAXA	FAMILY NAME	SCIENTIFIC NAME	COMMON NAME	CAAB CODE	RATIONALE
BC	Invertebrate	*Pectinidae*	*Pecten fumatus*	Commercial Scallop	23270007	AFMA Log, misidentification: outside fishery area. This species is commonly found oustide this fishery range.
BC	Invertebrate		*Sepia* spp.	Cuttlefish (mixed)	23607901	AFMA log, Obs. Added 8 *Sepia* spp to list
BC	Invertebrate		*Nototodarus gouldi*	Gould's squid	23636004	AFMA Log, misidentification: outside fishery area.
BP	Invertebrate		Order Teuthoidea - undifferentiated	Squids	23615000	AFMA Log. Apportioned squid species to list (*U. chinensis*, *U. edulis* and *S. lessoniana*)
BP	Invertebrate	Loliginidae	*Uroteuthis chinensis*	A squid	23617901	AFMA Obs. Split into two species. Now considered to be *Uroteuthis* sp 4. Of Yeatman 1993. M. Dunning (Queensland Museum).
BP	Invertebrate	Loliginidae	*Uroteuthis edulis*	A squid	23617009	Not in fishery based on recent genetic studies (M. Dunning, Queensland Musuem).
BC	Invertebrate	Sepiidae	*Sepia latimanus*	Broadclub cuttlefish	23607004	AFMA. Outside fishery, M. Dunning (Queensland Museum).
BC	Invertebrate	Sepiidae	*Metasepia pfefferi*	Flamboyant cuttlefish	23607015	AFMA. Outside fishery, M. Dunning (Queensland Museum).
BC	Invertebrate	Sepiidae	*Sepiella weberi*	A cuttlefish	23607035	AFMA. Outside fishery, M. Dunning (Queensland Museum).
BC	Invertebrate	Loliginidae	*Loligo opalescens*	Opalescent inshore squid	23617011	AFMA – misidentification.
BC	Invertebrate	Ommastrephidae	*Todaropsis eblanae*	Lesser flying squid	23636013	AFMA. Outside fishery, M. Dunning (Queensland Museum).
BC	Invertebrate	Ommastrephidae	*Todarodes pusillus*	A squid	23636014	AFMA. Outside fishery, M. Dunning (Queensland Museum).
BC	Invertebrate		Order Octopoda - undifferentiated	Octopoda	23650000	AFMA Obs. Added 2 octopus species to this list
BC	Invertebrate		Octopodidae - undifferentiated	Octopuses	23659000	AFMA Obs. Added 2 octopus species to this list
BC	Invertebrate		Class Crinoidea - undifferentiated	Crinoids	25001000	AFMA Obs. Added 7 species to list
BC	Invertebrate		Class Asteroidea - undifferentiated	Starfish	25102000	AFMA Obs. Added 8 species to list

ROLE IN FISHERY	TAXA	FAMILY NAME	SCIENTIFIC NAME	COMMON NAME	CAAB CODE	RATIONALE
BC	Invertebrate		Class Echinoidea - undifferentiated	Sea urchins	25200000	AFMA Obs. Added 2 species to list
BC	Invertebrate		Class Holothuroidea - undifferentiated	Holothurians	25400000	AFMA Obs. Apportioned holothurian species to this list
BC	Invertebrate		Order Stomatopoda - undifferentiated	Mantis shrimps	28030000	AFMA Obs. Apportioned to 2805031 (AFMA Obs) and 28005039 (AFMA Obs)
BC	Invertebrate	Squillidae	Squillidae - undifferentiated	Squilla mantis shrimps	28051000	AFMA Obs. Apportioned to 2805031 (AFMA Obs) and 28005039 (AFMA Obs)
BP	Invertebrate	Penaeidae	*Metapenaeus endeavouri* and *Metapenaeus ensis*	Endeavour prawns	28711902	AFMA Log. Apportioned to 2 species (*M. endeavouri* and *M. ensis*)
BC	Invertebrate	Penaeidae	*Metapenaeus* spp.	School Prawns (mixed)	28711904	AFMA Obs. Both *M. endeavouri* and *M. ensis* already exist in species list
BP	Invertebrate	Penaeidae	*Marsupenaeus japonicus*, *Penaeus esculentus* and *P. semisulcatus*	Tiger prawns (kuruma grooved brown)	28711905	AFMA Log. Apportioned to existing species in list (28711053 and 28711044)
BP	Invertebrate	Penaeidae	*Penaeus esculentus*, *Penaeus semisulcatus* and *Penaeus monodon*	Tiger prawns (mixed)	28711906	AFMA Log. Apportioned to *P esculentus* (28711044) and P. semisulatus (28711053).
C1	Invertebrate	Penaeidae	*Fenneropenaeus indicus* and *Fenneropenaeus merguiensis*	Banana prawns (mixed)	28711907	AFMA Log
BP	Invertebrate	Penaeidae	*Melicertus latisulcatus* and *Melicertus plebejus*	King prawns (eastern and western)	28711908	AFMA Log. Apportioned to 28711047 (*M. latisulcatus*- Western King Prawn)
BP	Invertebrate	Penaeidae	King prawns - *Melicertus latisulcatus*, *Melicertus plebejus* and *Melicertus longistylus*	King prawns (mixed)	28711910	AFMA Log. Apportioned to existing species in list (28711047 and 28711048)
BC	Invertebrate	Penaeidae	*Parapenaeopsis* spp. sensu lato	Coral prawns (mixed)	28711914	AFMA Obs. Insufficent taxonomic resolution. There are no *Parapenaeopsis* spp. sensu lato in Australian waters
BP	Invertebrate	Penaeidae	Commercial Prawns	Commercial prawns	28711999	AFMA Log
BC	Invertebrate		Penaeoidea - undifferentiated	Prawns (mixed)	28710000	AFMA Log, AFMA Obs. Apportioned to existing species in list. No change to role in fishery

ROLE IN FISHERY	TAXA	FAMILY NAME	SCIENTIFIC NAME	COMMON NAME	CAAB CODE	RATIONALE
BC	Invertebrate	Penaeidae	Penaeidae - undifferentiated	Penaeid prawns	28711000	AFMA Obs. Apportioned to existing species in list. No change to role in fishery
BP	Invertebrate	Nephropidae	*Metanephrops* and *Nephropsis* spp.	Scampi (mixed)	28786902	AFMA Log. Apportioned to 2 existing spec ies in list: 28786001 and 28786004
BP	Invertebrate	Palinuridae	*Linuparus trigonus*	Red champagne lobster	28820004	AFMA. This species has been split into two species *L. meridionalis* and *L. sordidus.* Peter Davie (Queensland Museum).
BP	Invertebrate	Palinuridae	*Linuparus* spp.	Champagne lobster - spear lobster	28820902	AFMA Log. *L. meridionalis* and *L. sordidus* have been added (Peter Davie, Queensland Museum)
BP	Invertebrate	Scyllaridae	*Thenus* spp.	Moreton bay bugs	28821903	AFMA Log. Added to existing 1 species in list and added another species
BP	Invertebrate	Scyllaridae	Scyllaridae - undifferentiated	Bugs - shovel nosed and slipper lobsters	28821000	AFMA Log, Obs. Apportioned to and added Scyllaridae species to list
BC	Invertebrate	Diogenidae	Diogenidae - undifferentiated	Hermit crabs	28827000	AFMA Obs. Insufficient taxonomic resolution. Did not apportion <1 kg - CSIRO data
BC	Invertebrate	Portunidae	*Portunus* spp	Swimmer crabs (mixed)	28911922	AFMA Obs. Apportioned to existing species: 28911005 and 28911006
BC	Invertebrate	Portunidae, Polybiidae	Portunidae, Polybiidae - undifferentiated	Swimming crabs	28911000	AFMA Obs. Apportioned to 4 existing species in list
BC	Invertebrate		Infraorder Brachyura - undifferentiated	Crabs	28850000	AFMA Obs. Apportioned to 4 existing species in list
BC	Invertebrate	Majidae	Majidae and related families - undifferentiated	Spider crabs (all families)	28880000	AFMA Obs. Insufficient taxonomic resolution. Did not apportion <1 kg
BC	Invertebrate	Portunidae	*Scylla* spp.	Mud Crabs	28911902	AFMA Obs. Insufficient taxonomic resolution. Did not apportion <1 kg
BC	Invertebrate		Class Ascidiacea - undifferentiated	Ascidians	35000000	AFMA Obs. Insufficient taxonomic resolution. Part of benthos
BC	Chondrichthyan	Alopiidae	Alopiidae - undifferentiated	Thresher sharks	37012000	AFMA Obs. Added 3 thresher sharks to list (37012001, 37012002, 37012003)

ROLE IN FISHERY	TAXA	FAMILY NAME	SCIENTIFIC NAME	COMMON NAME	CAAB CODE	RATIONALE
BC	Chondrichthyan	Sphyrnidae	*Sphyrna* spp.	Hammerhead sharks (mixed)	37019902	AFMA Obs. Apportioned to 37019001, 37019003 and 37019004
BC	Chondrichthyan	Sphyrnidae	Sphyrnidae - undifferentiated	Hammerhead sharks	37019000	AFMA Obs. Apportioned to 37019001, 37019003 and 37019004
BC	Chondrichthyan	Pristiophoridae	Pristiophoridae - undifferentiated	Sawsharks	37023000	AFMA Log, misidentification: outside fishery area
PS	Chondrichthyan	Pristidae	Pristidae	Sawfishes	37025000	AFMA Log. Apportioned catch to 4 species corresponding to family: Pristidae within list
BC	Chondrichthyan	Myliobatididae	Myliobatididae - undifferentiated	Eagle rays	37039000	AFMA Obs. Added to existing species in list
BC	Chondrichthyan	Rajidae	Rajidae - undifferentiated	Skates	37031000	AFMA Log, misidentification: outside fishery area
BC	Chondrichthyan			Pelagic stingrays	37035999	AFMA Obs. Existing species in list
BC	Chondrichthyan		Chimaeriformes - undifferentiated	Chimaeras	37990028	AFMA Log, misidentification: outside fishery area
BC	Teleost	Muraenesocidae	*Muraenesox* spp.	Pike eels (mixed)	37063901	AFMA Obs. Added 37063002 to list (species from Tiger Prawn sub-fishery list; AFMA Obs)
BC	Teleost	Congridae, Colocongridae	Congridae, Colocongridae - undifferentiated	Conger eels	37067000	AFMA Obs. Added 37067015 (from Tiger Prawn sub-fishery list)
BC	Teleost	Congridae	*Conger* spp.	Conger eel (mixed)	37067900	AFMA Obs. Added 37067015 (from Tiger Prawn sub-fishery list)
BC	Teleost	Ophichthidae	Ophichthidae - undifferentiated	Snake eels	37068000	AFMA Obs. Added 37068013, 37068033 to list. These species occurred in the Tiger Prawn sub-fishery (AFMA Obs)
BC	Teleost	Halosauridae	*Halosauropsis macrochir*	Abyssal halosaur	37081003	AFMA Log, misidentification: outside fishery area
BC	Teleost	Clupeidae	*Spratelloides robustus*	Blue sprat	37085003	AFMA Log, misidentification: outside fishery area
BC	Teleost	Clupeidae	Clupeidae, Pristigasteridae - undifferentiated	Herrings	37085000	AFMA Obs. Apportioned to existing Sardinella species within list
BC	Teleost	Clupeidae	*Sardinella* spp.	Sardines	37085906	AFMA Obs. Apportioned to existing Clupeidae species within list

ROLE IN FISHERY	TAXA	FAMILY NAME	SCIENTIFIC NAME	COMMON NAME	CAAB CODE	RATIONALE
BC	Teleost	Bathysauridae, Synodontidae	Bathysauridae, Synodontidae - undifferentiated	Lizardfishes and deepsea lizardfishes	37118000	AFMA Obs. Apportioned to existing Synodontidae species within list
BC	Teleost	Harpadontidae	*Harpadon nehereus*	Bombay duck	37119750	AFMA Log, misidentification: outside fishery area - not in AFZ
BC	Teleost	Myctophidae	Myctophidae - undifferentiated	Lanternfishes	37122000	AFMA Obs. Existing species in list (37122079) which also occurred in the Tiger Prawn sub-fishery
BC	Teleost	Ariidae	Ariidae - undifferentiated	Forktail Catfishes	37188000	AFMA Obs. Added 3 Ariidae species to list
BC	Teleost	Ariidae	*Arius* spp.	Forktail catfish (mixed)	37188901	AFMA Obs. Existing *Arius* species in list (37188006)
BC	Teleost	Plotosidae	Plotosidae - undifferentiated	Eeltail catfishes	37192000	AFMA Obs. Existing Plotosidae species in list.
BC	Teleost	Batrachoididae	*Batrachomoeus occidentalis*	Western frogfish	37205001	AFMA Log, misidentification: outside fishery area
BC	Teleost	Moridae	*Pseudophycis barbata*	Bearded rock cod	37224003	AFMA Log, misidentification: outside fishery area
BC	Teleost	Ophidiidae	*Genypterus* spp.	Ling (mixed)	37228901	AFMA Log, misidentification: outside fishery area
BC	Teleost	Hemiramphidae	*Hyporhamphus australis*	Eastern sea garfish	37234014	AFMA Log, misidentification: outside fishery area
BC	Teleost	Belonidae	Belonidae - undifferentiated	longtoms	37235000	AFMA Obs. Added 9 species belonging to family Belonidae
BC	Teleost	Scomberesocidae	Scomberesocidae - undifferentiated	Sauries	37236000	AFMA Log, misidentification: outside fishery area (and species within family)
BC	Teleost	Trachipteridae	Trachipteridae - undifferentiated	Ribbonfishes	37271000	AFMA Log, misidentification: outside fishery area? Spatial distirbution (Aus) suggests outside fishery range. Fishbase suggests within fishery range. Small discard in 5 years (<1 kg p/yr) (AFMA Obs)
BC	Teleost	Fistulariidae	Fistulariidae - undifferentiated	Flutemouths	37278000	AFMA Obs. Existing species in list
PS	Teleost	Syngnathidae	Syngnathidae - undifferentiated	Seahorses and pipefishes	37282000	AFMA Obs. 3 existing species in list
PS	Teleost	Syngnathidae	*Hippocampus* spp.	Seahorses - hippocampid	37282900	AFMA Obs. 3 existing species in list
BC	Teleost	Synbranchidae	*Monopterus albus*	Lai	37285001	AFMA Log, misidentification: outside fishery area. Known in Australia from Cape York to Townsville, Queensland. The Belut is a bottom-dwelling fish

ROLE IN FISHERY	TAXA	FAMILY NAME	SCIENTIFIC NAME	COMMON NAME	CAAB CODE	RATIONALE
						found in still water in muddy swamps, ponds and sometimes in quiet flowing streams. The species may also be found in brackish water and in temporary water bodies.
BC	Teleost	Sebastidae	*Helicolenus barathri* and *Helicolenus percoides*	Ocean and coral Perch	37287901	AFMA Log, misidentification: outside fishery area
BC	Teleost	Scorpaenidae	*Scorpaena* spp.	Scorpionfishes - scorpaenid	37287904	AFMA Obs.
BC	Teleost	Platycephalidae	*Neoplatycephalus richardsoni*	Tiger flathead	37296001	AFMA Log, misidentification: outside fishery area
BC	Teleost	Platycephalidae	*Neoplatycephalus conatus*	Deepwater flathead	37296002	AFMA Log, misidentification: outside fishery area
BC	Teleost	Platycephalidae	*Ratabulus diversidens*	Orange-freckled flathead	37296011	AFMA Log, misidentification: outside fishery area
BC	Teleost	Platycephalidae	Platycephalidae - undifferentiated	Flatheads	37296000	AFMA Obs. Exisitng species in list.
BC	Teleost	Scorpaenidae	Scorpaenidae - undifferentiated	Coral perch	37287900	AFMA Obs. no species added, small catch
BC	Teleost	Triglidae	Triglidae - undifferentiated	Searobins	37288900	AFMA Obs. no species added, small catch
BC	Teleost	Dactylopteridae	Dactylopteridae - undifferentiated	Flying gurnards	37308000	AFMA Obs. Existing (1) species in list
BC	Teleost	Polyprionidae	*Polyprion oxygeneios*	Hapuku	37311006	AFMA Log, misidentification: outside fishery area
BC	Teleost	Terapontidae	*Terapon* spp.	Terapon grunters	37321901	AFMA Obs. Exisitng species in list.
BC	Teleost	Teraponidae	Teraponidae - undifferentiated	Striped grunters	37321000	AFMA Obs. Exisitng species in list.
BC	Teleost	Priacanthidae	Priacanthidae - undifferentiated	Bigeyes	37326000	AFMA Obs. Exisitng species in list.
BC	Teleost	Apogonidae, Dinolestidae	Apogonidae, Dinolestidae - undifferentiated	Cardinalfishes	37327000	AFMA Obs. Exisitng species in list.
BC	Teleost	Sillaginidae	*Sillago flindersi*	Eastern school whiting	37330014	AFMA Log, misidentification: outside fishery area
BC	Teleost	Sillaginidae	Sillaginidae - undifferentiated	Whitings	37330000	AFMA Obs. Exisitng species in list.
BC	Teleost	Echeneididae	Echeneididae - undifferentiated	Suckerfishes, remoras	37336000	AFMA Obs. Exisitng species in list.

ROLE IN FISHERY	TAXA	FAMILY NAME	SCIENTIFIC NAME	COMMON NAME	CAAB CODE	RATIONALE
BC	Teleost	Carangidae	*Decapterus* spp.	Scad (mixed)	37337901	AFMA Obs. Exisitng species in list.
BC	Teleost	Carangidae	*Scomberoides* spp.	Queenfish (mixed)	37337905	AFMA Obs. Exisitng species in list.
BC	Teleost	Carangidae	*Caranx* and *Pseudocaranx* spp.	Trevallies	37337908	AFMA Obs. Exisitng species in list.
BC	Teleost	Carangidae	*Trachurus* spp.	Mackerel scads	37337907	AFMA Log, misidentification: outside fishery area
BC	Teleost	Carangidae	*Trachinotus* spp.	Dart (mixed)	37337904	AFMA Obs. Added 3 species to list
BC	Teleost	Carangidae	Carangidae - undifferentiated	Trevallies and scads	37337000	AFMA Obs. Exisitng species in list.
BC	Teleost	Leiognathidae	Leiognathidae - undifferentiated	Ponyfishes	37341000	AFMA Obs. Exisitng species in list.
BC	Teleost	Lutjanidae	*Pristipomoides typus*	Sharptooth jobfish	37346019	AFMA Obs. outside likely depth range of fishery
BC	Teleost	Lutjanidae	*Pristipomoides sieboldii*	Lavender snapper	37346064	AFMA Obs. outside likely depth range of fishery
BC	Teleost	Lutjanidae	*Lutjanus* sp.	Russell's snapper	37346012	AFMA Obs. Existing species in list
BC	Teleost	Bramidae	Bramidae - undifferentiated	Pomfret	37342000	AFMA Log, Obs.
BC	Teleost	Nemipteridae	*Nemipterus* spp	Threadfin breams	37347901	AFMA Obs. Existing species in list
BC	Teleost	Nemipteridae	*Nemipterus zysron*	Slender threadfin bream	37347013	AFMA Obs. Outside likely depth range of fishery
BC	Teleost	Nemipteridae	*Nemipterus mesoprion*	Mauvelip threadfin bream	37347026	AFMA Log, misidentification: outside fishery area
BC	Teleost	Gerreidae	*Gerres* spp.	Silverbiddies (mixed)	37349999	AFMA Obs. Existing species in list
BC	Teleost	Gerreidae	Gerreidae - undifferentiated	Silverbiddies (mixed)	37349000	AFMA Obs. Existing species in list
BC	Teleost	Haemulidae	*Pomadasys* spp	Grunter bream (mixed)	37350902	AFMA Obs. Existing species in list
BC	Teleost	Lethrinidae	*Lethrinus* spp.	Emperor	37351902	AFMA Obs. Existing species in list
BC	Teleost	Sciaenidae	Sciaenidae - undifferentiated	Jewfishes	37354000	AFMA Obs. Existing species in list
BC	Teleost	Mullidae	Mullidae - undifferentiated	Goatfishes (*Upeneus*)	37355000	AFMA Obs. Existing species in list
BC	Teleost	Mullidae	*Upeneus* spp.	Goatfishes (*Upeneus*)	37355999	AFMA Obs. Existing species in list

ROLE IN FISHERY	TAXA	FAMILY NAME	SCIENTIFIC NAME	COMMON NAME	CAAB CODE	RATIONALE
BC	Teleost	Mullidae	*Upeneus asymmetricus*	Asymmetric goatfish	37355010	AFMA Obs, misidentiifcation of this species. It is currently identified as *U. australiae*, which is outside the fishery area.
BC	Teleost	Mullidae	*Upeneichthys lineatus*	Bluestriped goatfish	37355001	AFMA Log, misidentification: outside fishery area
BC	Teleost	Mugilidae	*Myxus elongatus*	Sand grey mullet	37381003	AFMA Log, misidentification: outside fishery area
BC	Teleost	Chaetodontidae	Chaetodontidae - undifferentiated	Butterflyfishes	37365900	AFMA Obs. Existing species in list
BC	Teleost	Cheilodactylidae	*Nemadactylus douglasi*	Grey morwong	37377002	AFMA Log, misidentification: outside fishery area
BC	Teleost	Latridae	*Latris lineata*	Striped trumpeter	37378001	AFMA Log, misidentification: outside fishery area
BC	Teleost	Oplegnathidae	Oplegnathidae - undifferentiated	Knifejaws	37369000	AFMA Obs, misidentification: outside fishery area
BC	Teleost	Latridae	Latridae - undifferentiated	Trumpeters	37378000	AFMA Obs, misidentification: outside fishery area
BC	Teleost	Pempherididae, Leptobramidae	Pempherididae, Leptobramidae - undifferentiated	Bullseyes and beach salmons	37357000	AFMA Obs. not added, small catch
BC	Teleost	Mugilidae	Mugilidae - undifferentiated	Mullets	37381000	AFMA Obs. Existing species in list
BC	Teleost	Sphyraenidae	*Sphyraena* spp.	Barracudas	37382901	AFMA Obs. Existing species in list
BC	Teleost	Polynemidae	Polynemidae - undifferentiated	Threadfin salmons	37383000	AFMA Obs. Existing species in list
BC	Teleost	Labridae	Labridae - undifferentiated	Wrasses	37384000	AFMA Obs. Existing species in list
BC	Teleost	Labridae	*Choerodon* spp.		37384902	AFMA Obs. Existing species in list
BC	Teleost	Labridae	*Thalassoma* spp.	Moon wrasses (mixed)	37384999	AFMA Obs. Added 4 species to list
BC	Teleost	Percophidae	*Chrionema chlorotaenia*	Blotched duckbill	37393003	AFMA Obs, misidentification: outside fishery area
BC	Teleost	Uranoscopidae	Uranoscopidae - undifferentiated	Stargazers	37400000	AFMA Obs. Existing species (1) in list
BC	Teleost	Pinguipedidae	*Parapercis multiplicata*	Doublestitch grubfish	37390016	AFMA Obs, misidentification: outside fishery area
BC	Teleost	Uranoscopidae	*Uranoscopus kaianus*	Kai stargazer	37400024	AFMA Obs, misidentification: outside fishery area, depth range of fishery

ROLE IN FISHERY	TAXA	FAMILY NAME	SCIENTIFIC NAME	COMMON NAME	CAAB CODE	RATIONALE
BC	Teleost	Callionymidae	*Bathycallionymus bifilum*	Western ocellate dragonet	37427003	AFMA Obs, misidentification: outside fishery area
BC	Teleost	Callionymidae	*Pseudocalliurichthys goodladi*	Longspine dragonet	37427006	AFMA Obs, misidentification: outside fishery area
BC	Teleost	Callionymidae	*Calliurichthys australis*	Australian stinkfish	37427013	AFMA Obs, misidentification: outside fishery area
BC	Teleost	Draconettidae, Callionymidae	Draconettidae and Callionymidae - undifferentiated	Deepsea dragonets and dragonets	37427000	AFMA Obs. Existing species belonging to family Callionymidae in list
BC	Teleost	Gobiidae	Gobiidae - undifferentiated	Gobies	37428000	AFMA Obs. Existing species in list
BC	Teleost	Gempylidae	*Ruvettus pretiosus*	Oilfish	37439003	AFMA Obs. Outside likey depth range of fishery
BC	Teleost	Gempylidae	*Gempylus serpens*	Snake mackerel	37439010	AFMA Obs. Outside likely depth range of fishery and outside the GoC
BC	Teleost	Trichiuridae	*Trichiurus lepturus*	Largehead hairtail	37440004	AFMA Obs, misidentification: outside fishery area
BC	Teleost	Scombridae	Scombridae - undifferentiated	Mackerels	37441000	AFMA Obs. Existing species in list
BC	Teleost	Centrolophidae	Centrolophidae - undifferentiated	Trevallas	37445000	AFMA Obs. Existing species in list (1)
BC	Teleost	Centrolophidae	*Hyperoglyphe antarctica*	Blue-eye trevalla	37445001	AFMA Obs, misidentification: outside fishery area
BC	Teleost	Bothidae, Achiropsettidae, Paralichthyidae	Bothidae, Achiropsettidae, Paralichthyidae - undifferentiated	Lefteye flounders	37460000	AFMA Obs. Existing species in list
BC	Teleost	Soleidae	Soleidae - undifferentiated	Soles	37462000	AFMA Obs. Existing species in list
BC	Teleost	*Soleidae*	*Zebrias cancellatus*	Harrowed sole	37462006	AFMA Obs, misidentification: outside fishery area
BC	Teleost	Soleidae	*Brachirus nigra* (synonym: *Synaptura nigra)*	Black sole	37462017	AFMA Obs, misidentification: outside fishery area
BC	Teleost	Cynoglossidae	Cynoglossidae - undifferentiated	Tongue soles	37463000	AFMA Obs. Existing species in list (37463002)
BC	Teleost	Cynoglossidae	*Cynoglossus* spp.	Tongue soles (mixed)	37463901	AFMA Obs. Existing species in list (37463017)
BC	Teleost	Cynoglossidae	*Cynoglossus ogilbyi*	Ogilby's tongue sole	37463017	AFMA Obs, misidentification: outside fishery area. Also 37463901: *Cynoglossus* spp. (AFMA Obs)

ROLE IN FISHERY	TAXA	FAMILY NAME	SCIENTIFIC NAME	COMMON NAME	CAAB CODE	RATIONALE
BC	Teleost	Pleuronectidae	Pleuronectidae - undifferentiated	Righteye flounders	37461000	AFMA Obs, misidentification: outside fishery area
BC	Teleost	Balistidae, Monacanthidae	Balistidae and Monacanthidae - undifferentiated	Leatherjackets	37465000	AFMA Obs. Existing species corresponding to family in list
BC	Teleost	Monacanthidae	Monacanthidae - undifferentiated	Leatherjacket	37465903	AFMA Obs. Existing species corresponding to family in list
BC	Teleost	Ostraciidae	Ostraciidae - undifferentiated	Boxfishes	37466000	AFMA Obs. Existing species in list
BC	Teleost	Tetraodontidae	Tetraodontidae - undifferentiated	Toadfishes unspecified	37467000	AFMA Obs. Existing species in list
BC	Teleost	Tetraodontidae	*Lagocephalus* spp.	Toadfishes - lagocephalid	37467900	AFMA Obs. Existing species in list
BC	Teleost	Diodontidae	Diodontidae - undifferentiated	Porcupine fish	37469000	AFMA Obs. Existing species in list
BC	Teleost	Triodontidae	Triodontidae - undifferentiated	Pufferfishes	37468000	AFMA Obs. Depth >30 m (less likely)
BC	Teleost	Aplochitonidae	*Lovettia sealii* and *Galaxias* spp.	Whitebait	37990002	AFMA Obs, misidentiifcation: outside fishery area
PS	Marine reptile	Cheloniidae	Testudines - undifferentiated	Turtles	39001001	AFMA Log. Added 2 species to list: Hawksbill sea turtle (39020003) and Leatherback turtle (39021001)
PS	Marine reptile	Hydrophiidae	Hydrophiidae - undifferentiated	Sea snakes	39125000	AFMA Log. Existing species in list.
PS	Marine bird	Hydrobatidae	Hydrobatidae - undifferentiated	Storm-petrels	40042000	Added one species 40042004 to list. The two other species (40042001; 40042002) are rare and therefore not included in list. Blaber pers. comm.
PS	Marine bird	Laridae	Laridae - undifferentiated	Gulls skuas noddys and terns	40128000	AFMA Obs. Added 14 species to list

2.4.2 Level 2 PSA (Steps 2 and 3)

The results in the Tables below provide details of the PSA assessments for each species, separated by role in the fishery, and by taxa where appropriate. These assessments are limited to direct impacts from fishing, and the operational objective is to avoid over-exploitation due to fishing, either as over-fishing or becoming over-fished. The risk scores and categories (high, medium, or low) reflect potential rather than actual risk using the Level 2 (PSA) method. For species assessed at Level 2, no account is taken of the level of catch, the size of the population, or the likely exploitation rate. To assess actual risk for any species requires a Level 3 assessment which does account for these factors. However, recent fishing effort distributions are considered when calculating the availability attribute for the Level 2 analysis, whereas the entire jurisdictional range of the fishery is considered at Level 1.

The PSA analyses do not fully take account of management actions already in place in the fishery that may mitigate for high-risk species. Some management actions or strategies, however, can be accounted for in the analysis where they exist. These include spatial management that limits the range of the fishery (affecting availability), gear limits that affect the size of animals that are captured (selectivity), and handling practices that may affect the survival of species after capture (post capture mortality). Management strategies that are not reflected in the PSA scores include limits to fishing effort, use of catch limits (such as TACs), and some other controls such as seasonal closures.

It should be noted that the PSA method is likely to generate more false positives for high risk (species assessed to be high risk when they are actually low risk) than false negatives (species assessed to be low risk when they are actually high risk). This is due to the precautionary approach to uncertainty adopted in the PSA method, whereby attributes are set at high risk levels in the absence of information. It also arises from the nature of the PSA method assessing potential rather than actual risk, as discussed above. Thus, some species will be assessed at high risk because they have low productivity and are exposed to the fishery, even though they are rarely if ever caught and are relatively abundant.

In the PSA Tables below, the “Comments” column is used to provide information on one or more of the following aspects of the analysis for each species: use of overrides to alter susceptibility scores (for example based on use of observer data or taking account of specific management measures or mitigation); data or information sources or limitations; and information that supports the overall scores. The use of over-rides is explained more fully in Hobday et al. (2007).

The PSA Tables also report on “missing information” (the number of attributes with missing data that therefore score at the highest risk level by default). There are seven attributes used to score productivity and four aspects (availability, encounterability, selectivity and post capture mortality) used to score susceptibility (though encounterability is the average of two attributes). An attribute or aspect is scored as missing if there are no data available to score it, and it has defaulted to high risk for this reason. For some species, attributes may be scored on information from related species or other supplementary information, and even though this information is indirect and less reliable than if species specific information was available, this is not scored as a missing attribute.

There are differences between analyses for protected species and the other species components. In particular, target, by-product and by-catch species are included on the basis that they are known to be caught by the fishery (in some cases only very rarely). However protected species are included in the analysis on the basis that they occur in the area of the fishery, whether or not there has ever been an interaction with the fishery recorded. For this reason, there may be a higher proportion of false positives for high vulnerability for protected species, unless there is a robust observer program that can verify that species do not interact with the gear.

Observer data and observer expert knowledge are important sources of information in the PSA analyses, particularly for the bycatch and protected components. The level of observer data for this fishery is regarded as medium. An AFMA observer program has been operating since July 2003, and coverage varies depending on the fishing location. Information on target and byproduct species is well collected, and bycatch attempts are made, but may be compromised by taxonomic difficulties. Interactions with protected species are recorded, although again, taxonomic resolution is weak for some taxa (e.g. whales and seabirds).

Summary of Habitat PSA results

The Habitat component was not analysed at Level 2 in this report, as it was outside the project scope.

Summary of Community PSA results

The Community component was not analysed at Level 2 in this report, as while it was outside the project scope, it did not trigger a Level 2 analysis.

2.4.3 PSA results for individual units of analysis (Step 4-6)

The average productivity and susceptibility scores for each unit of analysis (e.g. for each species) are then used to place the individual units of analysis on 2D plots (as below). The relative position of the units on the plot will determine relative risk at the unit level as per PSA plot below. The overall risk value for a unit is the Euclidean distance from the origin of the graph. Units that fall in the upper third of the PSA plots are deemed to be at high risk. Units with a PSA score in the middle are at medium risk, while units in the lower third are at low risk with regard to the productivity and susceptibility attributes. The divisions between these risk categories are based on dividing the area of the PSA plots into equal thirds. If all productivity and susceptibility scores (scale 1-3) are assumed to be equally likely, then 1/3rd of the Euclidean overall risk values will be greater than 3.18 (high risk), 1/3rd will be between 3.18 and 2.64 (medium risk), and 1/3rd will be lower than 2.64 (low risk).

The PSA output allows identification and prioritization (via ranking the overall risk scores) of the units (e.g. species, habitat types, communities) at greatest risk to fishing activities. This prioritization means units with the lowest inherent productivity or highest susceptibility, which can only sustain the lowest level of impact, can be examined in detail. The overall risk of an individual unit will depend on the level of impact as well its productivity and susceptibility.

The overall risk value for each unit is the Euclidean distance from the origin to the location of the species on the PSA plot. The units are then divided into three risk categories, high, medium, and low, according to the risk values described above.

2.4.4 PSA results and discussion

a) Key/secondary commercial species

Under the revised ERAEF (AFMA 2017), key/secondary commercial species that undergo Tier stock assessments are not assessed at Level 2 (with respect to fishing). There were no other activities that triggered a Level 2 analysis for this component.

b) Commercial bait species

There are no commercial bait species in this sub-fishery.

c) Byproduct species

There were 14 byproduct invertebrate species considered in a PSA. Of these 14 species, none were high risk, four were medium risk and 10 were low risk. (Table 2.25).

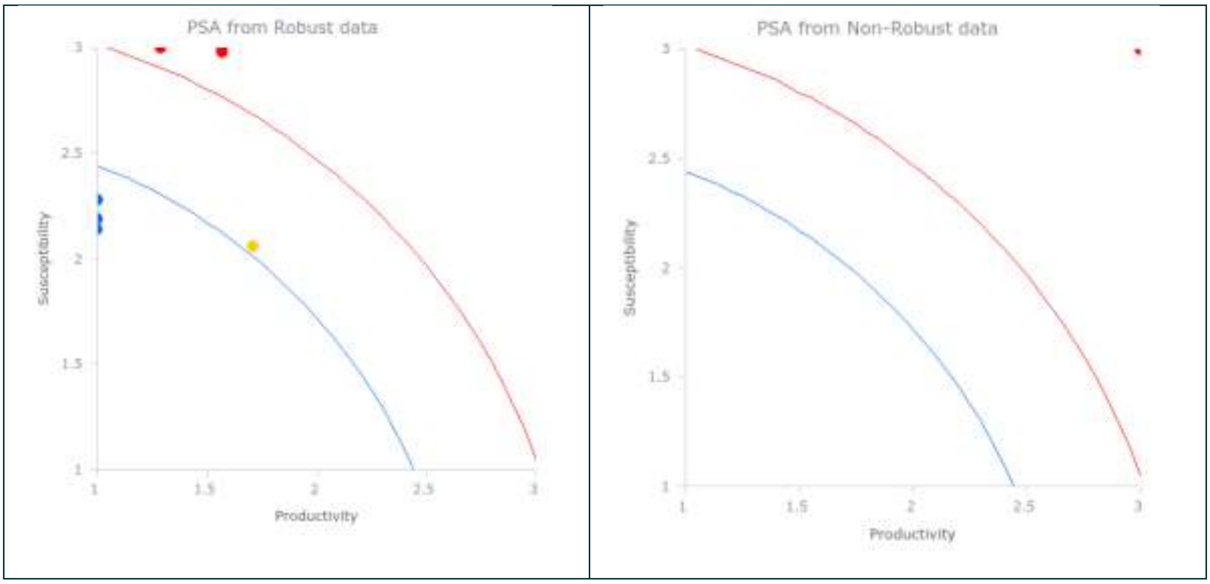

Figure 2.10. PSA plot for bycatch species in the NPF Banana Prawn sub-fishery for a) robust [left] and (b) data deficient [right] species. Note many species fall on some points.

Table 2.25. Summary of the PSA scores on the set of productivity and susceptibility attributes for byproduct species and residual risk (RR) for high risk species. Note: a residual risk analysis was not examined for this sub-fishery, if the risk score was medium or low. Productivity attributes (P1-P7) are listed in Table 2.28 (in report). Susceptibility attributes (S1-S4) are listed in Susceptibility attributes
Table 2.29 (in report). Missing attributes are highlighted (red). Productivity score (Prod. score); Susceptibility score (Susc. score). No. interactions (No. Int. 2013-2017) reported for high risk scores only (source: Commonwealth logbook (LOG) and observer (OBS) databases). Residual risk guidelines drawn from document "Revision of residual risk guidelines to reflect updated Ecological Risk Assessment Methodology – version Oct 12, 2016. See numbers at the foot of this table. R: retained. NE: not entered.

CAAB CODE	SCIENTIFIC NAME	COMMON NAME	P1	P2	P3	P4	P5	P6	P7	S1	S2	S3	S4	PROD. SCORE	SUSC. SCORE	MISSING ATTRIB-UTES	PSA 2D	RISK CATEGORY	NO. INT. OR CATCH (2013-2017)	RISK SCORE FOLLOWING RESIDUAL RISK	FINAL RISK SCORE
No CAAB	*Linuparus sordidus*	Red champagne lobster	3	3	1	1	1	3	3	3	1	3	3	2.14	2.28	5	3.13	Medium	NE	No RR required	Medium
No CAAB	*Linuparus meridionalis*	Red champagne lobster	3	3	1	1	1	3	3	3	1	3	3	2.14	2.28	5	3.13	Medium	NE	No RR required	Medium
No CAAB	*Uroteuthis sp.* 4 of Yeatman 1993	A squid	1	1	2	1	1	2	3	1	1	3	3	1.57	1.73	0	2.24	Low	NE	No RR required	Low
No CAAB	*Uroteuthis etheridgei*	A squid	1	1	2	1	1	2	3	1	1	3	3	1.57	1.73	0	2.24	Low	NE	No RR required	Low
28821007	*Thenus parindicus*	Mud bug	1	1	2	1	1	2	1	2	3	3	3	1.29	2.71	0	3	Medium	NE	No RR required	Medium
28786001	*Metanephrops australiensis*	Australian scampi	1	2	2	1	1	2	3	3	1	2	3	1.71	2.06	2	2.68	Medium	NE	No RR required	Medium
28711026	*Metapenaeus endeavouri*	Blue endeavour prawn	1	1	1	1	1	1	1	1	3	3	3	1	2.28	0	2.49	Low	NE	No RR required	Low
28711051	*Penaeus monodon*	Black tiger prawn - Leader prawn	1	1	1	1	1	1	1	1	3	3	3	1	2.28	0	2.49	Low	NE	No RR required	Low

CAAB CODE	SCIENTIFIC NAME	COMMON NAME	P1	P2	P3	P4	P5	P6	P7	S1	S2	S3	S4	PROD. SCORE	SUSC. SCORE	MISSING ATTRIB-UTES	PSA 2D	RISK CATEGORY	NO. INT. OR CATCH (2013-2017)	RISK SCORE FOLLOWING RESIDUAL RISK	FINAL RISK SCORE
28711045	*Penaeus indicus*	Redleg banana prawn	1	1	1	1	1	1	1	1	3	3	3	1	2.28	0	2.49	Low	NE	No RR required	Low
28711027	*Metapenaeus ensis*	Red endeavour prawn	1	1	1	1	1	1	1	1	3	3	3	1	2.28	0	2.49	Low	NE	No RR required	Low
28711044	*Penaeus esculentus*	Brown tiger prawn	1	1	1	1	1	1	1	1	2.56	3	3	1	2.19	0	2.41	Low	NE	No RR required	Low
28711053	*Penaeus semisulcatus*	Grooved tiger prawn	1	1	1	1	1	1	1	1	2.56	3	3	1	2.19	0	2.41	Low	NE	No RR required	Low
28711047	*Melicertus latisulcatus*	Western king prawn	1	1	1	1	1	1	1	1	2.33	3	3	1	2.14	0	2.36	Low	NE	No RR required	Low
28711048	*Melicertus longistylus*	Redspot king prawn	1	1	1	1	1	1	1	1	2.33	3	3	1	2.14	0	2.36	Low	NE	No RR required	Low

Risk ranking guidelines:

1	Risk rating due to missing, incorrect or out of date information	4	Effort and catch management arrangements for target and byproduct species
2	At risk due to external factors (cumulative risks)	5	Management arrangements to mitigate against the level of bycatch
3	At risk regarding level of interaction/capture with a zero or negligible level of susceptibility	6	Management arrangements relating to seasonal, spatial and depth closures

d) Bycatch species

There were 30 bycatch teleost species considered in this PSA, since they were un-assessable in SAFE (Table 2.26). Of these 30 species, 17 were high risk and 13 were medium risk. A residual risk analysis was performed on these 17 high risk species, resulting in all 17 species reduced to low risk.

Of other 67 invertebrate BC species assessed in this PSA, 49 were high risk, six medium risk and 12 low risk (Figure 2.11). A residual risk analysis was conducted on the 49 high risk species resulting in 44 species reduced to low risk and five species reduced to medium risk.

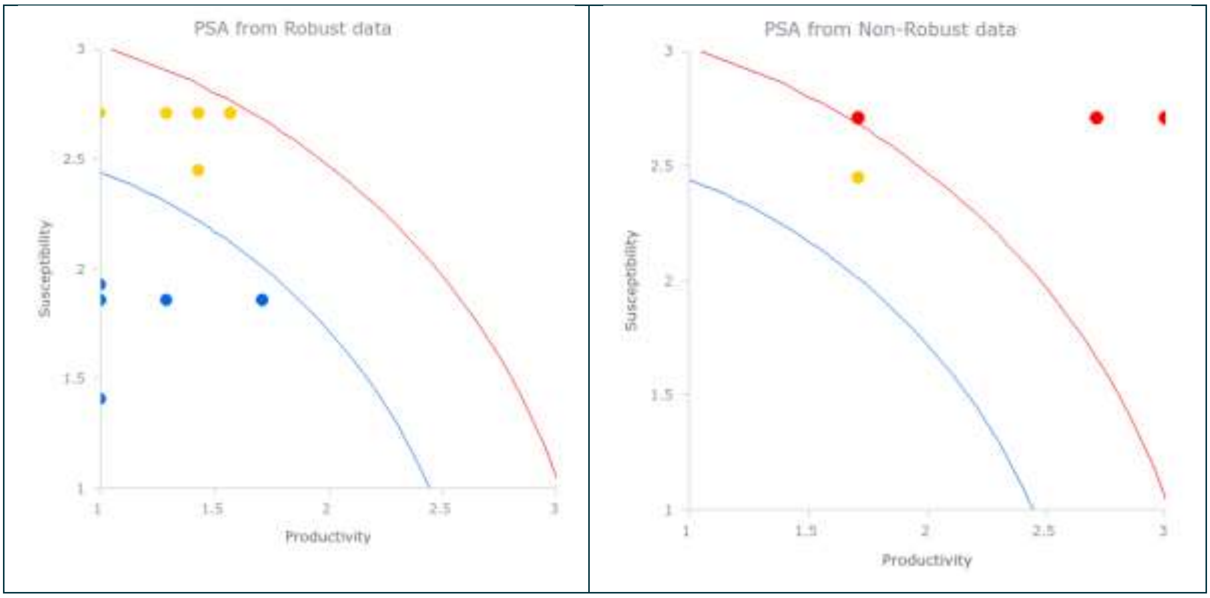

Figure 2.11. PSA plot for bycatch species in the NPF Banana Prawn sub-fishery for a) robust [left] and (b) data deficient [right] species. Note many species fall on some points.

Table 2.26. Summary of the PSA scores on the set of productivity and susceptibility attributes for bycatch species and residual risk (RR) for high risk species. Note: a residual risk (RR) analysis was not examined for this sub-fishery, if the risk score was not high. Productivity attributes (P1-P7) are listed in Table 2.28 (in report). Susceptibility attributes (S1-S4) are listed in Susceptibility attributes
Table 2.29 (in report). Missing attributes are highlighted (red). Productivity score (Prod. score); Susceptibility score (Susc. score). No. interactions (No. Int. 2012-2016) reported for high risk scores only (source: Commonwealth logbook (LOG) and observer (OBS) databases). Residual risk guidelines drawn from document "Revision of residual risk guidelines to reflect updated Ecological Risk Assessment Methodology – version Oct 12, 2016. See numbers at the foot of this table. R: retained. NE: not entered.

CAAB CODE	SCIENTIFIC NAME	COMMON NAME	P1	P2	P3	P4	P5	P6	P7	S1	S2	S3	S4	PROD. SCORE	SUSC. SCORE	MISSING ATTRIB-UTES	PSA 2D	RISK CATEGORY	NO. INT. OR CATCH (2012-2016)	RISK SCORE FOLLOWING RESIDUAL RISK	FINAL RISK SCORE
Following 30 BC species were un-assessable in bSAFE and analysed in PSA:																					
37466005	*Ostracion nasus* (synonym: *Rhynchostracion nasus*)	Shortnose boxfish	3	3	3	3	3	3	3	1	3	3	2	3	2.06	9	3.64	High	OBS: 0.08 kg dis. Also, Ostraciidae (37466000), OBS: 0.12 kg dis.	3- low interaction/capture level. Risk reduced to low.	Low
37464009	*Triacanthus nieuhofi*	Silver tripodfish	3	3	3	3	3	3	3	1	3	3	2	3	2.06	9	3.64	High	OBS: 1.97 kg dis.	3- low interaction/capture level. Risk reduced to low.	Low
37381010	*Valamugil buchanani*	Bluetail mullet	3	3	3	3	3	3	3	1	3	3	2	3	2.06	9	3.64	High	OBS: 0.06 kg dis. Also, Mugilidae (37381000), OBS: 4.4 kg dis.	3- low interaction/capture level. Risk reduced to low.	Low
37035020	*Maculabatis astra*, (synonym: *Himantura astra*)	Black-spotted whipray	3	3	3	3	3	3	3	1	3	3	2	3	2.06	9	3.64	High	OBS: 232.7 kg dis.	3- low interaction/capture level.	Low

CAAB CODE	SCIENTIFIC NAME	COMMON NAME	P1	P2	P3	P4	P5	P6	P7	S1	S2	S3	S4	PROD. SCORE	SUSC. SCORE	MISSING ATTRIB-UTES	PSA 2D	RISK CATEGORY	NO. INT. OR CATCH (2012-2016)	RISK SCORE FOLLOWING RESIDUAL RISK	FINAL RISK SCORE
																				Risk reduced to low.	
37341006	*Deveximentum insidiator* (synonym*: Secutor insidiator*)	Pugnose ponyfish	3	3	3	3	3	3	3	1	3	3	2	3	2.06	9	3.64	High	OBS: 6.6 kg dis. Also, Leiognathidae (37341000), OBS: 186.5 kg dis – i.e., 16996 individuals dis.	Widely distributed – Indo Pacific to northern Australia and eastwards to Samoa. 3- low interaction/capture level. Risk reduced to low.	Low
37068033	*Phyllopichthus xenodontus*	Flappy snake eel	3	3	3	3	3	3	3	1	3	3	2	3	2.06	8	3.64	High	Added from Ophichthidae (37068000), OBS: 1 individual dis.	3- low interaction/capture level. Risk reduced to low.	Low
37235011	*Tylosurus acus*	Keeljaw longtom	3	3	3	3	3	3	3	1	3	3	2	3	2.06	9	3.64	High	Added from Belonidae (37235000), OBS: 2 indivduals dis.	3- low interaction/capture level. Risk reduced to low.	Low
37235008	*Platybelone argalus*	Flat-tail longtom	3	3	3	3	3	3	3	1	3	3	2	3	2.06	9	3.64	High	Added from Belonidae (37235000), OBS: 2 indivduals dis.	3- low interaction/capture level. Risk reduced to low.	Low
37287089	*Synanceia verrucosa*	Reef stonefish	3	3	3	3	2	3	3	1	3	3	2	2.86	2.06	6	3.52	High	OBS: 0.005 kg dis.	3- low interaction/capture level. Risk reduced to low.	Low

CAAB CODE	SCIENTIFIC NAME	COMMON NAME	P1	P2	P3	P4	P5	P6	P7	S1	S2	S3	S4	PROD. SCORE	SUSC. SCORE	MISSING ATTRIB-UTES	PSA 2D	RISK CATEGORY	NO. INT. OR CATCH (2012-2016)	RISK SCORE FOLLOWING RESIDUAL RISK	FINAL RISK SCORE
37464008	*Pseudotriacanthus strigilifer*	Blotched tripodfish	3	3	3	3	3	3	2	1	3	3	2	2.86	2.06	8	3.52	High	OBS: 7.7 kg dis.	3- low interaction/capture level. Risk reduced to low.	Low
37210010	*Tetrabrachium ocellatum*	Humpback anglerfish	3	3	3	3	1	3	3	1	3	3	2	2.71	2.06	6	3.4	High	OBS: 1 individual dis.	3- low interaction/capture level. Risk reduced to low.	Low
37287033	*Apistops caloundra*	Shortfin waspfish	3	3	3	3	1	3	3	1	3	3	2	2.71	2.06	6	3.4	High	OBS: 0.2 kg dis.	3- low interaction/capture level. Risk reduced to low.	Low
37355031	*Upeneus vittatus*	Striped goatfish	3	3	1	3	3	3	3	1	3	3	2	2.71	2.06	7	3.4	High	OBS: 0.11 kg dis. Also: Mullidae (37355000), OBS: 5.8 kg dis. Also: *Upeneus* spp. (37355999), OBS: 25.3 kg. dis.	3- low interaction/capture level. Risk reduced to low.	Low
37188006	*Arius leptaspis*	Salmon catfish	3	3	3	1	2	3	3	1	3	3	2	2.57	2.06	4	3.29	High	Added from: Ariidae (37188000), OBS: 1.0 kg dis. Also: *Arius* spp. (37188901), OBS: 6.6 kg dis.	3- low interaction/capture level. Risk reduced to low.	Low

CAAB CODE	SCIENTIFIC NAME	COMMON NAME	P1	P2	P3	P4	P5	P6	P7	S1	S2	S3	S4	PROD. SCORE	SUSC. SCORE	MISSING ATTRIB-UTES	PSA 2D	RISK CATEGORY	NO. INT. OR CATCH (2012-2016)	RISK SCORE FOLLOWING RESIDUAL RISK	FINAL RISK SCORE
37438005	*Siganus javus*	Java rabbitfish	3	3	1	3	3	3	1	1	3	3	2	2.43	2.06	7	3.19	High	OBS: 0.005 kg. dis.	3- low interaction/capture level. Risk reduced to low.	Low
37290004	*Adventor elongatus*	Sandpaper velvetfish	3	3	3	1	1	3	3	1	3	3	2	2.43	2.06	4	3.19	High	OBS: 8 indivduals dis.	3- low interaction/capture level. Risk reduced to low.	Low
37309002	*Pegasus volitans*	Longtail seamouth	3	3	3	3	1	1	3	1	3	3	2	2.43	2.06	5	3.19	High	OBS: 0.09 kg. dis.	3- low interaction/capture level. Risk reduced to low.	Low
37287011	*Apistus carinatus*	Longfin waspfish	3	3	3	3	1	3	3	1	1	3	2	2.71	1.57	6	3.13	Medium	NE	No RR required	Medium
37018011	*Hemipristis elongata*	Fossil shark	3	3	3	2	2	3	3	1	3	1	2	2.71	1.57	2	3.13	Medium	NE	No RR required	Medium
37018020	*Hemigaleus australiensis*	Sicklefin weasel shark	3	3	3	2	2	3	3	1	3	1	2	2.71	1.57	2	3.13	Medium	NE	No RR required	Medium
37362003	*Zabidius novemaculeatus*	Shortfin batfish	3	3	3	1	2	1	3	1	3	3	2	2.29	2.06	3	3.08	Medium	NE	No RR required	Medium
37287021	*Minous versicolor*	Plumbstriped Stingfish	3	3	3	1	1	3	3	1	3	2	2	2.43	1.86	4	3.06	Medium	NE	No RR required	Medium
37336001	*Echeneis naucrates*	Live sharksucker	3	3	3	1	2	3	3	1	3	1	2	2.57	1.57	4	3.01	Medium	NE	No RR required	Medium
37037001	*Gymnura australis*	Australian butterfly ray	3	3	3	1	2	3	3	1	3	1	2	2.57	1.57	2	3.01	Medium	NE	No RR required	Medium

CAAB CODE	SCIENTIFIC NAME	COMMON NAME	P1	P2	P3	P4	P5	P6	P7	S1	S2	S3	S4	PROD. SCORE	SUSC. SCORE	MISSING ATTRIB-UTES	PSA 2D	RISK CATEGORY	NO. INT. OR CATCH (2012-2016)	RISK SCORE FOLLOWING RESIDUAL RISK	FINAL RISK SCORE
37013008	*Chiloscyllium punctatum*	Brownbanded bambooshark	3	3	3	2	2	2	3	1	3	1	2	2.57	1.57	3	3.01	Medium	NE	No RR required	Medium
37336002	*Remora remora*	Shark sucker	3	3	3	1	2	3	3	1	2.55	1	2	2.57	1.5	4	2.98	Medium	NE	No RR required	Medium
37466019	*Ostracion meleagris*	Black Boxfish	3	3	3	1	1	3	1	1	3	3	2	2.14	2.06	4	2.97	Medium	NE	No RR required	Medium
37364001	*Rhinoprenes pentanemus*	Threadfin scat	3	3	3	1	1	3	1	1	3	3	2	2.14	2.06	4	2.97	Medium	NE	No RR required	Medium
37362004	*Platax teira*	Longfin batfish	3	3	3	1	2	1	3	1	3	2	2	2.29	1.86	3	2.95	Medium	NE	No RR required	Medium
37278002	*Fistularia petimba*	Red cornetfish	3	3	3	2	2	1	3	1	2.63	1	2	2.43	1.51	3	2.86	Medium	NE	No RR required	Medium
Other BC species:																					
No CAAB	*Uroteuthis sp.*1	A squid	3	3	3	3	3	3	3	3	3	3	2	3	2.71	10	4.04	High	Added species, based on M. Dunning, encountered in trawls.	Current population size and trend unknown. Located mostly west of 136° East of the GoC (M. Dunning) and reported in low numbers in the GoC outside this assessment period (Milton et al. 2010).	Medium

CAAB CODE	SCIENTIFIC NAME	COMMON NAME	P1	P2	P3	P4	P5	P6	P7	S1	S2	S3	S4	PROD. SCORE	SUSC. SCORE	MISSING ATTRIB-UTES	PSA 2D	RISK CATEGORY	NO. INT. OR CATCH (2012-2016)	RISK SCORE FOLLOWING RESIDUAL RISK	FINAL RISK SCORE
																				Risk scores for species with same genus in this assessment is either low or medium. Given the above, risk is reduced to medium.	
No CAAB	*Uroteuthis sp.*2	A squid	3	3	3	3	3	3	3	3	3	3	2	3	2.71	10	4.04	High	Added species, based on M. Dunning, encountered in trawls.	Current population size and trend unknown. This species is the third most caught squid species in the NPF (M. Dunning). This species was more abundant between 12°-14°S and trawled between 10.4 to 63 m in GoC over two summer surveys (in 1990, 1991; Dunning et al. 1994).	Medium

CAAB CODE	SCIENTIFIC NAME	COMMON NAME	P1	P2	P3	P4	P5	P6	P7	S1	S2	S3	S4	PROD. SCORE	SUSC. SCORE	MISSING ATTRIB-UTES	PSA 2D	RISK CATEGORY	NO. INT. OR CATCH (2012-2016)	RISK SCORE FOLLOWING RESIDUAL RISK	FINAL RISK SCORE
																				Risk scores for species with same genus in this assessment is either low or medium. Given the above, risk reduced to medium.	
28911014	*Podophthalmus vigil*	Sentinel crab	3	3	3	3	3	3	3	3	3	3	2	3	2.71	10	4.04	High	OBS: 0.08 kg dis. Also, Portunidae and Polybiidae (28911000), OBS: 3.98 kg dis. [approx. 632 indivduals dis.]. Also, Infraorder Brachyura undifferen-tiated (28850000), OBS: 4.59 kg dis [approx. 606 indviduals dis].	3- low interaction/capture level. Risk reduced to low.	Low
28911001	*Charybdis feriata*	Crucifix crab	3	3	3	3	3	3	3	3	3	3	2	3	2.71	10	4.04	High	OBS: 0.54 kg dis. Also, Portunidae and	3- low interaction/capture level.	Low

CAAB CODE	SCIENTIFIC NAME	COMMON NAME	P1	P2	P3	P4	P5	P6	P7	S1	S2	S3	S4	PROD. SCORE	SUSC. SCORE	MISSING ATTRIB-UTES	PSA 2D	RISK CATEGORY	NO. INT. OR CATCH (2012-2016)	RISK SCORE FOLLOWING RESIDUAL RISK	FINAL RISK SCORE
																			Polybiidae (28911000), OBS: 3.98 kg dis. [approx. 632 indivduals dis.]. Also, Infraorder Brachyura – undifferen-tiated (28850000), OBS: 4.59 kg dis [approx. 606 indviduals dis].	Risk reduced to low.	
28821015	*Petrarctus demani*	Shovel-nosed lobster; slipper lobster	3	3	3	3	3	3	3	3	3	3	2	3	2.71	10	4.04	High	Added from 2882100: Scyllaridae – undifferen-tiatedLOG: 5.4 t ret. OBS: 20 individuals dis. Catch has been apportioned to this species and four other species of family Scyllaridae in this list.	Distributed across Indo-west Pacific region from Singapore south to Australia. Depth: 5-59 m in soft substrates (soft mud, sandy mud, shells and seen in coral reefs. (Sealifebase) 3- low interaction/capture level. Risk reduced to medium.	Medium

CAAB CODE	SCIENTIFIC NAME	COMMON NAME	P1	P2	P3	P4	P5	P6	P7	S1	S2	S3	S4	PROD. SCORE	SUSC. SCORE	MISSING ATTRIB-UTES	PSA 2D	RISK CATEGORY	NO. INT. OR CATCH (2012-2016)	RISK SCORE FOLLOWING RESIDUAL RISK	FINAL RISK SCORE
28821013	*Petrarctus rugosus*	Slipper lobster	3	3	3	3	3	3	3	3	3	3	2	3	2.71	10	4.04	High	Added from 2882100: Scyllaridae – undifferentiate LOG: 5.4 t ret. OBS: 20 individuals dis. Catch has been apportioned to this species and four other species of family Scyllaridae in this list.	Inhabits depths from 20-60 m in sand and mud, sometimes with coral. (Sealifebase) 3- low interaction/capture level. Risk reduced to medium.	Medium
28821005	*Scyllarides haanii*	Aesop slipper lobster	3	3	3	3	3	3	3	3	3	3	2	3	2.71	10	4.04	High	Added from 2882100: Scyllaridae – undifferen-tiated LOG: 5.4 t ret. OBS: 20 individuals dis. Catch has been apportioned to this species and four other species of family Scyllaridae in this list.	Depth range: 0-135 m. Known from depths 10-315 m over rocky bottom. (Sealifebase) 3- low interaction/capture level. Risk reduced to medium.	Medium
28820007	*Puerulus angulatus*	Banded whip lobster	3	3	3	3	3	3	3	3	3	3	2	3	2.71	10	4.04	High	OBS: 0.06 kg dis.	Depth: 274-536 m (Sealifebase).	Low

CAAB CODE	SCIENTIFIC NAME	COMMON NAME	P1	P2	P3	P4	P5	P6	P7	S1	S2	S3	S4	PROD. SCORE	SUSC. SCORE	MISSING ATTRIB-UTES	PSA 2D	RISK CATEGORY	NO. INT. OR CATCH (2012-2016)	RISK SCORE FOLLOWING RESIDUAL RISK	FINAL RISK SCORE
																				Most likely outside depth range of fishery effort. 3- low interaction/capture level. Risk reduced to low.	
28711037	*Parapenaeus lanceolatus*	Lance prawn	3	3	3	3	3	3	3	3	3	3	2	3	2.71	10	4.04	High	OBS: 0.25 kg dis.	Depth: 300-350 m (Sealifebase). Most likely outside depth range of fishery effort. 3- low interaction/capture level. Risk reduced to low.	Low
25417011	*Stichopus naso*	A holothurian	3	3	3	3	3	3	3	3	3	3	2	3	2.71	10	4.04	High	Added from Class Holothuroidea undifferentiated (25400000), OBS: 1.24 kg dis.	3- low interaction/capture level. Risk reduced to low.	Low
25417007	*Stichupus horrens*	A holothurian	3	3	3	3	3	3	3	3	3	3	2	3	2.71	10	4.04	High	Added from Class Holothuroidea – undifferentiated (25400000),	3- low interaction/capture level. Risk reduced to low.	Low

CAAB CODE	SCIENTIFIC NAME	COMMON NAME	P1	P2	P3	P4	P5	P6	P7	S1	S2	S3	S4	PROD. SCORE	SUSC. SCORE	MISSING ATTRIB-UTES	PSA 2D	RISK CATEGORY	NO. INT. OR CATCH (2012-2016)	RISK SCORE FOLLOWING RESIDUAL RISK	FINAL RISK SCORE
																			OBS: 1.24 kg dis.		
25417006	*Stichopus herrmanni*	Curryfish	3	3	3	3	3	3	3	3	3	3	2	3	2.71	10	4.04	High	Added from Class Holothuroidea – undifferentia-ted (25400000), OBS: 1.24 kg dis.	3- low interaction/capture level. Risk reduced to low.	Low
25416064	*Actinopyga spinea*	Burrowing blackfish	3	3	3	3	3	3	3	3	3	3	2	3	2.71	10	4.04	High	Added from Class Holothuroidea – undifferentia-ted (25400000), OBS: 1.24 kg dis.	3- low interaction/capture level. Risk reduced to low.	Low
25416050	*Holothuria arenicola*	Holothurian	3	3	3	3	3	3	3	3	3	3	2	3	2.71	10	4.04	High	Added from Class Holothuroidea – undifferentia-ted (25400000), OBS: 1.24 kg dis.	3- low interaction/capture level. Risk reduced to low.	Low
25416039	*Holothuria flavomaculata*	Holothurian	3	3	3	3	3	3	3	3	3	3	2	3	2.71	10	4.04	High	Added from Class Holothuroidea – undifferentia-ted (25400000), OBS: 1.24 kg dis.	3- low interaction/capture level. Risk reduced to low.	Low

CAAB CODE	SCIENTIFIC NAME	COMMON NAME	P1	P2	P3	P4	P5	P6	P7	S1	S2	S3	S4	PROD. SCORE	SUSC. SCORE	MISSING ATTRIB-UTES	PSA 2D	RISK CATEGORY	NO. INT. OR CATCH (2012-2016)	RISK SCORE FOLLOWING RESIDUAL RISK	FINAL RISK SCORE
25416033	*Holothuria whitmaei*	Black teatfish	3	3	3	3	3	3	3	3	3	3	2	3	2.71	10	4.04	High	Added from Class Holothuroidea - undifferentiated (25400000), OBS: 1.24 kg dis.	3- low interaction/capture level. Risk reduced to low.	Low
25416031	*Holothuria lessoni*	Golden sandfish	3	3	3	3	3	3	3	3	3	3	2	3	2.71	10	4.04	High	Added from Class Holothuroidea – undifferentia-ted (25400000), OBS: 1.24 kg dis.	3- low interaction/capture level. Risk reduced to low.	Low
25416030	*Holothuria ocellata*	A holothurian	3	3	3	3	3	3	3	3	3	3	2	3	2.71	10	4.04	High	Added from Class Holothuroidea – undifferentia-ted (25400000), OBS: 1.24 kg dis.	3- low interaction/capture level. Risk reduced to low.	Low
25416029	*Holothuria martensi*	A holothurian	3	3	3	3	3	3	3	3	3	3	2	3	2.71	10	4.04	High	Added from Class Holothuroidea – undifferentia-ted (25400000), OBS: 1.24 kg dis.	3- low interaction/capture level. Risk reduced to low.	Low
25408031	*Psuedocolochirus axiologus*	Selenka's sea cucumber	3	3	3	3	3	3	3	3	3	3	2	3	2.71	10	4.04	High	Added from Class Holothuroidea – undifferentia-ted	3- low interaction/capture level.	Low

CAAB CODE	SCIENTIFIC NAME	COMMON NAME	P1	P2	P3	P4	P5	P6	P7	S1	S2	S3	S4	PROD. SCORE	SUSC. SCORE	MISSING ATTRIB-UTES	PSA 2D	RISK CATEGORY	NO. INT. OR CATCH (2012-2016)	RISK SCORE FOLLOWING RESIDUAL RISK	FINAL RISK SCORE
																			(25400000), OBS: 1.24 kg dis.	Risk reduced to low.	
25408007	*Cercodemas anceps*	A holothurian	3	3	3	3	3	3	3	3	3	3	2	3	2.71	10	4.04	High	Added from Class Holothuroidea – undifferentia-ted (25400000), OBS: 1.24 kg dis.	3- low interaction/capture level. Risk reduced to low.	Low
25266005	*Peronella lesueuri*	Sand dollar	3	3	3	3	3	3	3	3	3	3	2	3	2.71	10	4.04	High	Added from Class Echinodea (25200000), OBS: 15.3 kg dis.	3- low interaction/capture level. Risk reduced to low.	Low
25211004	*Chaetodiadema granulatum*		3	3	3	3	3	3	3	3	3	3	2	3	2.71	9	4.04	High	Added from Class Echinodea (25200000), OBS: 15.3 kg dis.	3- low interaction/capture level. Risk reduced to low.	Low
25143013	*Metrodira subulata*	Seastar	3	3	3	3	3	3	3	3	3	3	2	3	2.71	10	4.04	High	Added from Class Asteroidea – undifferentia-ted (25102000), OBS: 0.89 kg dis.	3- low interaction/capture level. Risk reduced to low.	Low
25139001	*Euretaster insignis*	Seastar	3	3	3	3	3	3	3	3	3	3	2	3	2.71	10	4.04	High	Added from Class Asteroidea – undifferentia-	3- low interaction/capture level.	Low

CAAB CODE	SCIENTIFIC NAME	COMMON NAME	P1	P2	P3	P4	P5	P6	P7	S1	S2	S3	S4	PROD. SCORE	SUSC. SCORE	MISSING ATTRIB-UTES	PSA 2D	RISK CATEGORY	NO. INT. OR CATCH (2012-2016)	RISK SCORE FOLLOWING RESIDUAL RISK	FINAL RISK SCORE
																			ted (25102000), OBS: 0.89 kg dis.	Risk reduced to low.	
25127018	*Anthenea tuberculosa*		3	3	3	3	3	3	3	3	3	3	2	3	2.71	10	4.04	High	Added from Class Asteroidea – undifferentia-ted (25102000), OBS: 0.89 kg dis.	3- low interaction/capture level. Risk reduced to low.	Low
25124002	*Archaster typicus*		3	3	3	3	3	3	3	3	3	3	2	3	2.71	10	4.04	High	Added from Class Asteroidea – undifferentia-ted (25102000), OBS: 0.89 kg dis.	3- low interaction/capture level. Risk reduced to low.	Low
25122026	*Stellaster childreni*	Seastar	3	3	3	3	3	3	3	3	3	3	2	3	2.71	10	4.04	High	Added from Class Asteroidea – undifferentia-ted (25102000), OBS: 0.89 kg dis.	3- low interaction/capture level. Risk reduced to low.	Low
25122010	*Iconaster longimanus*	Seastar	3	3	3	3	3	3	3	3	3	3	2	3	2.71	10	4.04	High	Added from Class Asteroidea – undifferentia-ted (25102000), OBS: 0.89 kg dis.	3- low interaction/capture level. Risk reduced to low.	Low

CAAB CODE	SCIENTIFIC NAME	COMMON NAME	P1	P2	P3	P4	P5	P6	P7	S1	S2	S3	S4	PROD. SCORE	SUSC. SCORE	MISSING ATTRIB-UTES	PSA 2D	RISK CATEGORY	NO. INT. OR CATCH (2012-2016)	RISK SCORE FOLLOWING RESIDUAL RISK	FINAL RISK SCORE
25105005	*Luidia maculata*	Seastar	3	3	3	3	3	3	3	3	3	3	2	3	2.71	10	4.04	High	Added from Class Asteroidea – undifferentia-ted (25102000), OBS: 0.89 kg dis.	3- low interaction/capture level. Risk reduced to low.	Low
25105003	*Luidia hardwicki*	Seastar	3	3	3	3	3	3	3	3	3	3	2	3	2.71	10	4.04	High	Added from Class Asteroidea – undifferentia-ted (25102000), OBS: 0.89 kg dis.	3- low interaction/capture level. Risk reduced to low.	Low
25047001	*Ptilometra macronema*	A crinoid	3	3	3	3	3	3	3	3	3	3	2	3	2.71	10	4.04	High	Added from Class Crinoidea – undifferentia-ted (25001000), OBS: 0.01 kg dis.	3- low interaction/capture level. Risk reduced to low.	Low
25038002	*Amphimetra tessellata*	A crinoid	3	3	3	3	3	3	3	3	3	3	2	3	2.71	10	4.04	High	Added from Class Crinoidea – undifferentia-ted (25001000), OBS: 0.01 kg dis.	3- low interaction/capture level. Risk reduced to low.	Low
25030037	*Clarkcomanthus comanthipinna*	A crinoid	3	3	3	3	3	3	3	3	3	3	2	3	2.71	10	4.04	High	Added from Class Crinoidea – undifferentia-ted (25001000),	3- low interaction/capture level. Risk reduced to low.	Low

CAAB CODE	SCIENTIFIC NAME	COMMON NAME	P1	P2	P3	P4	P5	P6	P7	S1	S2	S3	S4	PROD. SCORE	SUSC. SCORE	MISSING ATTRIB-UTES	PSA 2D	RISK CATEGORY	NO. INT. OR CATCH (2012-2016)	RISK SCORE FOLLOWING RESIDUAL RISK	FINAL RISK SCORE
																			OBS: 0.01 kg dis.		
25030032	*Comatula solaris*	A crinoid	3	3	3	3	3	3	3	3	3	3	2	3	2.71	10	4.04	High	Added from Class Crinoidea – undifferentia-ted (25001000), OBS: 0.01 kg dis.	3- low interaction/capture level. Risk reduced to low.	Low
25030031	*Comatula rotalaria*	A crinoid	3	3	3	3	3	3	3	3	3	3	2	3	2.71	10	4.04	High	Added from Class Crinoidea – undifferentia-ted (25001000), OBS: 0.01 kg dis.	3- low interaction/capture level. Risk reduced to low.	Low
25030030	*Comatula pectinata*	A crinoid	3	3	3	3	3	3	3	3	3	3	2	3	2.71	10	4.04	High	Added from Class Crinoidea – undifferentia-ted (25001000), OBS: 0.01 kg dis.	3- low interaction/capture level. Risk reduced to low.	Low
25030002	*Capillaster multiradiatus*	A crinoid	3	3	3	3	3	3	3	3	3	3	2	3	2.71	10	4.04	High	Added from Class Crinoidea – undifferentia-ted (25001000), OBS: 0.01 kg dis.	3- low interaction/capture level. Risk reduced to low.	Low
24177010	*Tonna sulcosa*	Sulcosa tun shell	3	3	3	3	3	3	3	3	3	3	2	3	2.71	10	4.04	High	OBS: 0.25 kg dis.	3- low interaction/capture level. Risk reduced to low.	Low

CAAB CODE	SCIENTIFIC NAME	COMMON NAME	P1	P2	P3	P4	P5	P6	P7	S1	S2	S3	S4	PROD. SCORE	SUSC. SCORE	MISSING ATTRIB-UTES	PSA 2D	RISK CATEGORY	NO. INT. OR CATCH (2012-2016)	RISK SCORE FOLLOWING RESIDUAL RISK	FINAL RISK SCORE
23659039	*Octopus sp.* A (other names: *O. membranaceus,* misidentification)	An octopus	3	3	3	3	3	3	3	3	3	3	2	3	2.71	10	4.04	High	Added from: Octopodidae – undifferentia-ted (23659000), OBS: 2 kg dis. Also, Order Octopoda – undifferentia-ted (23650000), OBS: 4 individuals dis.	3- low interaction/capture level. Risk reduced to low.	Low
23659021	*Octopus cyanea*	Day octopus	3	3	3	3	3	3	3	3	3	3	2	3	2.71	10	4.04	High	Added from: Octopodidae – undifferentia-ted (23659000), OBS: 2 kg dis. Also, Order Octopoda – undifferentia-ted (23650000), OBS: 4 individuals dis.	3- low interaction/capture level. Risk reduced to low.	Low
25416003	*Holothuria atra*	Lolly fish	3	3	3	3	3	1	3	3	3	3	2	2.71	2.71	8	3.83	High	Added from Class Holothuroidea – undifferentia-ted (25400000), OBS: 1.24 kg dis.	3- low interaction/capture level. Risk reduced to low.	Low

CAAB CODE	SCIENTIFIC NAME	COMMON NAME	P1	P2	P3	P4	P5	P6	P7	S1	S2	S3	S4	PROD. SCORE	SUSC. SCORE	MISSING ATTRIB-UTES	PSA 2D	RISK CATEGORY	NO. INT. OR CATCH (2012-2016)	RISK SCORE FOLLOWING RESIDUAL RISK	FINAL RISK SCORE
25417004	*Thelenota anax*	Amberfish	3	3	3	3	3	1	3	3	3	3	2	2.71	2.71	8	3.83	High	Added from Class Holothuroidea – undifferentia-ted (25400000), OBS: 1.24 kg dis.	3- low interaction/capture level. Risk reduced to low.	Low
25416032	*Holothuria fuscopunctata*	Elephant's trunk fish	3	3	3	3	3	1	3	3	3	3	2	2.71	2.71	8	3.83	High	Added from Class Holothuroidea - undifferentiated (25400000), OBS: 1.24 kg dis.	3- low interaction/capture level. Risk reduced to low.	Low
25416004	*Holothuria scabra*	Sand fish	3	3	3	3	3	1	3	3	3	3	2	2.71	2.71	8	3.83	High	Added from Class Holothuroidea - undifferentiated (25400000), OBS: 1.24 kg dis.	3- low interaction/capture level. Risk reduced to low.	Low
28820013	*Panulirus versicolor*	Painted rocklobster - green cray	1	3	1	1	1	2	3	3	3	3	2	1.71	2.71	3	3.2	High	LOG: 100 kg ret. OBS: 2.55 kg dis.	3- low interaction/capture level. Risk reduced to low.	Low
28820006	*Panulirus ornatus*	Ornate rocklobster	1	3	1	1	1	2	3	3	3	3	2	1.71	2.71	3	3.2	High	OBS: 65 indivduals dis.	3- low interaction/capture level. Risk reduced to low.	Low

CAAB CODE	SCIENTIFIC NAME	COMMON NAME	P1	P2	P3	P4	P5	P6	P7	S1	S2	S3	S4	PROD. SCORE	SUSC. SCORE	MISSING ATTRIB-UTES	PSA 2D	RISK CATEGORY	NO. INT. OR CATCH (2012-2016)	RISK SCORE FOLLOWING RESIDUAL RISK	FINAL RISK SCORE
28051039	*Harpiosquilla stephensoni*	Stephenson's mantis shrimp	1	1	3	1	1	2	3	3	3	3	2	1.71	2.71	4	3.2	High	OBS: 0.66 kg dis. Also Order Stomatopoda – undifferentia-ted (28030000), OBS: 20 individuals dis. Also Squillidae – undifferentia-ted (28051000), OBS:4.4 kg dis (525 individuals dis).	3- low interaction/capture level. Risk reduced to low.	Low
28051030	*Dictyosquilla tuberculata*	Warty mantis shrimp	1	1	3	1	1	2	3	3	3	3	2	1.71	2.71	4	3.2	High	OBS: 0.84 kg dis. Also Order Stomatopoda – undifferentia-ted (28030000), OBS: 20 individuals dis. Also Squillidae – undifferentia-ted (28051000), OBS:4.4 kg dis (525 individuals dis).	3- low interaction/capture level. Risk reduced to low.	Low

CAAB CODE	SCIENTIFIC NAME	COMMON NAME	P1	P2	P3	P4	P5	P6	P7	S1	S2	S3	S4	PROD. SCORE	SUSC. SCORE	MISSING ATTRIB-UTES	PSA 2D	RISK CATEGORY	NO. INT. OR CATCH (2012-2016)	RISK SCORE FOLLOWING RESIDUAL RISK	FINAL RISK SCORE
23607013	*Sepia smithi*	A cuttlefish	1	1	2	1	1	2	3	1	3	3	2	1.57	2.06	0	2.59	Low	NE	No RR required	Low
23607011	*Sepia whitleyana*	Whitley's cuttlefish	1	1	2	1	1	2	3	1	3	3	2	1.57	2.06	1	2.59	Low	NE	No RR required	Low
23607008	*Sepia pharaonis*	Pharaoh cuttlefish	1	1	2	1	1	2	3	1	3	3	2	1.57	2.06	0	2.59	Low	NE	No RR required	Low
23607003	*Sepia elliptica*	Ovalbone cuttlefish	1	1	2	1	1	2	3	1	3	3	2	1.57	2.06	0	2.59	Low	NE	No RR required	Low
23617006	*Sepioteuthis lessoniana*	Northern calamari	1	1	2	1	1	2	2	1	3	3	2	1.43	2.06	0	2.51	Low	NE	No RR required	Low
28911005	*Portunus armatus*	Blue swimmer crab	1	1	1	1	1	3	2	3	3	3	2	1.43	2.71	2	3.06	Medium	NE	No RR required	Medium
28911006	*Portunus sanguinolentus*	Three-spotted crab	1	1	1	1	1	3	2	3	3	3	2	1.43	2.71	2	3.06	Medium	NE	No RR required	Medium
28821008	*Thenus australiensis*	Sandbug	1	1	2	1	1	2	1	3	3	3	2	1.29	2.71	1	3	Medium	NE	No RR required	Medium
23617010	*Uroteuthis noctiluca*	Luminous bay squid	1	1	2	1	1	2	3	3	3	2	2	1.57	2.45	1	2.91	Medium	NE	No RR required	Medium
28714011	*Solenocera australiana*	Coral prawn	1	1	1	1	1	1	1	3	3	3	2	1	2.71	2	2.89	Medium	NE	No RR required	Medium
23270003	*Amusium pleuronectes*	Saucer scallop; mud scallop	1	1	2	1	1	1	3	3	3	2	2	1.43	2.45	2	2.84	Medium	NE	No RR required	Medium
23607007	*Sepia papuensis*	Papuan cuttlefish	1	1	2	1	1	2	3	1	3	2	2	1.57	1.86	0	2.43	Low	NE	No RR required	Low
28786004	*Metanephrops sibogae*	Siboga scampi	1	2	2	1	1	2	3	3	1	2	2	1.71	1.86	2	2.53	Low	NE	No RR required	Low

CAAB CODE	SCIENTIFIC NAME	COMMON NAME	P1	P2	P3	P4	P5	P6	P7	S1	S2	S3	S4	PROD. SCORE	SUSC. SCORE	MISSING ATTRIB-UTES	PSA 2D	RISK CATEGORY	NO. INT. OR CATCH (2012-2016)	RISK SCORE FOLLOWING RESIDUAL RISK	FINAL RISK SCORE
28711003	*Atypopenaeus formosus*	Orange prawn	1	1	3	1	1	1	1	1	3	2	2	1.29	1.86	2	2.26	Low	NE	No RR required	Low
28711031	*Kishinouyepenaeop-sis cornuta*	Coral prawn	1	1	1	1	1	1	1	1	3	2	2	1	1.86	1	2.11	Low	NE	No RR required	Low
28711057	*Megokris gonospinifer*	Rough prawn	1	1	1	1	1	1	1	1	3	2	2	1	1.86	1	2.11	Low	NE	No RR required	Low
28711054	*Trachypenaeus anchoralis*	Northern rough Prawn	1	1	1	1	1	1	1	1	3	2	2	1	1.86	1	2.11	Low	NE	No RR required	Low
28711016	*Metapenaeopsis novaeguineae*	Northern velvet prawn	1	1	1	1	1	1	1	1	1	2	2	1	1.41	0	1.73	Low	NE	No RR required	Low

Risk ranking guidelines:

1	Risk rating due to missing, incorrect or out of date information	4	Effort and catch management arrangements for target and byproduct species
2	At risk due to external factors (cumulative risks)	5	Management arrangements to mitigate against the level of bycatch
3	At risk regarding level of interaction/capture with a zero or negligible level of susceptibility	6	Management arrangements relating to seasonal, spatial and depth closures

e) Protected species

Sawfishes would normally be subject to a bSAFE analysis since they are classified as chondrichthyans. However, their biological characteristics and reference points are uncertain, so a PSA, which is a precautionary method was conducted for the four sawfish species. In addition, a residual risk analysis (RRA) was performed on these sawfish species.

There were 39 protected species assessed in this PSA. Of these species, nine were high risk (one bird, six marine reptiles, two chondrichthyans), 29 medium risk (12 marine birds, 15 marine reptiles, two chondricthyans) and one species low risk (one marine bird) (Table 2.27; Figure 2.12a, b). A residual risk analysis was performed on the nine high risk species (one marine bird, six marine reptiles, two chondrichthyans). Of the nine high risk species, two species remained high risk (narrow sawfish *Anoxypristis cuspidata*; dwarf sawfish *Pristis clavata*), six species were reduced to medium risk and one species was reduced to low risk (Crested tern, *Thalasseus bergii*), following a residual risk analysis.

In addition, the overall risk score for the remaining two sawfish species was increased from medium to a precautionary high risk following a residual risk analysis. These species were green sawfish (*Pristis zijsron*) and freshwater sawfish (*Pristis pristis*).

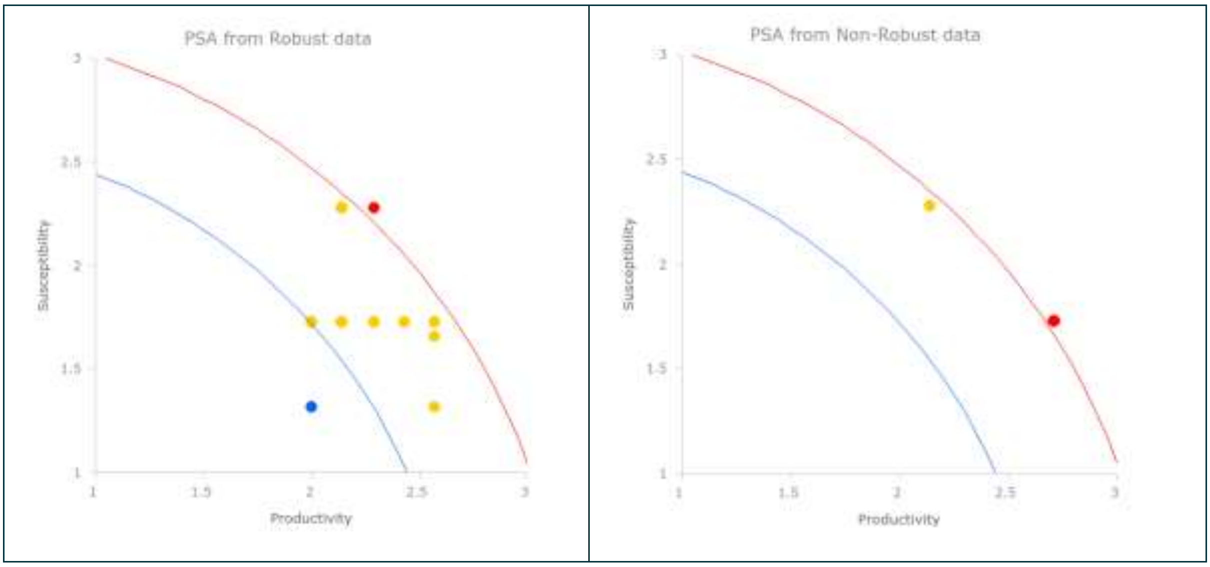

Figure 2.12. PSA plot for protected species in the NPF Banana Prawn sub-fishery for (a) robust [left] and (b) data deficient [right] species. Note many species fall on some points.

Table 2.27. Summary of the PSA scores on the set of productivity and susceptibility attributes for protected species and residual risk (RR) for high risk species. Note: residual risk analyses were not examined for this sub-fishery, if the overall risk score was not high. Productivity attributes (P1-P7) are listed in Table 2.28 (in report). Susceptibility attributes (S1-S4) are listed in Susceptibility attributes
Table 2.29 (in report). Missing attributes are highlighted (red). Productivity score (Prod. score); Susceptibility score (Susc. score). No. interactions (No. Int. 2012-2016) reported for high risk scores only (source: Commonwealth logbook (LOG) and observer (OBS) databases). Residual risk guidelines drawn from document "Revision of residual risk guidelines to reflect updated Ecological Risk Assessment Methodology – version Oct 12, 2016. See numbers at the foot of this table. Ret: retained. Dis: Discarded; NE: not entered. A: alive; D: dead; U: unknown. NPFM: Northern Prawn Fishing Monitoring; CMO: Crew Member Observer data.

CAAB CODE	SCIENTIFIC NAME	COMMON NAME	P1	P2	P3	P4	P5	P6	P7	S1	S2	S3	S4	PROD. SCORE	SUSC. SCORE	MISSING ATTRIB-UTES	PSA 2D	RISK CATEGORY	NO. INT. (2012-2016) AND OTHER INFORMATION	RISK SCORE FOLLOWING RESIDUAL RISK	FINAL RISK SCORE
40128025	*Thalasseus bergii*	Crested tern	1	3	3	1	2	3	3	3	1	3	3	2.29	2.28	2	3.23	High	Added from Terns (40128000), OBS: 0.11 kg dis (2 birds)	3- low interaction/capture level. Risk reduced to low.	Low
39125001	*Acalyptophis peronii*	Horned sea snake	3	3	3	2	2	3	3	1	3	1	3	2.71	1.73	3	3.22	High	OBS: 1 individual dis. (alive). Also Hydrophiidae, Subfamily: Hydrophiinae, (39125000): LOG: 6704 sea snakes (5270 A; 1434 D). OBS: 5 kg dis.	Distribution: North Australia to Taiwan. Distributed across the top and mid-west and east coasts of Australia (Cogger 1992). There are no estimates of population size. Standardized CPUE unavailable within assessment period. Low fecundity: 3 – 6 young per litter however young occur in shallower waters and not on trawl grounds (Fry et al 2001).	Medium

CAAB CODE	SCIENTIFIC NAME	COMMON NAME	P1	P2	P3	P4	P5	P6	P7	S1	S2	S3	S4	PROD. SCORE	SUSC. SCORE	MISSING ATTRIB-UTES	PSA 2D	RISK CATEGORY	NO. INT. (2012-2016) AND OTHER INFORMATION	RISK SCORE FOLLOWING RESIDUAL RISK	FINAL RISK SCORE
																				Post capture survival rates from trawling between 77-90% based on Crew Member Scientific surveys in the NPF. TED and BRDs are used in this fishery. There may be more animals of this species caught which has been attributed to 39125000. Therefore, risk reduced to medium.	
39125033	*Pelamis platurus*	Yellow-bellied sea snake	3	3	3	2	2	3	3	1	3	1	3	2.71	1.73	3	3.22	High	OBS: 1 individual dis. (A). Also Hydrophiidae, Subfamily: Hydrophiinae, (39125000): LOG: 6704 sea snakes (5270 A; 1434 D). OBS: 5 kg dis.	Population trend is considered stable, but unknown (https://www.iucnredlist.org/species/176738/115883818). Distribution: widely distributed from east coast of Africa, through Indian and Pacific Oceans, to west coast of Americas. Distribution pattern within Australia ranges from the south west northwards to south east coast, including within GoC (Cogger	Medium

CAAB CODE	SCIENTIFIC NAME	COMMON NAME	P1	P2	P3	P4	P5	P6	P7	S1	S2	S3	S4	PROD. SCORE	SUSC. SCORE	MISSING ATTRIB-UTES	PSA 2D	RISK CATEGORY	NO. INT. (2012-2016) AND OTHER INFORMATION	RISK SCORE FOLLOWING RESIDUAL RISK	FINAL RISK SCORE
																				1992, Milton et al. 2008). Standardized CPUE unavailable within assessment period. Post capture survival rates from trawling are highly uncertain due to low sample sizes (~18% - 50%), from Crew Member Scientific surveys in the NPF. TED and BRDs are used in this fishery. Limited species distribution overlap with the fishery operations. There may be more animals of this species caught which has been attributed to 39125000. Therefore, risk reduced to medium.	
39125011	*Disteira major*	Olive-headed sea snake	3	3	3	2	2	3	3	1	3	1	3	2.71	1.73	3	3.22	High	OBS: 6.95 kg dis. (29 individuals dis; 16 A, 10 D, 3 U). Also Hydrophiidae, Subfamily: Hydrophiinae,	Population trend is unknown. Overall flat standardized CPUE trend within assessment period (accounting for 95% C.Is (Fry et al. 2018).	Medium

CAAB CODE	SCIENTIFIC NAME	COMMON NAME	P1	P2	P3	P4	P5	P6	P7	S1	S2	S3	S4	PROD. SCORE	SUSC. SCORE	MISSING ATTRIB-UTES	PSA 2D	RISK CATEGORY	NO. INT. (2012-2016) AND OTHER INFORMATION	RISK SCORE FOLLOWING RESIDUAL RISK	FINAL RISK SCORE
																			(39125000): LOG: 6704 sea snakes (5270 A; 1434 D). OBS: 5 kg dis.	Distribution: coastal waters of northern Australia from north-western WA and the Arafura Sea to eastern Qld, widely distributed within GoC (Cogger 1992, Milton et al. 2008). Commonly caught in the NPF (GoC). https://www.iucnredlist.org/species/176729/7292011 Low fecundity: 5 young per litter however young occur in shallower waters and not on trawl grounds (Fry et al 2001). Post capture survival rates from trawling are high (68% - 77%), from Crew Member Scientific surveys in the NPF. TED and BRDs are used in this fishery. There may be more animals of this species caught which has been attributed to 39125000.	

CAAB CODE	SCIENTIFIC NAME	COMMON NAME	P1	P2	P3	P4	P5	P6	P7	S1	S2	S3	S4	PROD. SCORE	SUSC. SCORE	MISSING ATTRIB-UTES	PSA 2D	RISK CATEGORY	NO. INT. (2012-2016) AND OTHER INFORMATION	RISK SCORE FOLLOWING RESIDUAL RISK	FINAL RISK SCORE
																				Widely distributed outside of fishery, relatively high post trawl survival rates and flat standardized CPUE. Therefore, risk reduced to medium.	
39125010	*Disteira kingii*	Spectacled sea snake	3	3	3	2	2	3	3	1	3	1	3	2.71	1.73	3	3.22	High	OBS: 1 kg dis. (2 individuals dis; 3 A). Also Hydrophiidae, Subfamily: Hydrophiinae, (39125000): LOG: 6704 sea snakes (5270 A; 1434 D). OBS: 5 kg dis.	Distribution: confined to the tropical coastal waters northern Australia from WA to the eastern coast of Qld (Cogger 1992). Population trend is unknown. Restricted distribution in GoC (Milton et al 2008) and considered rare in trawl catches. Catch rates (0.075 – 0.336 snakes/ha) from surveys in the GoC (Milton et al. 2008). Standardized CPUE higher in shallower waters (Milton et al. 2008). Species distribution in GoC overlaps fishery effort.	Medium

CAAB CODE	SCIENTIFIC NAME	COMMON NAME	P1	P2	P3	P4	P5	P6	P7	S1	S2	S3	S4	PROD. SCORE	SUSC. SCORE	MISSING ATTRIB-UTES	PSA 2D	RISK CATEGORY	NO. INT. (2012-2016) AND OTHER INFORMATION	RISK SCORE FOLLOWING RESIDUAL RISK	FINAL RISK SCORE
																				Standardized CPUE unavailable within assessment period. Low fecundity: 4 – 6 young per litter however young occur in shallower waters and not on trawl grounds (Fry et al 2001). Post capture survival rates from trawling are relatively high, but uncertain, due to low sample sizes (67% - 75% within assessment period), from Crew Member Scientific surveys in the NPF. TED and BRDs are used in this fishery. There may be more animals of this species caught which has been attributed to 39125000. Risk reduced to medium.	
39125009	*Astrotia stokesii*	Stokes' sea snake	3	3	3	2	2	3	3	1	3	1	3	2.71	1.73	3	3.22	High	OBS: 1 kg dis. (3 individuals dis; 3 A).	Distribution: coastal and shelf waters of tropical Australia and Australasia, including New	Medium

CAAB CODE	SCIENTIFIC NAME	COMMON NAME	P1	P2	P3	P4	P5	P6	P7	S1	S2	S3	S4	PROD. SCORE	SUSC. SCORE	MISSING ATTRIB-UTES	PSA 2D	RISK CATEGORY	NO. INT. (2012-2016) AND OTHER INFORMATION	RISK SCORE FOLLOWING RESIDUAL RISK	FINAL RISK SCORE
																			Also Hydrophiidae, Subfamily: Hydrophiinae, (39125000): LOG: 6704 sea snakes (5270 A; 1434 D). OBS: 5 kg dis.	Guinea and south-east Asian waters (Cogger 1992). Population trend is unknown. Overall flat standardized CPUE trend within assessment period (accounting for 95% C.I's (Fry et al. 2018), but apparent increase since 2010. This species is considered relatively common in this fishery (https://www.iucnredlist.org/species/176708/136257093). Low to medium fecundity: 8 – 12 young per litter however young occur in shallower waters and not on trawl grounds (Fry et al 2001). There may be more animals of this species caught which has been attributed to 39125000.	

CAAB CODE	SCIENTIFIC NAME	COMMON NAME	P1	P2	P3	P4	P5	P6	P7	S1	S2	S3	S4	PROD. SCORE	SUSC. SCORE	MISSING ATTRIB-UTES	PSA 2D	RISK CATEGORY	NO. INT. (2012-2016) AND OTHER INFORMATION	RISK SCORE FOLLOWING RESIDUAL RISK	FINAL RISK SCORE
																				Post capture survival rates from trawling are high (86% - 89% within assessment period), from Crew Member Scientific surveys in the NPF. TED and BRDs are used in this fishery. Therefore, risk rediced to medium.	
39125012	*Emydocephalus annulatus*	Turtle-headed sea snake	1	3	3	1	2	3	3	3	3	1	3	2.29	2.28	4	3.23	High	OBS: 2 individuals alive; 1 individual dead. Also Hydrophiidae, Subfamily: Hydrophiinae, (39125000): LOG: 6704 sea snakes (5270 A; 1434 D). OBS: 5 kg dis.	Distribution: This species, as currently described, is found in the waters of tropical Australia from the Timor Sea to the southwestern Pacific Ocean. Not found in the GoC. Depth: mostly <15 m. There are no estimates of population size. There is limited gene flow between populations of this species on the east and west coasts of Australia (Lukoschek and Keogh 2006), suggesting that populations are unlikely to recover from local	Medium

CAAB CODE	SCIENTIFIC NAME	COMMON NAME	P1	P2	P3	P4	P5	P6	P7	S1	S2	S3	S4	PROD. SCORE	SUSC. SCORE	MISSING ATTRIB-UTES	PSA 2D	RISK CATEGORY	NO. INT. (2012-2016) AND OTHER INFORMATION	RISK SCORE FOLLOWING RESIDUAL RISK	FINAL RISK SCORE
																				extinctions by dispersal. Standardized CPUE unavailable within assessment period. TED and BRDs are used in this fishery. There may be more animals of this species caught which has been attributed to 39125000. Species unlikely to be widely distributed within the prawn trawl grounds. Therefore, risk reduced to medium.	
40128006	*Chlidonias hybrida*	Whiskered tern	2	2	3	1	1	3	3	3	1	3	3	2.14	2.28	2	3.13	Medium	NE	No RR required	Medium
40128031	*Gelochelidon nilotica*	Gull-billed tern	2	2	3	1	1	3	3	3	1	3	3	2.14	2.28	2	3.13	Medium	NE	No RR required	Medium
40128029	*Sterna hirundo*	Common tern	1	3	3	1	1	3	3	3	1	3	3	2.14	2.28	2	3.13	Medium	NE	No RR required	Medium
40128028	*Onychoprion fuscatus*	Sooty tern	1	3	3	1	1	3	3	3	1	3	3	2.14	2.28	2	3.13	Medium	NE	No RR required	Medium
40128007	*Chlidonias leucopterus*	White-winged black tern	1	3	3	1	1	3	3	3	1	3	3	2.14	2.28	3	3.13	Medium	NE	No RR required	Medium

CAAB CODE	SCIENTIFIC NAME	COMMON NAME	P1	P2	P3	P4	P5	P6	P7	S1	S2	S3	S4	PROD. SCORE	SUSC. SCORE	MISSING ATTRIB-UTES	PSA 2D	RISK CATEGORY	NO. INT. (2012-2016) AND OTHER INFORMATION	RISK SCORE FOLLOWING RESIDUAL RISK	FINAL RISK SCORE
39020001	*Caretta caretta*	Loggerhead turtle	3	3	2	2	2	3	3	1	3	1	3	2.57	1.73	1	3.1	Medium	NE	No RR required	Medium
39020002	*Chelonia mydas*	Green turtle	3	3	2	2	2	3	3	1	3	1	3	2.57	1.73	1	3.1	Medium	NE	No RR required	Medium
39020004	*Lepidochelys olivacea*	Olive ridley turtle	3	3	3	1	2	3	3	1	2.55	1	3	2.57	1.66	1	3.06	Medium	NE	No RR required	Medium
39020003	*Eretmochelys imbricata*	Hawksbill turtle	3	3	2	1	2	3	3	1	3	1	3	2.43	1.73	1	2.98	Medium	NE	No RR required	Medium
39020005	*Natator depressus*	Flatback turtle	2	3	3	1	2	3	3	1	3	1	3	2.43	1.73	2	2.98	Medium	NE	No RR required	Medium
39021001	*Dermochelys coriacea*	Leatherback turtle	3	3	2	2	2	3	3	1	1	1	3	2.57	1.32	1	2.89	Medium	NE	No RR required	Medium
39125003	*Aipysurus duboisii*	Reef shallows sea snake	1	2	3	2	2	3	3	1	3	1	3	2.29	1.73	1	2.87	Medium	NE	No RR required	Medium
40128026	*Hydroprogne caspia*	Caspian tern	1	3	3	1	2	3	3	1	1	3	3	2.29	1.73	1	2.87	Medium	NE	No RR required	Medium
39125007	*Aipysurus laevis*	Golden sea snake	1	2	3	2	2	3	3	1	3	1	3	2.29	1.73	1	2.87	Medium	NE	No RR required	Medium
39125004	*Aipysurus mosaicus*	Stagger-banded sea snake	1	2	3	1	2	3	3	1	3	1	3	2.14	1.73	1	2.75	Medium	NE	No RR required	Medium
40128002	*Anous stolidus*	Common noddy	1	3	3	1	1	3	3	1	1	3	3	2.14	1.73	1	2.75	Medium	NE	No RR required	Medium
39125031	*Lapemis curtis*	Spine-bellied sea snake	1	1	3	2	2	3	3	1	3	1	3	2.14	1.73	1	2.75	Medium	NE	No RR required	Medium
39125029	*Hydrophis pacificus*	Large-headed sea snake	1	1	3	2	2	3	3	1	3	1	3	2.14	1.73	1	2.75	Medium	NE	No RR required	Medium
39125028	*Hydrophis ornatus*	Spotted sea snake	1	1	3	2	2	3	3	1	3	1	3	2.14	1.73	1	2.75	Medium	NE	No RR required	Medium

CAAB CODE	SCIENTIFIC NAME	COMMON NAME	P1	P2	P3	P4	P5	P6	P7	S1	S2	S3	S4	PROD. SCORE	SUSC. SCORE	MISSING ATTRIB-UTES	PSA 2D	RISK CATEGORY	NO. INT. (2012-2016) AND OTHER INFORMATION	RISK SCORE FOLLOWING RESIDUAL RISK	FINAL RISK SCORE
39125013	*Enhydrina schistosa*	Beaked sea snake	1	1	3	2	2	3	3	1	3	1	3	2.14	1.73	0	2.75	Medium	NE	No RR required	Medium
39125021	*Hydrophis elegans*	Elegant sea snake	1	1	3	2	2	3	3	1	3	1	3	2.14	1.73	1	2.75	Medium	NE	No RR required	Medium
39125025	*Hydrophis mcdowelli*	Small-headed sea snake	1	1	3	1	2	3	3	1	3	1	3	2	1.73	1	2.64	Medium	NE	No RR required	Medium
40128034	*Sterna sumatrana*	Black-naped tern	1	2	3	1	1	3	3	1	1	3	3	2	1.73	1	2.64	Medium	NE	No RR required	Medium
40128027	*Sterna dougallii*	Roseate tern	1	2	3	1	1	3	3	1	1	3	3	2	1.73	1	2.64	Medium	NE	No RR required	Medium
40128024	*Thalasseus bengalensis*	Lesser crested tern	1	2	3	1	1	3	3	1	1	3	3	2	1.73	1	2.64	Medium	NE	No RR required	Medium
40128023	*Onychoprion anaethetus*	Bridled tern	1	2	3	1	1	3	3	1	1	3	3	2	1.73	1	2.64	Medium	NE	No RR required	Medium
40042004	*Oceanites oceanicus*	Wilson's storm-petrel	1	2	3	1	1	3	3	1	1	3	3	2	1.73	1	2.64	Medium	NE	No RR required	Medium
40128013	*Chroicocephalus novaehollandiae*	Silver gull	1	2	3	1	1	3	3	1	1	1	3	2	1.32	1	2.4	Low	NE	No RR required	Low
A PSA was conducted on the following four sawfish species:																					
37025002	*Anoxypristis cuspidata*	Narrow sawfish	2	3	3	3	3	3	3	1	3	1	3	2.86	1.73	0	3.34	High	217 [165 A; 52 D]. Also, an unknown proportion of Pristidae, sawfishes – unidentified: 812 [593 A; 219 D]	Sawfish appear to have a high entanglement rate in trawl nets and escapement rates of sawfish from trawl nets through TED openings are currently unknown.	High

CAAB CODE	SCIENTIFIC NAME	COMMON NAME	P1	P2	P3	P4	P5	P6	P7	S1	S2	S3	S4	PROD. SCORE	SUSC. SCORE	MISSING ATTRIB-UTES	PSA 2D	RISK CATEGORY	NO. INT. (2012-2016) AND OTHER INFORMATION	RISK SCORE FOLLOWING RESIDUAL RISK	FINAL RISK SCORE
																				Post-release survival rates of sawfish are currently unknown. However, post capture mortality is high (88%) in nearby areas (east coast inshore Finfish fishery; Tobin et al. 2010). The catch per unit effort (CPUE) trend between 2013-16 for Narrow Sawfish and Pristidae combined, is flat based on survey data (Fry et al. 2018). In Australia, this species is listed as migratory (EPBC Act) and critically endangered elsewhere (IUCN Redlist). The presence of distinct sub-populations suggests that if local depletion occurs, it would not be replenished by adjacent locations (i.e. between eastern and western	

CAAB CODE	SCIENTIFIC NAME	COMMON NAME	P1	P2	P3	P4	P5	P6	P7	S1	S2	S3	S4	PROD. SCORE	SUSC. SCORE	MISSING ATTRIB-UTES	PSA 2D	RISK CATEGORY	NO. INT. (2012-2016) AND OTHER INFORMATION	RISK SCORE FOLLOWING RESIDUAL RISK	FINAL RISK SCORE
																				part of range; D'Anastasi 2010). The risk score remains High.	
37025004	*Pristis clavata*	Dwarf sawfish	2	3	3	3	3	3	3	1	2.63	1	3	2.86	1.68	0	3.31	High	35 [25 A; 10 D]. Also, an unknown proportion of Pristidae, sawfishes – unidentified: 812 [593 A; 219 D]	Sawfish appear to have a high entanglement rate in trawl nets and escapement rates of sawfish from trawl nets through TED openings are currently unknown. Post-release survival rates of sawfish are currently unknown. This species has low biological productivity, matures at 8 years, and is long lived (34 years; Peverell 2009). In Australia, this species is listed as vulnerable (EPBC Act) and critically endangered elsewhere (IUCN Redlist). No population estimates are available, and this species occurs now	High

CAAB CODE	SCIENTIFIC NAME	COMMON NAME	P1	P2	P3	P4	P5	P6	P7	S1	S2	S3	S4	PROD. SCORE	SUSC. SCORE	MISSING ATTRIB-UTES	PSA 2D	RISK CATEGORY	NO. INT. (2012-2016) AND OTHER INFORMATION	RISK SCORE FOLLOWING RESIDUAL RISK	FINAL RISK SCORE
																				only in Australia, as there have been no records elsewhere in the world for more than a century (https://www.iucnssg.org/regional-fast-facts-australia.html). Also, trends in catch-per-unit-effort (CPUE) are based on too few data points and only one within the assessment period (2013; Fry et al., 2018). This species has the smallest distribution of any sawfish species in Australia. There may be local refuges where commercial fishing does not occur, but given there are no verified population estimates, and unknown PCS rates, the risk remains High.	
37025001	*Pristis zijsron*	Green sawfish	2	3	3	3	3	3	3	1	1	1	3	2.86	1.32	0	3.15	Medium	107 [71 A; 36 D]. Also, an unknown proportion of Pristidae, sawfishes –	Sawfish appear to have a high entanglement rate in trawl nets and escapement rates of sawfish from trawl nets through TED	High

CAAB CODE	SCIENTIFIC NAME	COMMON NAME	P1	P2	P3	P4	P5	P6	P7	S1	S2	S3	S4	PROD. SCORE	SUSC. SCORE	MISSING ATTRIB-UTES	PSA 2D	RISK CATEGORY	NO. INT. (2012-2016) AND OTHER INFORMATION	RISK SCORE FOLLOWING RESIDUAL RISK	FINAL RISK SCORE
																			unidentified: 812 [593 A; 219 D]	openings are currently unknown. Post-release survival rates of sawfish are currently unknown. However, post capture mortality is high (100%) in nearby areas (east coast inshore Finfish fishery; Tobin et al 2010). No population estimates are available. Also, trends in catch-per-unit-effort (CPUE) are based on too few data points and only one within the assessment period (2013; Fry et al., 2018). This species is long lived (>50 years), grows slowly, matures late (9 years; and has low fecundity (Peverell 2009). In Australia, this species is listed as vulnerable (EPBC Act) and critically	

CAAB CODE	SCIENTIFIC NAME	COMMON NAME	P1	P2	P3	P4	P5	P6	P7	S1	S2	S3	S4	PROD. SCORE	SUSC. SCORE	MISSING ATTRIB-UTES	PSA 2D	RISK CATEGORY	NO. INT. (2012-2016) AND OTHER INFORMATION	RISK SCORE FOLLOWING RESIDUAL RISK	FINAL RISK SCORE
																				endangered elsewhere (IUCN Redlist). This species is listed as vulnerable, it has low biological productivity, no available population estimates in northern Australia or trends in CPUE are available, vulnerable to capture by trawl nets and have 100% PCM estimates. Therefore, the risk has been changed to a (precautionary) High.	
37025003	*Pristis pristis*	Freshwater sawfish	2	3	3	3	3	3	3	1	1	1	3	2.86	1.32	0	3.15	Medium	12 [12 A; 0 D]. Also, an unknown proportion of Pristidae, sawfishes – unidentified: 812 [593 A; 219 D]	Sawfish appear to have a high entanglement rate in trawl nets and escapement rates of sawfish from trawl nets through TED openings are currently unknown. Post-release survival rates of sawfish are currently unknown. This species is long lived (44 years), grows slowly, matures late (8-10	High

CAAB CODE	SCIENTIFIC NAME	COMMON NAME	P1	P2	P3	P4	P5	P6	P7	S1	S2	S3	S4	PROD. SCORE	SUSC. SCORE	MISSING ATTRIB-UTES	PSA 2D	RISK CATEGORY	NO. INT. (2012-2016) AND OTHER INFORMATION	RISK SCORE FOLLOWING RESIDUAL RISK	FINAL RISK SCORE
																				years; and has low fecundity (Peverell 2009). In Australia, this species is listed as vulnerable (EPBC Act) and critically endangered elsewhere (IUCN Redlist). This species is listed as vulnerable, it has low biological productivity, no population abundance estimates in northern Australia or trends in CPUE are available and are highly vulnerable to capture by trawl nets. Therefore, the risk has been changed to (precautionary) High.	

Risk ranking guidelines:

1	Risk rating due to missing, incorrect or out of date information	4	Effort and catch management arrangements for target and byproduct species
2	At risk due to external factors (cumulative risks)	5	Management arrangements to mitigate against the level of bycatch
3	At risk regarding level of interaction/capture with a zero or negligible level of susceptibility	6	Management arrangements relating to seasonal, spatial and depth closures

Productivity attributes

Table 2.28. Productivity attribute names and cutoff scores for the ERAF L2 PSA method. These cutoffs have been determined from analysis of the distribution of attribute values for species in the ERAF database, and are intended to divide the attribute values into low, medium and high productivity categories.

ATTRIBUTE NUMBER	ATTRIBUTE NAME	LOW PRODUCTIVITY (RISK SCORE: 3)	MEDIUM PRODUCTIVITY (RISK SCORE: 2)	HIGH PRODUCTIVITY (RISK SCORE: 1)
P1	Average age at maturity	> 15 years	5 – 15 years	< 5 years
P2	Average max age	> 25 years	10-25 years	< 10 years
P3	Fecundity	< 100 eggs per years	100-20,000 eggs per year	> 20,000 eggs per year
P4	Average max size	> 300 cm	100-300 cm	< 100 cm
P5	Average size at Maturity	> 200 cm	40-200 cm	< 40 cm
P6	Reproductive strategy	Taxa is “Marine bird" or "Marine mammal"	Family is : "Syngnathidae" or "Solenostomidae" Or Reproductive Strategy is: “Demersal Spawner” Or “Brooder”	Reproductive Strategy is “Broadcast Spawner”
P7	Trophic level	> 3.25	2.75-3.25	< 2.75

Susceptibility attributes

Table 2.29. Susceptibility attribute names and cutoff scores for the ERAF L2 PSA method. These cutoffs have been determined from analysis of the distribution of attribute values for species in the ERAF database, and are intended to divide the attribute values into low, medium and high susceptibility categories.

ATTRIBUTE NUMBER	ATTRIBUTE NAME	LOW SUSCEPTIBILITY (RISK SCORE: 1)	MEDIUM SUSCEPTIBILITY (RISK SCORE: 2)	HIGH SUSCEPTIBILITY (RISK SCORE: 3)
S1	Availability	< 10% overlap	Continuous [1,3]	> 30% overlap
S2	Encounterability (habitat and bathymetry based)	Fishery Specific	Fishery Specific	Fishery Specific
S3	Selectivity (size based)	Fishery Specific	Fishery Specific	Fishery Specific
S4	Post-Capture Mortality (role in fishery based, protected Species based)	Some Protected (Live)	Byproduct or bycatch Some protected (generally alive)	Key or secondary commercial Some protected (likely to be dead)

Post Capture Mortality

The following rules were used to assign a risk score to Post Capture Mortality (PCM), based on each species ERAEF classification (see also Table 2.30):

- Commercial, secondary commercial, commercial bait, or byproduct species: score is 3.
- Bycatch species: score is 2
- Protected species (which are discarded), PCM is based on taxa, i.e.,
    - marine birds and marine reptiles: score is 3
    - marine mammals and chondricthyans: score is 2
    - syngnathids: score is 1

Table 2.30. Post capture mortality attribute risk score for the Banana Prawn sub-fishery for the ERAEF L2 PSA and bSAFE methods. High: H; M: medium; Low: L. Risk scores that are not assigned by taxa (not specific) for each ERAEF classification are shaded.

ROLE IN FISHERY	TAXA	RATIONALE		RISK CATEGORY	RISK SCORE
Key commercial	Not specific	Retained, therefore dead		H	3
Secondary commercial	Not specific	Retained, therefore dead		H	3
Commercial bait	Not specific	Retained, therefore dead		H	3
Byproduct	Not specific	Retained, therefore dead		H	3
Bycatch	Not specific	Discarded alive or dead		M	2
Protected Species	Marine birds	Long duration set, if caught, highly likely to drown		H	3
	Marine reptiles	Long duration set, if caught, highly likely to drown		H	3
	Marine mammals	Large enough/strong swimming to have a chance of survival		M	2
	Chondrichthyans	Large enough/strong swimming to have a chance of survival		M	2
	All others e.g. syngnathids, invertebrates (if any)	Likely to survive		L	1

2.4.5 Uncertainty analysis ranking of overall risk (Step 5)

The final PSA result for a species is obtained by ranking overall risk value resulting from scoring the productivity and susceptibility attributes. Uncertainty in the PSA results can arise when there is imprecise, incorrect or missing data, where an average for a higher taxonomic unit was used (e.g. average genera value for species units), or because an inappropriate attribute was included. The number of missing attributes, and hence conservative scores, is tallied for each unit of analysis. Units with missing scores will have a more conservative overall risk value than those species with fewer missing attributes, as the highest score for the attribute is used in the absence of data. Gathering the information to allow the attribute to be scored may reduce the overall risk value. Identification of high-risk units with missing attribute information should translate into prioritisation of additional research (an alternative strategy).

A second measure of uncertainty is due to the selection of the attributes. The influence of particular attributes on the final result for a unit of analysis (e.g. a habitat unit) can be quantified with an uncertainty analysis, using a Monte Carlo resampling technique. A set of productivity and susceptibility scores for each unit is calculated by removing one of the productivity or susceptibility attributes at a time, until all attribute combinations have been used. The variation (standard deviation) in the productivity and susceptibility scores is a measure of the uncertainty in the overall PSA score. If the uncertainty analysis shows that the unit would be treated differently with regard to risk, it should be the subject of more study.

The validity of the ranking can also be examined by comparing the results with those from other data sources or modelling approaches that have already been undertaken in specific fisheries. For example, the PSA results of the individual species (target, byproduct and bycatch and protected) can be compared against catch rates for any species or against completed stock assessments. These comparisons will show whether the PSA ranking agrees with these other sources of information or more rigorous approaches.

2.5 bSAFE results and discussion

Each of the reference points (MSM, LIM, and CRASH) were evaluated. If the biological reference point mean was higher than the estimated F attributed to this sub-fishery, then the species was categorised as ‘Below’. When the biological reference point mean was lower than the estimated F attributed to the sub-fishery, then the species was categorised as ‘Above’ for that species and reference point measure. The overall risk is a summary of the three reference point measures (Table 2.31). If all reference points are categorised as ‘Below’, then the overall risk is low.

Table 2.31 Overall risk summary against each of the three reference point measures.

MSM	LIM	CRASH	OVERALL RISK
Below	Below	Below	Low
Above	Below	Below	Medium
Above	Above	Below	High
Above	Above	Above	Extreme

2.5.1 bSAFE – Key/secondary commercial species

Under the revised ERAEF (AFMA 2017), key commercial species that undergo Tier stock assessments are not assessed at Level 2.

2.5.2 bSAFE - Commercial bait species

There were no commercial bait species in this sub-fishery.

2.5.3 bSAFE - Byproduct species

There were no byproduct species considered in this SAFE. Instead, they were assessed in a PSA (all invertebrate species).

2.5.4 bSAFE - Bycatch species

There were 264 bycatch species considered in this SAFE (Figure 2.13a, b). Thirty species were un-assessable due to missing biological attributes employed in the SAFE method (Table 2.32, classified as NA: un-assessable). A PSA was conducted on these 30 species (Table 2.27). Of the remaining species, none were extreme, high, or medium risk and 234 species were low risk (Table 2.32).

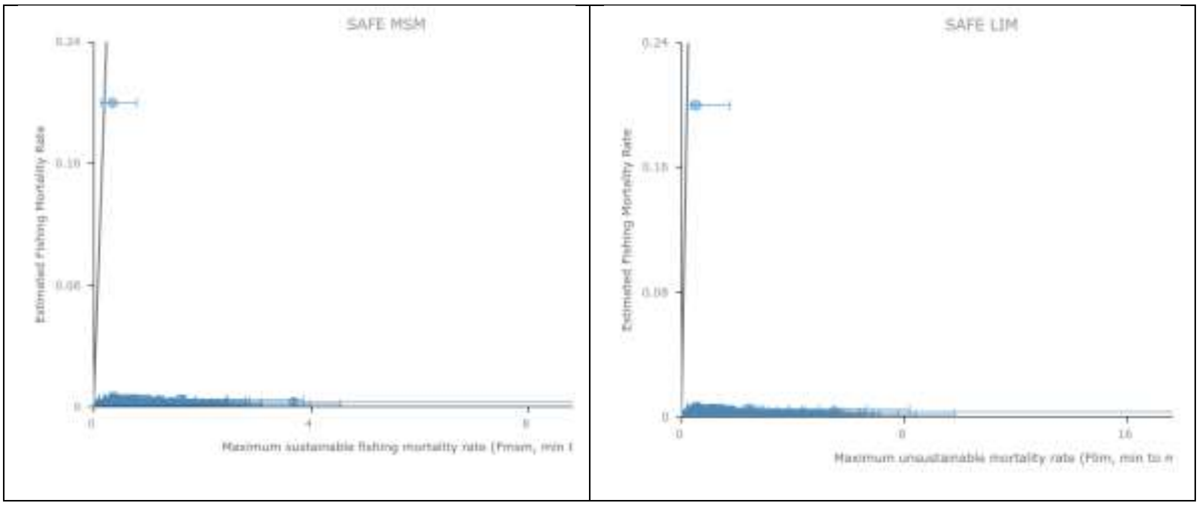

Figure 2.13. SAFE plot for Bycatch species in the NPF Banana Prawn sub-fishery for (a) SAFE-MSM reference point [left] and (b) SAFE limit (LIM) reference point [right].

Table 2.32. bSAFE risk categories for bycatch species ecological component for F_MSM, F_Lim and F_crash. Note: a residual risk analysis was not examined for this sub-fishery, if the risk score was medium or low. Catch from Commonwealth logbook (LOG) and observer (OBS) databases. Residual risk guidelines drawn from document "Revision of residual risk guidelines to reflect updated Ecological Risk Assessment Methodology – version Oct 12, 2016. See numbers at the foot of this table. R: retained. NE: not entered. NA: not assessable.

CAAB CODE	SCIENTIFIC NAME	COMMON NAME	SUSCEPT-IBILITY	F MSM	F MSM RISK	F Lim	F Lim RISK	F CRASH	F CRASH RISK	F OVERALL RISK	CATCH (2012-2016) AND OTHER INFORM-ATION	RISK SCORE FOLLOWING RESIDUAL RISK	FINAL RISK SCORE
The following 30 species have been analysed in the PSA (see Table 2.25):													
37013008	*Chiloscyllium punctatum*	Brownbanded bambooshark	0.001	-	NA	-	NA	-	NA	NA	-	-	see Table 2.26
37466019	*Ostracion meleagris*	Black boxfish	0.005	-	NA	-	NA	-	NA	NA	-	-	see Table 2.26
37466005	*Ostracion nasus* (synonym: *Rhynchostracion nasus*)	Shortnose boxfish	0.002	-	NA	-	NA	-	NA	NA	-	-	see Table 2.26
37464009	*Triacanthus nieuhofi*	Silver tripodfish	0.001	-	NA	-	NA	-	NA	NA	-	-	see Table 2.26
37464008	*Pseudotriacanthus strigilifer*	Blotched tripodfish	0.003	-	NA	-	NA	-	NA	NA	-	-	see Table 2.26
37438005	*Siganus javus*	Java rabbitfish	0.005	-	NA	-	NA	-	NA	NA	-	-	see Table 2.26
37381010	*Valamugil buchanani*	Bluetail mullet	0.002	-	NA	-	NA	-	NA	NA	-	-	see Table 2.26
37364001	*Rhinoprenes pentanemus*	Threadfin scat	0.002	-	NA	-	NA	-	NA	NA	-	-	see Table 2.26
37362004	*Platax teira*	Longfin batfish	0.002	-	NA	-	NA	-	NA	NA	-	-	see Table 2.26
37362003	*Zabidius novemaculeatus*	Shortfin batfish	0.003	-	NA	-	NA	-	NA	NA	-	-	see Table 2.26
37355031	*Upeneus vittatus*	Striped goatfish	0.003	-	NA	-	NA	-	NA	NA	-	-	see Table 2.26
37341006	*Deveximentum insidiator* (synonym: *Secutor insidiator*)	Pugnose ponyfish	0.002	-	NA	-	NA	-	NA	NA	-	-	see Table 2.26
37336002	*Remora remora*	Shark sucker	0.001	-	NA	-	NA	-	NA	NA	-	-	see Table 2.26
37336001	*Echeneis naucrates*	Live sharksucker	0.001	-	NA	-	NA	-	NA	NA	-	-	see Table 2.26
37309002	*Pegasus volitans*	Longtail seamouth	0.002	-	NA	-	NA	-	NA	NA	-	-	see Table 2.26
37290004	*Adventor elongatus*	Sandpaper velvetfish	0.002	-	NA	-	NA	-	NA	NA	-	-	see Table 2.26

CAAB CODE	SCIENTIFIC NAME	COMMON NAME	SUSCEPT-IBILITY	F MSM	F MSM RISK	F Lim	F Lim RISK	F CRASH	F CRASH RISK	F OVERALL RISK	CATCH (2012-2016) AND OTHER INFORM-ATION	RISK SCORE FOLLOWING RESIDUAL RISK	FINAL RISK SCORE
37287089	*Synanceia verrucosa*	Reef stonefish	0.001	-	NA	-	NA	-	NA	NA	-	-	see Table 2.26
37287033	*Apistops caloundra*	Shortfin waspfish	0.004	-	NA	-	NA	-	NA	NA	-	-	see Table 2.26
37287021	*Minous versicolor*	Plumbstriped stingfish	0.003	-	NA	-	NA	-	NA	NA	-	-	see Table 2.26
37287011	*Apistus carinatus*	Longfin waspfish	0.001	-	NA	-	NA	-	NA	NA	-	-	see Table 2.26
37278002	*Fistularia petimba*	Red cornetfish	<0.001	-	NA	-	NA	-	NA	NA	-	-	see Table 2.26
37235011	*Tylosurus acus*	Keeljaw longtom	0.002	-	NA	-	NA	-	NA	NA	-	-	see Table 2.26
37235008	*Platybelone argalus*	Flat-tail longtom	0.005	-	NA	-	NA	-	NA	NA	-	-	see Table 2.26
37210010	*Tetrabrachium ocellatum*	Humpback anglerfish	0.003	-	NA	-	NA	-	NA	NA	-	-	see Table 2.26
37188006	*Arius leptaspis*	Salmon catfish	0.005	-	NA	-	NA	-	NA	NA	-	-	see Table 2.26
37068033	*Phyllopichthus xenodontus*	Flappy snake eel	0.005	-	NA	-	NA	-	NA	NA	-	-	see Table 2.26
37037001	*Gymnura australis*	Australian butterfly ray	0.001	-	NA	-	NA	-	NA	NA	-	-	see Table 2.26
37035020	*Maculabatis astra*, (synonym: *Himantura astra*)	Black-spotted whipray	0.002	-	NA	-	NA	-	NA	NA	-	-	see Table 2.26
37018020	*Hemigaleus australiensis*	Sicklefin weasel shark	0.001	-	NA	-	NA	-	NA	NA	-	-	see Table 2.26
37018011	*Hemipristis elongata*	Fossil shark	0.001	-	NA	-	NA	-	NA	NA	-	-	see Table 2.26
Other BC species:													
37012001	*Alopias vulpinus*	Thresher Shark	<0.001	0.08	Below	0.12	Below	0.16	Below	Low	NE	No RR required	Low
37012002	*Alopias superciliosus*	Bigeye Thresher	<0.001	0.06	Below	0.09	Below	0.11	Below	Low	NE	No RR required	Low
37012003	*Alopias pelagicus*	Pelagic Thresher	<0.001	0.06	Below	0.1	Below	0.13	Below	Low	NE	No RR required	Low
37018006	*Rhizoprionodon acutus*	Milk shark	0.001	0.25	Below	0.37	Below	0.49	Below	Low	NE	No RR required	Low
37018009	*Carcharhinus coatesi*	Whitecheek shark	<0.001	0.08	Below	0.13	Below	0.17	Below	Low	NE	No RR required	Low
37018013	*Carcharhinus sorrah*	Spot-tail shark	0.001	0.14	Below	0.21	Below	0.28	Below	Low	NE	No RR required	Low
37018014	*Carcharhinus tilstoni*	Australian blacktip shark	0.001	0.1	Below	0.15	Below	0.2	Below	Low	NE	No RR required	Low
37018021	*Carcharhinus leucas*	Bull Shark	0.001	0.06	Below	0.08	Below	0.11	Below	Low	NE	No RR required	Low
37018023	*Carcharhinus brevipinna*	Spinner Shark	0.001	0.07	Below	0.11	Below	0.15	Below	Low	NE	No RR required	Low
37018024	*Rhizoprionodon taylori*	Australian sharpnose shark	<0.001	0.31	Below	0.47	Below	0.63	Below	Low	NE	No RR required	Low

CAAB CODE	SCIENTIFIC NAME	COMMON NAME	SUSCEPT-IBILITY	F MSM	F MSM RISK	F Lim	F Lim RISK	F CRASH	F CRASH RISK	F OVERALL RISK	CATCH (2012-2016) AND OTHER INFORM-ATION	RISK SCORE FOLLOWING RESIDUAL RISK	FINAL RISK SCORE
37018025	*Carcharhinus macloti*	Hardnose shark	0.001	0.07	Below	0.1	Below	0.13	Below	Low	NE	No RR required	Low
37018026	*Carcharhinus amboinensis*	Pigeye shark	0.001	0.07	Below	0.1	Below	0.13	Below	Low	NE	No RR required	Low
37018035	*Carcharhinus fitzroyensis*	Creek whaler	0.001	0.07	Below	0.1	Below	0.13	Below	Low	NE	No RR required	Low
37018039	*Carcharhinus limbatus*	Blacktip shark	0.001	0.1	Below	0.15	Below	0.19	Below	Low	NE	No RR required	Low
37019001	*Sphyrna lewini*	Scalloped hammerhead	<0.001	0.07	Below	0.1	Below	0.14	Below	Low	NE	No RR required	Low
37019003	*Eusphyra blochii*	Winghead shark	0.001	0.1	Below	0.15	Below	0.2	Below	Low	NE	No RR required	Low
37019004	*Sphyrna zygaena*	Smooth hammerhead	<0.001	0.09	Below	0.13	Below	0.18	Below	Low	NE	No RR required	Low
37020001	*Centrophorus moluccensis*	Endeavour dogfish	<0.001	0.06	Below	0.09	Below	0.12	Below	Low	NE	No RR required	Low
37026005	*Rhynchobatus australiae*	Whitespotted guitarfish	0.001	0.11	Below	0.16	Below	0.21	Below	Low	NE	No RR required	Low
37035004	*Neotrygon australiae*	Bluespotted maskray	0.002	0.11	Below	0.16	Below	0.22	Below	Low	Width: to 47 cm; level of TED exclusion not clear (smaller ones probably poorly excluded, larger ones excluded to some extent);	No RR required	Low

CAAB CODE	SCIENTIFIC NAME	COMMON NAME	SUSCEPT-IBILITY	F MSM	F MSM RISK	F Lim	F Lim RISK	F CRASH	F CRASH RISK	F OVERALL RISK	CATCH (2012-2016) AND OTHER INFORM-ATION	RISK SCORE FOLLOWING RESIDUAL RISK	FINAL RISK SCORE
											risk is somewhat mitigated by being largely an inshore species (although not well studied in general). Dave. Brewer (pers. comm.)		
37035012	*Neotrygon annotata*	Plain maskray	0.001	0.1	Below	0.16	Below	0.21	Below	Low	NE	No RR required	Low
37035013	*Neotrygon leylandi*	Painted maskray	<0.001	0.1	Below	0.16	Below	0.21	Below	Low	NE	No RR required	Low
37035017	*Taeniurops meyeni*	Blotched fantail ray	0.001	0.1	Below	0.16	Below	0.21	Below	Low	NE	No RR required	Low
37035026	*Himantura leoparda*	Leopard whipray	0.001	0.1	Below	0.16	Below	0.21	Below	Low	Width: to 140 cm; likely to have high exclusion rates from TEDs (D. Brewer, pers. comm.)	No RR required	Low
37038001	*Urolophus bucculentus*	Sandyback stingaree	<0.001	0.15	Below	0.23	Below	0.31	Below	Low	NE	No RR required	Low
37039002	*Aetomylaeus caeruleofasciatus*	Banded eagle ray	0.001	0.07	Below	0.11	Below	0.14	Below	Low	NE	No RR required	Low
37039003	*Aetobatus ocellatus*	Spotted eagle ray	0.001	0.08	Below	0.12	Below	0.17	Below	Low	NE	No RR required	Low
37063002	*Muraenesox cinereus*	Daggertooth pike conger	0.001	0.23	Below	0.35	Below	0.47	Below	Low	NE	No RR required	Low

CAAB CODE	SCIENTIFIC NAME	COMMON NAME	SUSCEPT-IBILITY	F MSM	F MSM RISK	F Lim	F Lim RISK	F CRASH	F CRASH RISK	F OVERALL RISK	CATCH (2012-2016) AND OTHER INFORM-ATION	RISK SCORE FOLLOWING RESIDUAL RISK	FINAL RISK SCORE
37067015	*Conger cinereus*	Blacklip conger	0.001	0.23	Below	0.34	Below	0.45	Below	Low	NE	No RR required	Low
37068017	*Ichthyapus vulturis*	Vulture eel	<0.001	-	Below	-	Below	-	Below	Low	NE	No RR required	Low
37085006	*Amblygaster sirm*	Spotted sardinella	0.004	1.09	Below	1.64	Below	2.19	Below	Low	NE	No RR required	Low
37085007	*Herklotsichthys koningsbergeri*	Largespotted herring	0.003	0.96	Below	1.44	Below	1.92	Below	Low	NE	No RR required	Low
37085008	*Herklotsichthys lippa*	Smallspotted herring	0.003	0.96	Below	1.44	Below	1.92	Below	Low	NE	No RR required	Low
37085009	*Pellona ditchela*	Indian pellona	0.003	0.9	Below	1.35	Below	1.8	Below	Low	NE	No RR required	Low
37085010	*Dussumieria elopsoides*	Slender rainbow sardine	0.005	0.93	Below	1.4	Below	1.87	Below	Low	NE	No RR required	Low
37085012	*Ilisha lunula*	Longtail ilisha	0.004	0.91	Below	1.37	Below	1.83	Below	Low	NE	No RR required	Low
37085013	*Sardinella gibbosa*	Goldstripe sardinella	0.002	0.9	Below	1.35	Below	1.8	Below	Low	NE	No RR required	Low
37085014	*Sardinella albella*	White sardinella	0.003	0.9	Below	1.35	Below	1.8	Below	Low	NE	No RR required	Low
37085015	*Anodontostoma chacunda*	Chacunda gizzard shad	0.002	0.75	Below	1.12	Below	1.49	Below	Low	NE	No RR required	Low
37085025	*Herklotsichthys quadrimaculatus*	Goldspot herring	0.005	0.67	Below	1.01	Below	1.35	Below	Low	NE	No RR required	Low
37085030	*Spratelloides gracilis*	Silver-stripe round herring	0.003	3.69	Below	5.53	Below	7.37	Below	Low	NE	No RR required	Low
37085034	*Ilisha striatula*	Banded ilisha	<0.001	-	Below	-	Below	-	Below	Low	NE	No RR required	Low
37086004	*Thryssa setirostris*	Longjaw thryssa	0.003	1.47	Below	2.21	Below	2.95	Below	Low	NE	No RR required	Low
37086005	*Thryssa hamiltonii*	Hamilton's thryssa	0.002	1.42	Below	2.13	Below	2.85	Below	Low	NE	No RR required	Low
37086006	*Stolephorus indicus*	Indian anchovy	0.005	1.63	Below	2.44	Below	3.26	Below	Low	NE	No RR required	Low
37086008	*Setipinna tenuifilis*	Common hairfin anchovy	0.001	1.57	Below	2.35	Below	3.14	Below	Low	NE	No RR required	Low
37087001	*Chirocentrus dorab*	Dorab wolf herring	0.001	0.23	Below	0.35	Below	0.46	Below	Low	NE	No RR required	Low
37118001	*Saurida undosquamis*	Brushtooth lizardfish	0.001	0.56	Below	0.85	Below	1.13	Below	Low	NE	No RR required	Low
37118005	*Saurida argentea*	Shortfin saury	0.002	0.53	Below	0.8	Below	1.06	Below	Low	NE	No RR required	Low
37118028	*Saurida tumbil*	Common saury	0.001	0.53	Below	0.8	Below	1.07	Below	Low	NE	No RR required	Low
37119001	*Harpadon translucens*	Glassy bombay duck	0.002	0.75	Below	1.12	Below	1.5	Below	Low	NE	No RR required	Low
37122079	*Benthosema pterotum*	Opaline lanternfish	0.001	1.11	Below	1.66	Below	2.21	Below	Low	NE	No RR required	Low
37188001	*Netuma thalassina*	Giant sea catfish	0.002	0.3	Below	0.45	Below	0.6	Below	Low	NE	No RR required	Low
37188013	*Plicofollis nella*	Shieldhead catfish	0.004	0.3	Below	0.45	Below	0.59	Below	Low	NE	No RR required	Low

CAAB CODE	SCIENTIFIC NAME	COMMON NAME	SUSCEPT-IBILITY	F MSM	F MSM RISK	F Lim	F Lim RISK	F CRASH	F CRASH RISK	F OVERALL RISK	CATCH (2012-2016) AND OTHER INFORM-ATION	RISK SCORE FOLLOWING RESIDUAL RISK	FINAL RISK SCORE
37192003	*Euristhmus nudiceps*	Nakedhead catfish	0.002	0.45	Below	0.67	Below	0.89	Below	Low	NE	No RR required	Low
37192004	*Euristhmus lepturus*	Longtail catfish	0.004	0.45	Below	0.67	Below	0.89	Below	Low	NE	No RR required	Low
37225002	*Bregmaceros mcclellandi*	Unicorn codlet	<0.001	-	Below	-	Below	-	Below	Low	NE	No RR required	Low
37225003	*Bregmaceros atlanticus*	Antenna codlet	<0.001	-	Below	-	Below	-	Below	Low	NE	No RR required	Low
37228005	*Sirembo imberbis*	Golden cusk	<0.001	0.18	Below	0.27	Below	0.35	Below	Low	NE	No RR required	Low
37234016	*Hyporhamphus affinis*	Tropical garfish	0.002	0.67	Below	1.01	Below	1.34	Below	Low	NE	No RR required	Low
37235001	*Ablennes hians*	Barred longtom	0.001	0.41	Below	0.62	Below	0.82	Below	Low	NE	No RR required	Low
37235002	*Tylosurus gavialoides*	Stout longtom	0.001	0.36	Below	0.54	Below	0.72	Below	Low	NE	No RR required	Low
37235003	*Strongylura leiura*	Slender longtom	0.001	0.47	Below	0.71	Below	0.94	Below	Low	NE	No RR required	Low
37235004	*Strongylura strongylura*	Blackspot longtom	0.002	0.39	Below	0.58	Below	0.78	Below	Low	NE	No RR required	Low
37235005	*Tylosurus crocodilus*	Crocodile longtom	0.002	0.36	Below	0.54	Below	0.72	Below	Low	NE	No RR required	Low
37235006	*Tylosurus punctulatus*	Spongyjaw longtom	0.001	0.36	Below	0.54	Below	0.72	Below	Low	NE	No RR required	Low
37235007	*Strongylura incisa*	Reef longtom	0.002	0.39	Below	0.58	Below	0.78	Below	Low	NE	No RR required	Low
37261001	*Sargocentron rubrum*	Red squirrelfish	0.005	1.6	Below	2.4	Below	3.2	Below	Low	NE	No RR required	Low
37261002	*Myripristis murdjan*	Pinecone soldierfish	0.002	1.75	Below	2.62	Below	3.5	Below	Low	NE	No RR required	Low
37269002	*Velifer hypselopterus*	Sailfin velifer	<0.001	0.44	Below	0.66	Below	0.88	Below	Low	NE	No RR required	Low
37280001	*Centriscus scutatus*	Grooved razorfish	0.002	0.95	Below	1.42	Below	1.89	Below	Low	NE	No RR required	Low
37287012	*Pterois russelii*	Plaintail lionfish	<0.001	0.42	Below	0.62	Below	0.83	Below	Low	NE	No RR required	Low
37287014	*Cottapistus cottoides*	Marbled stingfish	0.001	0.4	Below	0.6	Below	0.8	Below	Low	NE	No RR required	Low
37287040	*Pterois volitans*	Red lionfish	0.002	0.33	Below	0.5	Below	0.67	Below	Low	NE	No RR required	Low
37287060	*Paracentropogon vespa*	Wasp roguefish	0.001	0.65	Below	0.98	Below	1.31	Below	Low	NE	No RR required	Low
37287101	*Brachypterois serrulifer*	Sawcheek scorpionfish	0.001	0.33	Below	0.5	Below	0.67	Below	Low	NE	No RR required	Low
37296010	*Inegocia harrisii*	Harris' flathead	0.003	0.4	Below	0.59	Below	0.79	Below	Low	NE	No RR required	Low
37296013	*Elates ransonnettii*	Dwarf flathead	0.002	0.4	Below	0.59	Below	0.79	Below	Low	NE	No RR required	Low
37296018	*Cociella hutchinsi*	Brownmargin flathead	0.001	0.4	Below	0.59	Below	0.79	Below	Low	NE	No RR required	Low
37296023	*Cymbacephalus nematophthalmus*	Fringe-eye flathead	0.003	0.4	Below	0.59	Below	0.79	Below	Low	NE	No RR required	Low
37296029	*Inegocia japonica*	Japanese flathead	0.002	0.4	Below	0.59	Below	0.79	Below	Low	NE	No RR required	Low
37296033	*Platycephalus australis*	Bartail flathead	0.004	0.39	Below	0.58	Below	0.78	Below	Low	NE	No RR required	Low

CAAB CODE	SCIENTIFIC NAME	COMMON NAME	SUSCEPT-IBILITY	F MSM	F MSM RISK	F Lim	F Lim RISK	F CRASH	F CRASH RISK	F OVERALL RISK	CATCH (2012-2016) AND OTHER INFORM-ATION	RISK SCORE FOLLOWING RESIDUAL RISK	FINAL RISK SCORE
37308004	*Dactyloptena orientalis*	Purple flying gurnard	0.001	0.9	Below	1.35	Below	1.8	Below	Low	NE	No RR required	Low
37311017	*Epinephelus sexfasciatus*	Sixbar grouper	0.002	0.32	Below	0.49	Below	0.65	Below	Low	NE	No RR required	Low
37311028	*Synagrops philippinensis*	Sharptooth seabass	0.001	0.44	Below	0.66	Below	0.88	Below	Low	NE	No RR required	Low
37311062	*Epinephelus bilobatus*	Frostback rockcod	0.001	0.2	Below	0.29	Below	0.39	Below	Low	NE	No RR required	Low
37321001	*Pelates quadrilineatus*	Fourlined terapon	0.002	0.85	Below	1.27	Below	1.7	Below	Low	NE	No RR required	Low
37321002	*Terapon jarbua*	Jarbua terapon	0.001	0.77	Below	1.15	Below	1.53	Below	Low	NE	No RR required	Low
37321003	*Terapon theraps*	Largescaled terapon	0.001	0.89	Below	1.34	Below	1.78	Below	Low	NE	No RR required	Low
37321006	*Terapon puta*	Spinycheek grunter	0.002	0.85	Below	1.28	Below	1.7	Below	Low	NE	No RR required	Low
37326001	*Priacanthus macracanthus*	Red bigeye	<0.001	0.88	Below	1.32	Below	1.75	Below	Low	NE	No RR required	Low
37326003	*Priacanthus tayenus*	Purple-spotted bigeye	0.004	0.75	Below	1.12	Below	1.49	Below	Low	NE	No RR required	Low
37326005	*Priacanthus hamrur*	Lunartail bigeye	0.001	0.64	Below	0.96	Below	1.28	Below	Low	NE	No RR required	Low
37327008	*Ostorhinchus fasciatus*	Broadbanded cardinalfish	0.002	1.78	Below	2.67	Below	3.57	Below	Low	NE	No RR required	Low
37327014	*Ozichthys albimaculosus*	Creamspotted cardinalfish	0.002	1.31	Below	1.97	Below	2.62	Below	Low	NE	No RR required	Low
37327016	*Jaydia melanopus*	Monster cardinalfish	0.001	1.31	Below	1.97	Below	2.62	Below	Low	NE	No RR required	Low
37327026	*Jaydia poecilopterus*	Pearlyfin cardinalfish	0.001	1.31	Below	1.97	Below	2.62	Below	Low	NE	No RR required	Low
37330003	*Sillago analis*	Sand whiting	0.001	0.67	Below	1.01	Below	1.34	Below	Low	NE	No RR required	Low
37330006	*Sillago sihama*	Northern whiting	0.002	0.73	Below	1.1	Below	1.46	Below	Low	NE	No RR required	Low
37330015	*Sillago maculata*	Trumpeter whiting	0.003	0.71	Below	1.07	Below	1.42	Below	Low	NE	No RR required	Low
37333001	*Lactarius lactarius*	False trevally	0.004	0.76	Below	1.14	Below	1.52	Below	Low	NE	No RR required	Low
37335001	*Rachycentron canadum*	Cobia	<0.001	0.32	Below	0.48	Below	0.63	Below	Low	NE	No RR required	Low
37337005	*Carangoides malabaricus*	Malabar trevally	0.002	0.67	Below	1.01	Below	1.34	Below	Low	NE	No RR required	Low
37337008	*Selar boops*	Oxeye scad	0.001	0.77	Below	1.16	Below	1.54	Below	Low	NE	No RR required	Low
37337010	*Alepes apercna*	Smallmouth scad	0.001	0.68	Below	1.02	Below	1.36	Below	Low	NE	No RR required	Low
37337012	*Gnathanodon speciosus*	Golden trevally	0.001	0.51	Below	0.77	Below	1.03	Below	Low	NE	No RR required	Low
37337014	*Seriolina nigrofasciata*	Blackbanded trevally	0	0.58	Below	0.87	Below	1.17	Below	Low	NE	No RR required	Low
37337015	*Selaroides leptolepis*	Yellowstripe scad	0.002	0.96	Below	1.44	Below	1.92	Below	Low	NE	No RR required	Low
37337016	*Caranx bucculentus*	Bluespotted trevally	0.001	0.47	Below	0.7	Below	0.93	Below	Low	NE	No RR required	Low

CAAB CODE	SCIENTIFIC NAME	COMMON NAME	SUSCEPT-IBILITY	F MSM	F MSM RISK	F Lim	F Lim RISK	F CRASH	F CRASH RISK	F OVERALL RISK	CATCH (2012-2016) AND OTHER INFORM-ATION	RISK SCORE FOLLOWING RESIDUAL RISK	FINAL RISK SCORE
37337017	*Decapterus macrosoma*	Shortfin scad	<0.001	0.81	Below	1.22	Below	1.63	Below	Low	NE	No RR required	Low
37337021	*Carangoides*	Coastal trevally	0.002	0.57	Below	0.86	Below	1.15	Below	Low	NE	No RR required	Low
37337022	*Carangoides gymnostethus*	Bludger	0.002	0.62	Below	0.92	Below	1.23	Below	Low	NE	No RR required	Low
37337024	*Atule mate*	Barred yellowtail scad	0.001	0.62	Below	0.94	Below	1.25	Below	Low	NE	No RR required	Low
37337028	*Megalaspis cordyla*	Torpedo scad	0.002	0.57	Below	0.86	Below	1.14	Below	Low	NE	No RR required	Low
37337031	*Carangoides humerosus*	Duskyshoulder trevally	0.003	0.62	Below	0.92	Below	1.23	Below	Low	NE	No RR required	Low
37337032	*Scomberoides commersonnianus*	Talang queenfish	0.001	0.55	Below	0.83	Below	1.11	Below	Low	NE	No RR required	Low
37337036	*Alepes kleinii*	Razorbelly trevally	0.001	0.59	Below	0.89	Below	1.19	Below	Low	NE	No RR required	Low
37337037	*Carangoides fulvoguttatus*	Yellowspotted trevally	0.002	0.62	Below	0.92	Below	1.23	Below	Low	NE	No RR required	Low
37337038	*Alectis indica*	Indian threadfish	0.002	0.48	Below	0.72	Below	0.96	Below	Low	NE	No RR required	Low
37337039	*Caranx sexfasciatus*	Bigeye trevally	0.001	0.41	Below	0.62	Below	0.82	Below	Low	NE	No RR required	Low
37337041	*Ulua aurochs*	Silvermouth trevally	0.002	0.58	Below	0.87	Below	1.17	Below	Low	NE	No RR required	Low
37337042	*Carangoides hedlandensis*	Bumpnose trevally	0.004	0.62	Below	0.92	Below	1.23	Below	Low	NE	No RR required	Low
37337043	*Carangoides talamparoides*	Whitetongue trevally; imposter trevally	0.001	0.62	Below	0.92	Below	1.23	Below	Low	NE	No RR required	Low
37337044	*Scomberoides tol*	Needlescaled queenfish	0.003	0.6	Below	0.9	Below	1.19	Below	Low	NE	No RR required	Low
37337045	*Scomberoides tala*	Barred queenfish	0.002	0.55	Below	0.83	Below	1.11	Below	Low	NE	No RR required	Low
37337046	*Scomberoides lysan*	Doublespotted queenfish	0.002	0.51	Below	0.77	Below	1.02	Below	Low	NE	No RR required	Low
37337047	*Pantolabus radiatus*	Fringefin trevally	0.002	0.58	Below	0.87	Below	1.17	Below	Low	NE	No RR required	Low
37337049	*Caranx tille*	Tille trevally	0.002	0.59	Below	0.88	Below	1.17	Below	Low	NE	No RR required	Low
37337056	*Decapterus kurroides*	Redtail scad	<0.001	0.7	Below	1.04	Below	1.39	Below	Low	NE	No RR required	Low
37337064	*Caranx papuensis*	Brassy trevally	0.001	0.37	Below	0.56	Below	0.75	Below	Low	NE	No RR required	Low
37337068	*Carangoides ferdau*	Blue trevally	0.003	0.49	Below	0.74	Below	0.99	Below	Low	NE	No RR required	Low
37337072	*Parastromateus niger*	Black pomfret	0.001	0.55	Below	0.82	Below	1.1	Below	Low	NE	No RR required	Low
37337073	*Trachinotus anak*	Giant oystercracker	0.004	0.58	Below	0.87	Below	1.16	Below	Low	NE	No RR required	Low
37337074	*Trachinotus baillonii*	Smallspotted dart	0.001	0.48	Below	0.73	Below	0.97	Below	Low	NE	No RR required	Low
37337075	*Trachinotus blochii*	Snubnose dart	<0.001	0.48	Below	0.73	Below	0.97	Below	Low	NE	No RR required	Low
37340001	*Mene maculata*	Moonfish	0.001	0.99	Below	1.49	Below	1.98	Below	Low	NE	No RR required	Low

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37341002	*Photopectoralis bindus*	Orangefin ponyfish	0.002	1.53	Below	2.29	Below	3.05	Below	Low	NE	No RR required	Low
37341004	*Aurigequula longispina*	Longspine ponyfish	0.002	1.48	Below	2.21	Below	2.95	Below	Low	NE	No RR required	Low
37341005	*Equulites leuciscus*	Whipfin ponyfish	0.003	1.41	Below	2.11	Below	2.81	Below	Low	NE	No RR required	Low
37341007	*Gazza minuta*	Toothpony	0.002	1.27	Below	1.9	Below	2.53	Below	Low	NE	No RR required	Low
37341009	*Aurigequula fasciata*	Striped ponyfish	0.001	1.65	Below	2.48	Below	3.3	Below	Low	NE	No RR required	Low
37341010	*Eubleekeria splendens*	Splendid ponyfish	0.002	1.31	Below	1.96	Below	2.62	Below	Low	NE	No RR required	Low
37341013	*Nuchequula glenysae*	Twoblotch ponyfish	0.002	1.99	Below	2.99	Below	3.98	Below	Low	NE	No RR required	Low
37341014	*Leiognathus equulus*	Common ponyfish	0.002	1.49	Below	2.23	Below	2.97	Below	Low	NE	No RR required	Low
37341015	*Leiognathus ruconius*	Deep pugnosed ponyfish	0.002	1.65	Below	2.48	Below	3.3	Below	Low	NE	No RR required	Low
37342008	*Taractes asper*	Flathead pomfret	<0.001	0.25	Below	0.38	Below	0.5	Below	Low	NE	No RR required	Low
37342014	*Taractes rubescens*	Knifetail pomfret	<0.001	0.25	Below	0.38	Below	0.5	Below	Low	NE	No RR required	Low
37342015	*Taractichthys steindachneri*	Sickle pomfret	<0.001	0.25	Below	0.38	Below	0.5	Below	Low	NE	No RR required	Low
37346003	*Lutjanus vitta*	Brownstripe Red snapper	0.005	0.43	Below	0.64	Below	0.85	Below	Low	NE	No RR required	Low
37346007	*Lutjanus malabaricus*	Saddletail snapper	0.001	0.3	Below	0.46	Below	0.61	Below	Low	NE	No RR required	Low
37346008	*Lutjanus lutjanus*	Bigeye snapper	0.002	0.42	Below	0.63	Below	0.84	Below	Low	NE	No RR required	Low
37346030	*Lutjanus johnii*	Golden snapper	0.001	0.31	Below	0.47	Below	0.63	Below	Low	NE	No RR required	Low
37346034	*Lutjanus fulviflamma*	Blackspot snapper	0.005	0.43	Below	0.65	Below	0.87	Below	Low	NE	No RR required	Low
37346057	*Lutjanus timoriensis*	Timor snapper	0.2	0.35	Below	0.53	Below	0.7	Below	Low	NE	No RR required	Low
37346065	*Lutjanus russellii*	Moses' snapper	0.002	0.35	Below	0.52	Below	0.7	Below	Low	NE	No RR required	Low
37347008	*Scolopsis meridiana* (synoym: *Scolopsis taenioptera*)	Redspot monocle bream	0.005	0.69	Below	1.04	Below	1.38	Below	Low	NE	No RR required	Low
37347014	*Nemipterus hexodon*	Ornate threadfin bream	0.002	1.04	Below	1.57	Below	2.09	Below	Low	NE	No RR required	Low
37347028	*Pentapodus paradiseus*	Paradise whiptail	0.004	0.99	Below	1.49	Below	1.98	Below	Low	NE	No RR required	Low
37349002	*Pentaprion longimanus*	Longfin mojarra	0.001	1.24	Below	1.86	Below	2.48	Below	Low	NE	No RR required	Low
37349003	*Gerres filamentosus*	Whipfin silver-biddy	0.003	1.23	Below	1.84	Below	2.46	Below	Low	NE	No RR required	Low
37349004	*Gerres oyena*	Blacktip silverbiddy	0.004	1.22	Below	1.82	Below	2.43	Below	Low	NE	No RR required	Low

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37349005	*Gerres subfasciatus*	Common silverbiddy	0.004	1.18	Below	1.76	Below	2.35	Below	Low	NE	No RR required	Low
37350002	*Pomadasys maculatus*	Blotched javelin	0.002	0.59	Below	0.89	Below	1.19	Below	Low	NE	No RR required	Low
37350003	*Diagramma pictum*	Painted sweetlip	0.001	0.57	Below	0.86	Below	1.15	Below	Low	NE	No RR required	Low
37350008	*Pomadasys trifasciatus*	Black-ear Javelin	0.003	0.6	Below	0.9	Below	1.2	Below	Low	NE	No RR required	Low
37350011	*Pomadasys kaakan*	Javelin grunter	0.004	0.58	Below	0.87	Below	1.16	Below	Low	NE	No RR required	Low
37351006	*Lethrinus laticaudis*	Grass emperor	0.005	0.36	Below	0.54	Below	0.72	Below	Low	NE	No RR required	Low
37351012	*Lethrinus rubrioperculatus*	Spotcheek emperor	0.002	0.42	Below	0.63	Below	0.83	Below	Low	NE	No RR required	Low
37351026	*Monotaxis grandoculis*	Humpnose big-eye bream	0.005	0.34	Below	0.51	Below	0.68	Below	Low	NE	No RR required	Low
37354003	*Protonibea diacanthus*	Black jewfish	<0.001	0.42	Below	0.62	Below	0.83	Below	Low	NE	No RR required	Low
37354004	*Johnius laevis*	Smooth jewfish	0.001	0.6	Below	0.91	Below	1.21	Below	Low	NE	No RR required	Low
37354006	*Otolithes ruber*	Silver teraglin	0.002	0.55	Below	0.83	Below	1.11	Below	Low	NE	No RR required	Low
37354007	*Johnius borneensis*	River jewfish	0.001	0.51	Below	0.77	Below	1.03	Below	Low	NE	No RR required	Low
37354009	*Johnius amblycephalus*	Bearded jewfish	0.001	0.6	Below	0.91	Below	1.21	Below	Low	NE	No RR required	Low
37354012	*Atrobucca brevis*	Orange jewfish	<0.001	0.4	Below	0.6	Below	0.79	Below	Low	NE	No RR required	Low
37354026	*Larimichthys pamoides*	Southern yellow jewfish	0.001	0.41	Below	0.61	Below	0.81	Below	Low	NE	No RR required	Low
37355003	*Upeneus moluccensis*	Goldband goatfish	0.001	0.77	Below	1.16	Below	1.54	Below	Low	NE	No RR required	Low
37355005	*Parupeneus indicus*	Yellowspot goatfish	0.002	0.82	Below	1.23	Below	1.64	Below	Low	NE	No RR required	Low
37355007	*Upeneus sulphureus*	Sulphur goatfish	0.002	1	Below	1.5	Below	2	Below	Low	NE	No RR required	Low
37355013	*Upeneus sundaicus*	Ochrebanded goatfish	0.003	0.88	Below	1.31	Below	1.75	Below	Low	NE	No RR required	Low
37355014	*Upeneus tragula*	Bartail goatfish	0.005	1.01	Below	1.51	Below	2.01	Below	Low	NE	No RR required	Low
37362005	*Drepane punctata*	Spotted sicklefish	0.002	0.37	Below	0.56	Below	0.75	Below	Low	NE	No RR required	Low
37363001	*Selenotoca multifasciata*	Striped scat	0.001	1	Below	1.5	Below	2	Below	Low	NE	No RR required	Low
37365015	*Chelmon muelleri*	Blackfin coralfish	0.001	0.8	Below	1.21	Below	1.61	Below	Low	NE	No RR required	Low
37365068	*Forcipiger flavissimus*	Longnose butterfly fish	0.002	0.8	Below	1.21	Below	1.61	Below	Low	NE	No RR required	Low
37380002	*Acanthocepola abbreviata*	Yellowspotted bandfish	0.002	0.48	Below	0.72	Below	0.95	Below	Low	NE	No RR required	Low
37381002	*Mugil cephalus*	Sea mullet	<0.001	0.38	Below	0.57	Below	0.75	Below	Low	NE	No RR required	Low
37382001	*Sphyraena pinguis*	Striped barracuda	0.002	0.32	Below	0.48	Below	0.65	Below	Low	NE	No RR required	Low
37382004	*Sphyraena jello*	Pickhandle barracuda	0.001	0.42	Below	0.63	Below	0.83	Below	Low	NE	No RR required	Low

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37382009	*Sphyraena qenie*	Darkfinned seapike	0.001	0.34	Below	0.51	Below	0.67	Below	Low	NE	No RR required	Low
37383001	*Polydactylus nigripinnis*	Blackfin threadfin	0.003	0.82	Below	1.23	Below	1.65	Below	Low	NE	No RR required	Low
37383002	*Polydactylus multiradiatus*	Australian threadfin	0.003	0.82	Below	1.23	Below	1.65	Below	Low	NE	No RR required	Low
37383004	*Eleutheronema tetradactylum*	Blue threadfin	0.005	0.82	Below	1.23	Below	1.65	Below	Low	NE	No RR required	Low
37384004	*Choerodon cephalotes*	Purple tuskfish	0.005	0.39	Below	0.59	Below	0.79	Below	Low	NE	No RR required	Low
37384008	*Choerodon monostigma*	Darkspot tuskfish	0.005	0.39	Below	0.59	Below	0.79	Below	Low	NE	No RR required	Low
37384009	*Choerodon sugillatum*	Wedgetail tuskfish	0.002	0.39	Below	0.59	Below	0.79	Below	Low	NE	No RR required	Low
37384166	*Thalassoma jansenii*	Jansen's wrasse	<0.001	0.56	Below	0.85	Below	1.13	Below	Low	NE	No RR required	Low
37384167	*Thalassoma lunare*	Moon wrasse	0.005	0.47	Below	0.71	Below	0.95	Below	Low	NE	No RR required	Low
37384169	*Thalassoma purpureum*	Surge wrasse	0.001	0.56	Below	0.85	Below	1.13	Below	Low	NE	No RR required	Low
37384170	*Thalassoma quinquevittatum*	Red-ribbon Wrasse	0.002	0.56	Below	0.85	Below	1.13	Below	Low	NE	No RR required	Low
37390005	*Parapercis nebulosa*	Pinkbanded grubfish	0.004	0.42	Below	0.64	Below	0.85	Below	Low	NE	No RR required	Low
37400010	*Ichthyscopus fasciatus*	Banded stargazer	0.006	0.37	Below	0.55	Below	0.74	Below	Low	NE	No RR required	Low
37427007	*Calliurichthys grossi*	Longnose stinkfish	0.005	0.77	Below	1.16	Below	1.55	Below	Low	NE	No RR required	Low
37428001	*Yongeichthys nebulosus*	Hairfin goby	<0.001	1.26	Below	1.89	Below	2.52	Below	Low	NE	No RR required	Low
37438004	*Siganus canaliculatus*	White-spotted spinefoot	0.003	1.13	Below	1.69	Below	2.26	Below	Low	NE	No RR required	Low
37438008	*Siganus corallinus*	Blue-spotted spinefoot	<0.001	1.09	Below	1.63	Below	2.17	Below	Low	NE	No RR required	Low
37441007	*Scomberomorus commerson*	Spanish mackerel	0.001	0.41	Below	0.61	Below	0.82	Below	Low	NE	No RR required	Low
37441012	*Rastrelliger kanagurta*	Mouth mackerel	0.002	1.21	Below	1.81	Below	2.41	Below	Low	NE	No RR required	Low
37441014	*Scomberomorus queenslandicus*	School mackerel	0.001	0.53	Below	0.8	Below	1.07	Below	Low	NE	No RR required	Low
37441015	*Scomberomorus munroi*	Spotted mackerel	0.001	0.66	Below	1	Below	1.33	Below	Low	NE	No RR required	Low
37445007	*Psenopsis humerosa*	Blackspot butterfish	<0.001	0.38	Below	0.57	Below	0.77	Below	Low	NE	No RR required	Low
37457001	*Psettodes erumei*	Australian halibut	<0.001	0.48	Below	0.71	Below	0.95	Below	Low	NE	No RR required	Low
37460002	*Pseudorhombus jenynsii*	Smalltooth flounder	0.003	0.49	Below	0.74	Below	0.98	Below	Low	NE	No RR required	Low
37460008	*Pseudorhombus elevatus*	Deep flounder	0.001	0.54	Below	0.81	Below	1.09	Below	Low	NE	No RR required	Low

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37460009	*Pseudorhombus arsius*	Largetooth flounder	0.002	0.42	Below	0.64	Below	0.85	Below	Low	NE	No RR required	Low
37462001	*Aesopia cornuta*	Unicorn sole	<0.001	0.33	Below	0.5	Below	0.66	Below	Low	NE	No RR required	Low
37462003	*Zebrias craticulus*	Wicker-work sole	0.002	0.38	Below	0.57	Below	0.75	Below	Low	NE	No RR required	Low
37462007	*Brachirus muelleri*	Tufted sole	0.002	0.38	Below	0.57	Below	0.75	Below	Low	NE	No RR required	Low
37463002	*Paraplagusia longirostris*	Pinocchio tongue sole	0.005	0.55	Below	0.83	Below	1.1	Below	Low	NE	No RR required	Low
37464001	*Trixiphichthys weberi*	Blacktip tripodfish	0.002	0.32	Below	0.48	Below	0.64	Below	Low	NE	No RR required	Low
37464002	*Triacanthus biaculeatus*	Short-nosed tripodfish	0.003	0.32	Below	0.48	Below	0.64	Below	Low	NE	No RR required	Low
37465009	*Monacanthus chinensis*	Fan-bellied leatherjacket	0.004	0.44	Below	0.65	Below	0.87	Below	Low	NE	No RR required	Low
37465010	*Anacanthus barbatus*	Bearded leatherjacket	0.002	0.44	Below	0.65	Below	0.87	Below	Low	NE	No RR required	Low
37465020	*Pseudomonacanthus peroni*	Potbelly leatherjacket	0.001	0.44	Below	0.65	Below	0.87	Below	Low	NE	No RR required	Low
37465024	*Paramonacanthus filicauda*	Threadfin leatherjacket	0.002	0.44	Below	0.65	Below	0.87	Below	Low	NE	No RR required	Low
37466002	*Anoplocapros inermis*	Eastern smooth boxfish	<0.001	-	Below	-	Below	-	Below	Low	NE	No RR required	Low
37467007	*Lagocephalus sceleratus*	Silver toadfish	0.002	0.4	Below	0.59	Below	0.79	Below	Low	NE	No RR required	Low
37467010	*Feroxodon multistriatus*	Ferocious puffer	0.001	0.42	Below	0.63	Below	0.84	Below	Low	NE	No RR required	Low
37467012	*Lagocephalus lunaris*	Rough golden toadfish	0.002	0.4	Below	0.6	Below	0.81	Below	Low	NE	No RR required	Low
37467015	*Chelonodon patoca*	Milkspotted puffer	0.002	0.42	Below	0.63	Below	0.84	Below	Low	NE	No RR required	Low
37467017	*Lagocephalus spadiceus*	Brownback toadfish	0.002	0.4	Below	0.6	Below	0.81	Below	Low	NE	No RR required	Low
37469004	*Tragulichthys jaculiferus*	Longspine burrfish	0.002	0.55	Below	0.82	Below	1.1	Below	Low	NE	No RR required	Low
37469007	*Cyclichthys orbicularis*	Shortspine porcupinefish	0.002	0.55	Below	0.82	Below	1.1	Below	Low	NE	No RR required	Low
37469008	*Cyclichthys hardenbergi*	Plain porcupinefish	0.002	0.55	Below	0.82	Below	1.1	Below	Low	NE	No RR required	Low

Risk ranking guidelines:

1	Risk rating due to missing, incorrect or out of date information	4	Effort and catch management arrangements for target and byproduct species
2	At risk due to external factors (cumulative risks)	5	Management arrangements to mitigate against the level of bycatch
3	At risk regarding level of interaction/capture with a zero or negligible level of susceptibility	6	Management arrangements relating to seasonal, spatial and depth closures

2.5.5 bSAFE - Protected species

There were three protected species considered in this SAFE (Figure 2.14a, b). All species were low risk.

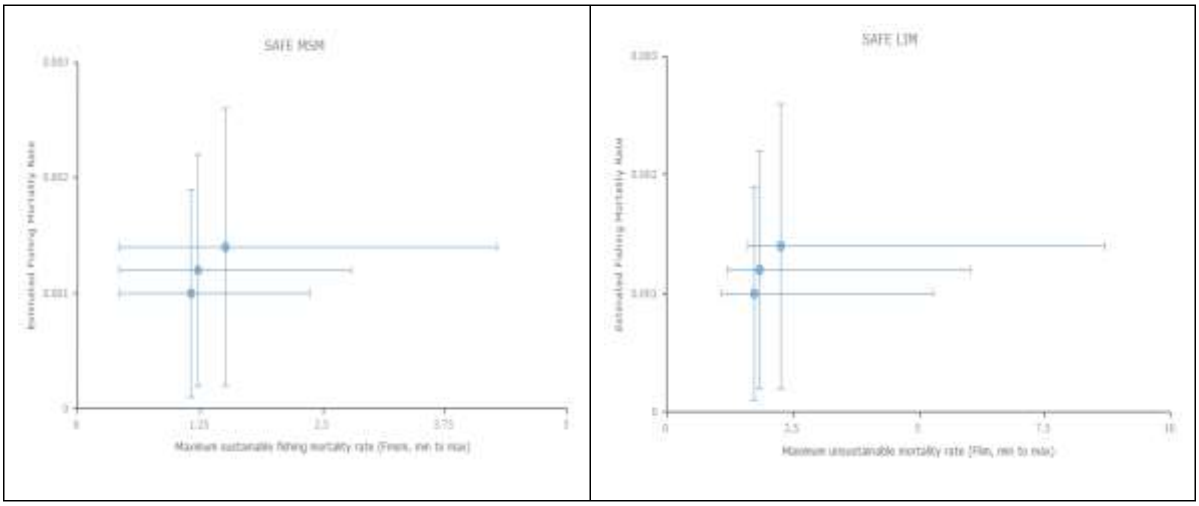

Figure 2.14 SAFE plot for protected species in the NPF Banana Prawn sub-fishery for (a) SAFE-MSM reference point [left] and (b) SAFE limit (LIM) reference point [right].

Table 2.33. bSAFE risk categories for protected species ecological component for F_MSM, F_Lim and F_crash. Note: a residual risk analysis (RR) was not examined for this sub-fishery, if the risk score was medium or low. Catch from Commonwealth logbook (LOG) and observer (OBS) databases. NE: not entered. A: Alive; D: Dead.

CAAB CODE	SCIENTIFIC NAME	COMMON NAME	SUSCEPT-IBILITY	F MSM	F MSM RISK	F LIM	F LIM RISK	F CRASH	F CRASH RISK	F OVERALL RISK	CATCH (2012-2016) AND OTHER INFORMATION	RISK SCORE FOLLOWING RESIDUAL RISK	FINAL RISK SCORE
37282101	*Trachyrhamphus longirostris*	Straightstick pipefish	0.001	1.23	Below	1.84	Below	2.46	Below	Low	NE	No RR required	Low
37282006	*Trachyrhamphus bicoarctatus*	Bentstick pipefish	0.001	1.16	Below	1.74	Below	2.32	Below	Low	NE	No RR required	Low
37282124	*Hippocampus multispinus*	Northern spiny seahorse	0.001	1.51	Below	2.26	Below	3.02	Below	Low	NE	No RR required	Low

2.6 Habitat Component

The Habitat component was not assessed at Level 2, as it is outside the project scope.

2.7 Community Component

The Community component was eliminated at Level 1.

2.8 Decision rules to move from Level 2 to Level 3 (Step 7)

For the PSA overall risk values, units that fall in the upper third (risk value > 3.18) and middle third (2.64 < risk value < 3.18) of the PSA plots are deemed to be at high and medium risk, respectively. For the SAFE method, species that fall above the SAFE-MSM or limit reference point (SAFE-LIM) are considered to be at risk of overfishing (Table 2.31). Species identified from either method need to be the focus of further work, either through implementing a management response to address the risk to the vulnerable species or by further examination for risk within the ecological component at Level 3. PSA-units at low risk, (i.e. in the lower third), or at SAFE where units were below the overfishing limit point (i.e. SAFE-LIM) will be deemed not at risk from the sub-fishery and the assessment is concluded for these units.

The output from the Level 2 analysis will result in four options:

- The risk of a unit of analysis within a component (e.g. single species or habitat type) is not high, the rationale is documented, and the impact of the fishing activity on this unit need not be assessed at a higher level unless management or the fishery changes.
- The risk of a unit is high, but management strategies are introduced rapidly that will reduce this risk, this unit need not be assessed further unless the management or the fishery changes.
- The risk of a unit is high but there is additional information that can be used to determine if Level 3, or even a new management action is required. This information should be sought before action is taken.
- The risk of a unit is high and there are no planned management interventions that would remove this risk; therefore, the reasons are documented and the assessment moves to Level 3.

At the conclusion of the Level 2 analysis, a fishery can decide to further investigate the risk of fishing to the species via a Level 3 assessment or implement a management response to mitigate the risk. To ensure all fisheries follow a consistent process in responding to the results of the risk assessment, AFMA has developed an ecological risk management framework. The framework (Figure 2.15) makes use of the existing AFMA management structures to enable the ERAs to become a part of normal fisheries management, including the involvement of fisheries consultative committees. A separate document, the ERM report, will be developed that outlines the reasons why species are at high risk and what actions the fishery will implement to respond to the risks.

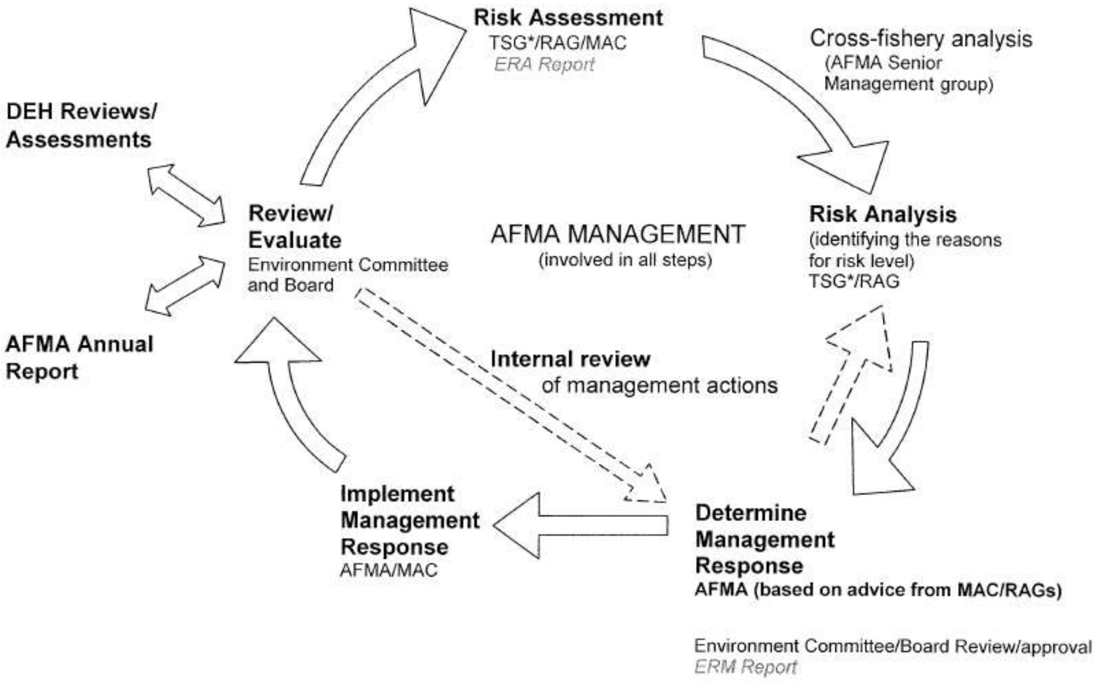

Figure 2.15. Schematic of the Ecological risk management cycle. TSG – Technical Support Group.

2.9 Extreme and high-risk categorisation (Step 8): update with Residual Risk information

PSA

Byproduct species: A residual risk analysis was not required.

Bycatch species: A residual risk analysis was performed on the 17 high risk species (from the 30 initially ranked as un-assessable), resulting in all 17 species reduced to low risk.

Forty-four of these 49 high risk species were reduced to low risk and five species were reduced to medium risk following a residual risk analysis.

Protected species: Of the 39 protected species assessed, nine were high risk (one bird, six marine reptiles, two chondrichthyans), 29 medium risk (12 marine birds, 15 marine reptiles, two chondrichthyans) and one species low risk (one marine bird). A residual risk analysis was performed on the nine high risk species. Of the nine high risk species, two species remained high risk (narrow sawfish *Anoxypristis cuspidata*; dwarf sawfish *Pristis clavata*), six species were reduced to medium risk and one species was reduced to low risk (Crested tern *Thalasseus bergii*). The overall risk score for the remaining two sawfish species increased from medium to a precautionary high risk following a residual risk analysis. These species were green sawfish (*Pristis zijsron*) and freshwater sawfish (*Pristis pristis*).

bSAFE

Byproduct species: No bSAFE was performed for these species, as a PSA was conducted instead.

Bycatch species: No residual risk analysis was required, as all risks scores were classified as low (234).

Protected species: All three species were low risk following a bSAFE analysis, so no residual risk analysis was conducted.

3 General discussion and research implications

3.1 Level 1

In this case, 21 out of 32 possible activities were identified as occurring in this sub-fishery, including all six external scenarios. Thus, a total of 21 activity-component scenarios were considered at Level 1. This resulted in 105 scenarios (of 160 possible) to be developed and evaluated using the unit lists (key commercial/secondary, byproduct/bycatch, protected species, habitats, communities).

3.2 Level 2

3.2.1 Species at risk

A Level 2 analysis was triggered for two ecological components: byproduct/bycatch species, protected species, as risk (consequence) scores were $\geq$3 in the Level 1 SICA analysis.

Residual risk

As discussed elsewhere in this report (Section 1), the ERAEF methods are both hierarchically structured and precautionary. The Level 1 (SICA) analyses are used to identify potential hazards associated with fishing and which broad components of the ecological system they apply to. The Level 2 (PSA) analyses consider the direct impacts of fishing on individual species and habitats (rather than whole components), but the large numbers of species that need to be assessed and the nature of the information available for most species in the PSA analyses limits these analyses in several important respects. These include that some existing management measures are not directly accounted for, and that no direct account is taken of the level of mortality associated with fishing. Both these factors are taken into account in the ERAEF framework at Level 3, but the analyses reported here stop at Level 2. This means that the risk levels for species must be regarded as identifying potential rather than actual risk, and due to the precautionary assumptions made in the PSA analyses, there will be a tendency to overestimate absolute levels of risk from fishing.

In moving from ERA to ERM, AFMA will focus scarce resources on the highest priority species and habitats (those likely to be most at risk from fishing). To that end, and because Level 3 analyses are not yet available for most species, AFMA (with input from CSIRO and other stakeholders) has developed guidelines to assess "residual risk" for those species identified as being at high potential risk based on the PSA analyses. The residual risk guidelines will be applied on a species-by-species basis and include consideration of existing management measures not currently accounted for in the PSA analyses, as well as additional information about the levels of direct mortality. These guidelines will also provide a transparent process for including more precise or missing information into the PSA analysis as it becomes available.

CSIRO and AFMA will continue to work together to include the broad set of management arrangements in Level 2 analyses, and these methods will be incorporated in future developments of the ERAEF framework. CSIRO has also undertaken some preliminary Level 3 analyses for bycatch species for several fisheries, and these or similar methods will also form part of the overall ERAEF framework into the future.

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Glossary of Terms

Assemblage	A subset of the species in the community that can be easily recognized and studied. For example, the set of sharks and rays in a community is the Chondricythian assemblage.
Attribute	A general term for a set of properties relating to the productivity or susceptibility of a particular unit of analysis.
Bycatch species	A non-target species captured in a fishery, usually of low value and often discarded (see also Byproduct).
Byproduct species	A non-target species captured in a fishery, but it may have value to the fisher and be retained for sale.
Community	A complete set of interacting species.
Component	A major area of relevance to fisheries with regard to ecological risk assessment (e.g. target species, bycatch and byproduct species, threatened and endangered species, habitats, and communities).
Component model	A conceptual description of the impacts of fishing activities (hazards) on components and sub-components, linked through the processes and resources that determine the level of a component.
Consequence	The effect of an activity on achieving the operational objective for a sub-component.
Core objective	The overall aim of management for a component.
End point	A term used in risk assessment to denote the object of the assessment; equivalent to component or sub-component in ERAEF
Ecosystem	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).
External factor	Factors other than fishing that affect achievement of operational objectives for components and sub-components.
Fishery method	A technique or set of equipment used to harvest fish in a fishery (e.g. long-lining, purse-seining, trawling).
Fishery	A related set of fish harvesting activities regulated by an authority (e.g. Southern and Eastern Scalefish and Shark Fishery).
F_MSM	Maximum sustainable fishing mortality
F_Lim	Limit fishing mortality which is half of the maximum sustainable fishing mortality
F_Crash	Minimum unsustainable fishing mortality rate that may lead to population extinction in the longer term
Habitat	The place where fauna or flora complete all or a portion of their life cycle.
Hazard identification	The identification of activities (hazards) that may impact the components of interest.

Indicator	Used to monitor the effect of an activity on a sub-component. An indicator is something that can be measured, such as biomass or abundance.
Likelihood	The chance that a sub-component will be affected by an activity.
Operational objective	A measurable objective for a component or sub-component (typically expressed as "the level of X does not fall outside acceptable bounds")
Precautionary approach	The approach whereby, if there is uncertainty about the outcome of an action, the benefit of the doubt should be given to the biological entity (such as species, habitat or community).
PSA	Productivity-Susceptibility Analysis. Used at Level 2 in the ERAEF methodology.
Scoping	A general step in an ERA or the first step in the ERAEF involving the identification of the fishery history, management, methods, scope and activities.
SICA	Scale, Impact, Consequence Analysis. Used at Level 1 in the ERAEF methodology.
Sub-component	A more detailed aspect of a component. For example, within the target species component, the sub-components include the population size, geographic range, and the age/size/sex structure.
Sub-fishery	A subdivision of the fishery on the basis of the gear or areal extent of the fishery. Ecological risk is assessed separately for each sub-fishery within a fishery.
Sustainability	Ability to be maintained indefinitely.
Target species	A species or group of species whose capture is the goal of a fishery, sub-fishery, or fishing operation.
Trophic position	Location of an individual organism or species within a foodweb.
Unit of analysis	The entities for which attributes are scored in the Level 2 analysis. For example, the units of analysis for the Target Species component are individual "species", while for Habitats, they are "biotypes", and for Communities the units are "assemblages".

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