



Australian Government

Australian Fisheries Management Authority



# Ecological Risk Management

REPORT FOR THE NORTHERN PRAWN FISHERY  
TIGER AND BANANA PRAWN SUB-FISHERIES

February 2012

## Summary of priority issues for managing the ecological effects of fishing in the Northern Prawn Fishery

The ecological risk assessment (ERA) process was designed to assess and rank the ecological effects of fishing in Commonwealth fisheries. The ERA process for the Northern Prawn Fishery (NPF) analysed the effect of commercial fishing, based on the effects on all organisms (protected species, bycatch, byproduct and target species), habitats and ecological communities that occur in the area of the fishery.

The process provided a list of species, habitats and ecological communities that are at risk of ecological damage from the effects of fishing. The ecological effects of fishing in the NPF are largely due to the incidental capture of non-target species (including the capture of protected species). The methods of fishing employed in the NPF were found to have little to no detrimental impact on the physical marine environment.

The highest level of ERA assessment conducted on the NPF is a quantitative Level 2.5 assessment. The initial ERA process was completed in 2009 and identified seven species at high risk to the effects of fishing in the NPF (Table 1).

**Table 1 Priority species list from the initial ERA process for the NPF**

Taxonomic Group	Scientific Name	Common Name	Role in Fishery	Highest Level of Assessment	Risk Score
Chondrichthyan	<i>Taeniura meyeni</i>	Blotched fantail ray	DI	SAFE	Extreme High Risk
	<i>Urogymnus asperrimus</i>	Porcupine ray	DI	SAFE	Extreme High Risk
Teleost	<i>Dendrochirus brachypterus</i>	Dwarf lionfish	DI	SAFE	Precautionary Extreme High Risk
	<i>Scorpaenopsis venosa</i>	Raggy scorpionfish	DI	SAFE	Precautionary Extreme High Risk
Invertebrate	<i>Solenocera australiana</i>	Prawn	BP	Level 2 PSA	High
	<i>Dictyosquilla tuberculata</i>	Mantis shrimp	BP	Level 2 PSA	High
	<i>Harpiosquilla stephensoni</i>	Mantis shrimp	BP	Level 2 PSA	High

A recommendation on the Wildlife Trade Operation (WTO) approval under the *Environment, Protection and Biodiversity Conservation Act 1999* (EPBC Act) was that the Level 2.5 Sustainability Assessment for Fishing Effects (SAFE) assessment be run again. The reason for this was to update the fishing effort data in the assessment to reflect changes in fishing effort since the most recent structural adjustment which significantly reduced the fishing capacity of the NPF fleet. This SAFE assessment coupled with updated information since the last Ecological Risk Management report (ERM) was produced has resulted in a new set of priority species for the NPF (Table 2).



**Table 2 Current list of priority species for the NPF, which AFMA will focus ERM efforts**

Taxonomic Group	Scientific Name	Common Name	Role in Fishery	Highest level of Assessment	Risk Score
Chondrichthyan	<i>Urogymnus asperrimus</i>	Porcupine ray	DI	SAFE	Precautionary High risk
Invertebrate	<i>Dictyosquilla tuberculata</i>	Mantis shrimp	BP	Level 2 PSA	High
	<i>Harpiosquilla stephensoni</i>	Mantis shrimp	BP	Level 2 PSA	High

This ERM report outlines how AFMA will respond to the high risk environmental components in the NPF to reduce the effects of fishing on the species in the priority list.

No target or protected species were assessed to be at high risk from the effects of fishing in the NPF, however consistent with AFMA’s ERM process, all protected species that the fishery may interact with are managed to minimise interactions and fatalities.

Priority issues for managing the ecological effects of fishing in the NPF will largely be captured by the actions within the NPF Bycatch and Discarding Workplan. There are however a number of other initiatives aimed at managing the ecological effects of fishing in the NPF, including mandatory use of Bycatch Reduction Devices (BRDs) and Turtle Excluder Devices (TEDs), the NPF Harvest Strategy and the Scientific and Crew Member Observer (CMO) Programs.



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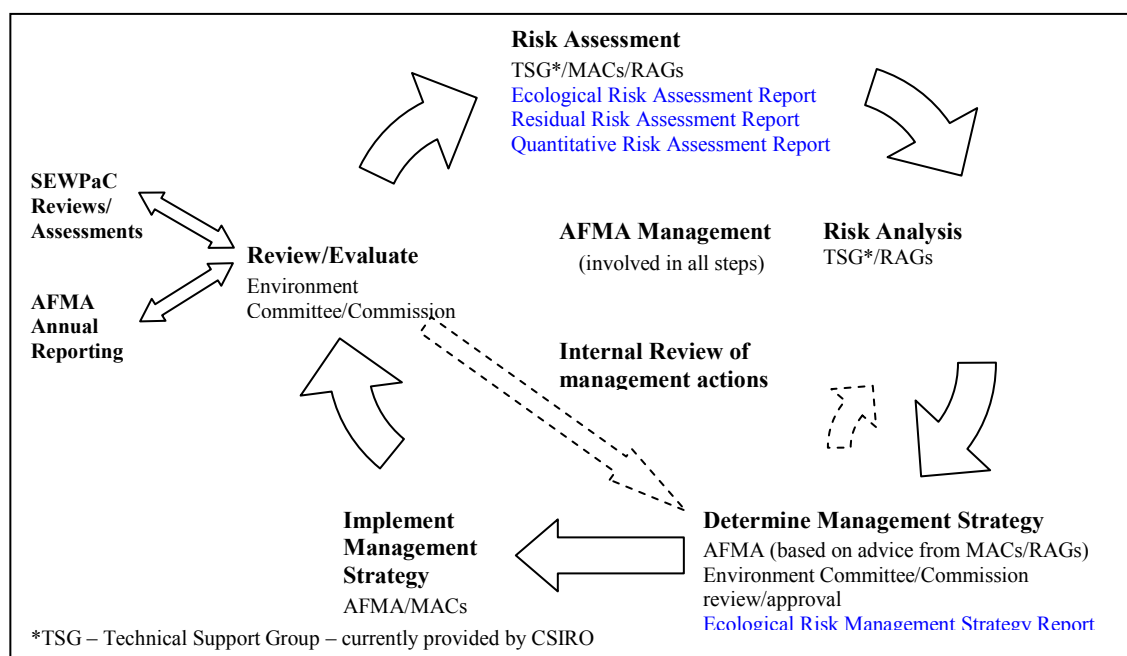


## Overview

### **Implementing ecological risk management in Commonwealth managed fisheries**

AFMA aims to minimise the impacts of Commonwealth managed fisheries on all aspects of the marine ecosystem. AFMA’s adoption of the ecological component of Ecologically Sustainable Development (ESD) is a significant departure from traditional fisheries management with the focus shifted from the direct management of target species to also considering the impacts on bycatch species, Threatened, Endangered and Protected (TEP) species, habitats, and communities.

Key to AFMA’s implementation of the ecological component of ESD has been the development and implementation of an ecological risk management (ERM) framework (Figure 1). The framework details a robust and transparent process to assess, analyse and respond to the ecological risks posed by Commonwealth managed fisheries.

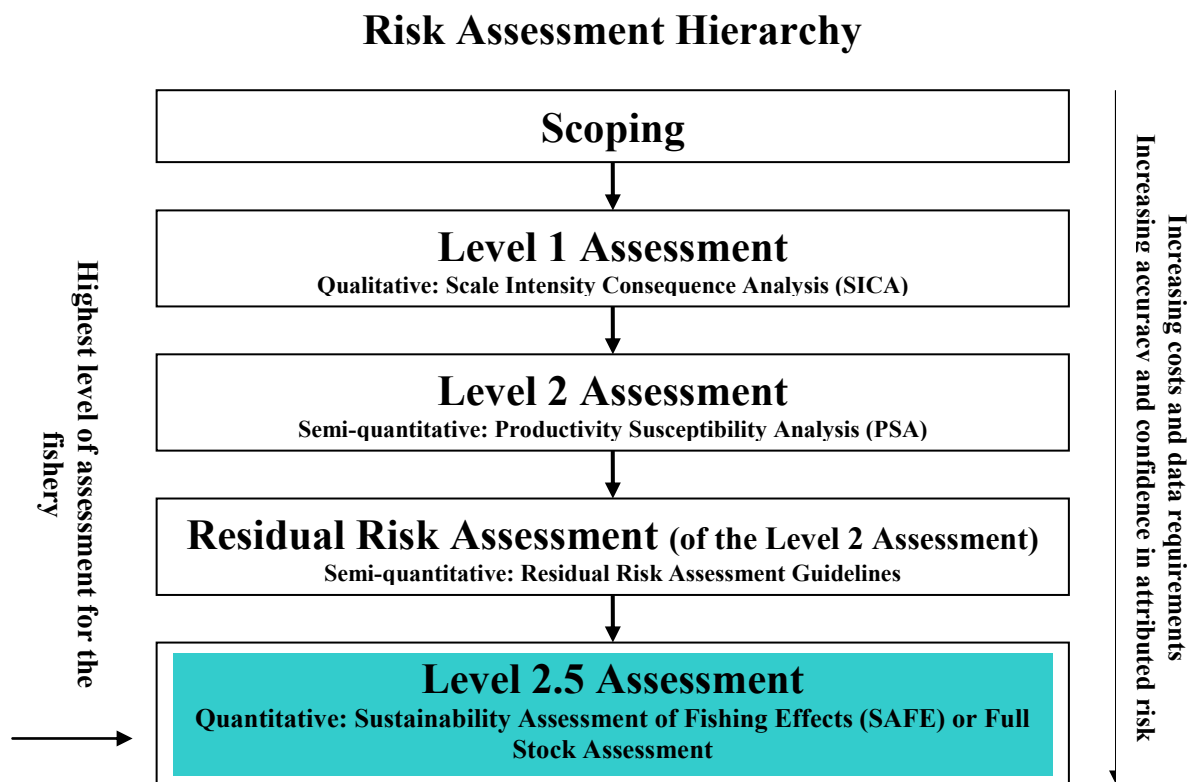


**Figure 1: Ecological Risk Management framework**

The ERM framework progresses through a number of steps and involves a hierarchy of risk assessment methodologies progressing from a comprehensive but largely qualitative analysis at Level 1 to a quantitative analysis at Level 3 (Figure 2). This approach is a cost and time efficient means of screening out low risk activities and focusing more intensive and quantitative analyses on those activities assessed as having a greater environmental impact on AFMA managed fisheries resources.

The initial assessment stage involves the development of a qualitative Ecological Risk Assessment (ERA) for each individual fishery. ERAs assess the impact, direct and indirect, that a fishery’s activities may have on the marine ecosystem. These assessments provide the foundation for further risk assessment and analysis. While it has been a long and complex process, ERAs have now been completed (to varying degrees – either Level 1, 2 or 3) for all major Commonwealth managed fisheries.

The next stage of the assessment process involves the development of a residual risk assessment of the outcomes of the qualitative Level 2 PSA assessment for each individual fishery. Level 2 PSA Residual Risk assessments evaluate and refine ERA high risk outcomes by taking into account additional information not considered through the ERA process, in particular the mitigating effects of some current management arrangements. In addition to the residual risk process, a number of fisheries have also undergone further quantitative risk assessment (Level 3 assessment).



**Figure 2: Risk assessment hierarchy**

The combined results of the risk assessments are now the focus for the development and implementation of this ERM strategy. Further information on the risk assessment process and methodologies applied can be found on AFMA’s website.

### ***Developing an ecological risk management (ERM) strategy***

The priority list for the NPF fishery was developed using:

- the SAFE methodology (2.5 Level Assessment) for any teleost and chondrichthyan species identified as precautionary high risk or above (conducted in 2007 and 2011 to update fishing effort information); and
- Level 2 PSA Residual Risk for all other non-TEP species identified as high risk.

In addition, all reasonable steps will be taken to minimise interactions with TEP species which have been identified through the ERA process.

Once identified, species that form the priority list for each fishery will be managed either through fishery specific arrangements or under one or more of the following policies or measures:

- Harvest Strategy Policy and Guidelines;



- Byproduct Species Policy;
- Bycatch and Discarding Workplan;
- Shark Policy and the Chondrichthyan Guide for Fisheries Managers; and
- TEP species under various international plans of action, recovery plans including:
  - Recovery for Marine Turtles in Australia
  - National Plan of Action and Conservation and Management of Sharks, and
  - National Recovery Plan for Whale Sharks.

The NPF ERM strategy clearly identifies how each species or group of species may be managed under the policies or measures described above.

ERM strategies to address those remaining species identified as at medium or low risk may be implemented at a later date. Due to limitations in the ERA methodology, for assessing the impacts of fishing operations on habitats and communities, AFMA will defer the development of an ERM strategy for these components until more refined and meaningful results become available.



## Ecological Risk Management Priority List

The risks that the NPF poses to the sustainability of the marine ecosystem have been assessed through the application of a progression of risk assessment methodologies, as described in Figure 2.

Assessments undertaken for the fishery include:

1. an individual ERA completed to Level 2 in June 2006;
2. a residual risk assessment completed in July 2007;
3. a rapid quantitative risk assessment completed in July 2007; and
4. a re-run of the rapid quantitative assessment completed in February 2011.

A summary of the results of each level of assessment for the fishery are provided in Attachment 1.

### ***NPF Priority Species List***

The initial outcomes of each assessment were compiled to form a priority species list for the fishery (Attachment 2). Following evaluation and discussion by the NPF Bycatch Subcommittee and scientific experts in 2009, 20 species were removed from the list. Seven species remained as priorities for the fishery, after the initial run of the ERA.

The WTO accreditation for the NPF under the EPBC Act contains a recommendation that a Level 2.5 assessment was to be re-run to include recent catch and effort data for the fishery. The re-run of the SAFE assessment produced five species of elasmobranch at Precautionary High Risk. Examination of additional information available on these species, including biological and behavioural, suggested that the true risk of mortality from the NPF was overestimated. This examination resulted in these species being removed from the final list of priority species. The SAFE report further concluded that it is likely that no elasmobranchs are at true risk of unsustainable capture during NPF tiger prawn fishing. The re-run of the Level 2.5 assessment reduced the list of priority species from three to one for this level of assessment.

Since the completion of the initial Level 2 residual risk assessment another species of invertebrate has been removed from the list by expert opinion. Fry *et al* 2009 stated that “the ‘at risk’ prawn species has a widespread distribution across the northern Australian EEZ and is consistently caught in significant numbers in NPF trawls. We conclude that this species is unlikely to be at risk and should be removed from the list of species being monitored”.

The NPF priority list (**Table 3**) subsequent to running the ERA process is made up of one chondrichthyan and two invertebrates:

- one species identified through the Level 2.5 assessment as precautionary high risk; and
- two species identified through the Level 2 residual risk assessment as high risk.

The species that were removed following the re-run of the Level 2.5 SAFE assessment (one elasmobranch and two teleosts) will continue to be monitored by the AFMA Scientific Observer and CMO Programs.

The nature of trawling operations means that it is difficult to design measures which mitigate the capture of a single species. As such, the aim of the NPF ERM is to mitigate the capture of entire groups of like-species.



**Table 3 Priority Species List for the NPF**

Taxonomic Group	Scientific Name	Common Name	Role in Fishery	Highest Level of Assessment	Risk Score	ERM Strategy to be applied
Chondrichthyan	<i>Urogymnus asperrimus</i>	Porcupine ray	DI	SAFE	Precautionary Extreme High Risk	<ul style="list-style-type: none"> <li>• NPF Bycatch and Discarding Workplan</li> <li>• CMO and Scientific Observer program</li> </ul>
Invertebrate	<i>Dictyosquilla tuberculata</i>	Mantis shrimp	BP	Level 2 PSA	High	<ul style="list-style-type: none"> <li>• NPF Bycatch and Discarding Workplan</li> <li>• CMO and Scientific Observer program</li> <li>• Byproduct species policy (pending)</li> </ul>
	<i>Harpiosquilla stephensoni</i>	Mantis shrimp	BP	Level 2 PSA	High	<ul style="list-style-type: none"> <li>• NPF Bycatch and Discarding Workplan</li> <li>• CMO and Scientific Observer program</li> <li>• Byproduct species policy (pending)</li> </ul>

## Ecological Risk Management Strategy

The NPF is currently managed through a series of effort controls including: temporal and spatial closures, limited entry and restrictions on gear (Statutory Fishing Rights). As of August 2012 the NPF will be managed under output controls in the form of quota Statutory Fishing Rights (SFRs). There will be three quota SFRs to cover the three quota species (tiger prawns, white banana prawns and red-legged banana prawns), each of which will have an annual Total Allowable Catch (TAC) set. The setting of TACs for the target species will be conducted in line with the NPF Harvest Strategy, which also controls for the catch of some byproduct species (blue endeavour prawns, Scampi, Squid and Bugs).

Fishers will continue to be required to use TEDs and BRDs when fishing in the NPF. Priority species identified through the ERA process, and TEP species are monitored through a combination of the AFMA Scientific Observer and CMO Programs.

To address the four species identified as priorities through the ERA assessment, the ERM strategy for the NPF will employ a number of fisheries management policies and measures to deliver appropriate actions to mitigate risk posed by the fishery. A summary of ERM strategies and actions for the NPF are provided in Table 4.

**Table 4 ERM strategies and actions in the NPF**

ERM Strategy	Action
<b>Harvest Strategies for Key Commercial (Target and Some Byproduct) Species</b>	<ul style="list-style-type: none"> <li>• Annual setting of TAC's for the three main target species (tiger, banana and red-legged banana prawns).</li> <li>• The Harvest Strategy also includes other catch triggers and limits for various byproduct species. All operators will adhere to byproduct limits specified in the harvest strategy.</li> </ul>
<b>Management of Byproduct Species</b>	<ul style="list-style-type: none"> <li>• When completed, AFMA will implement the byproduct policy with specific focus given to three of the four priority species.</li> </ul>
<b>Managing Bycatch and Discards</b>	<ul style="list-style-type: none"> <li>• All operators will adhere to current BRD and TED requirements.</li> </ul>
<b>Protected (TEP) Species</b>	<ul style="list-style-type: none"> <li>• Operators to continue to report all interactions with TEP species to AFMA</li> <li>• AFMA to report all interactions to Department of Sustainability, Environment, Water, Populations and Communities (SEWPaC).</li> <li>• All operators to adhere to current BRD and TED requirements, and continue to minimise interactions with all TEP species.</li> </ul>
<b>Additional Fishery Specific Management Arrangements</b>	<ul style="list-style-type: none"> <li>• CSIRO, industry and AFMA to continue to monitor and analyse data collected through the AFMA Scientific Observer and CMO Programs, with specific attention to filling knowledge gaps for bycatch species.</li> </ul>

### ***Harvest Strategies for key commercial (target and select byproduct) species***

The implementation of Harvest Strategies for all Commonwealth managed fisheries is a key component of AFMA's management of key commercial species (target and select byproduct). Target species are typically the most highly sought after component of the catch taken in a



fishery. In recent years the harvest of target species in the NPF have resulted in it being the most valuable Commonwealth managed fishery.

Individual Harvest Strategies set out clear decision rules to manage fisheries in an environmentally sustainable manner while also ensuring maximum economic returns. In 2011, the NPF Harvest Strategy was developed for three target species and a number of byproduct species in the NPF. The document specifically provides an operating framework which will deliver stock sustainability and maximise economic return for the NPF.

**Target Species:** White banana, red-legged banana, grooved tiger, brown tiger prawns.

**Byproduct Species:** Blue endeavour, red endeavour, western king, red-spot king and giant tiger prawns, Bugs, Scampi, Squid, Mud Crab, ornate tropical rock lobster, northern saucer scallop, Emperor, Seabream, Trout, cod, Groupers, Longtail Tuna, Snapper and Mackerel.

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**Action:** Annual implementation of catch limits for the three main target species.

All operators will adhere to catch triggers and limits on byproduct species specified in the harvest strategy.

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### **Management of byproduct species**

AFMA is currently developing a policy to address gaps in the management of byproduct species in Commonwealth fisheries. Once developed, two of the three priority species for the NPF will fall under this policy; two mantis shrimps (*Dictyosquilla tuberculata* and *Harpisquilla stephensoni*). Other byproduct groups for the NPF will also fall under this policy.

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**Action:** On completion, AFMA will implement the byproduct policy with specific focus given to two of the priority species.

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### **Managing bycatch and discards**

AFMA's program for addressing bycatch and discarding in Commonwealth managed fisheries was released in March 2008. The program implements a two streamed approach for minimising and mitigating against capture of bycatch and TEP species as well as strategies to minimise discards of target and quota species.

The main features of the Bycatch and Discarding Workplan are to specify management measures to monitor and reduce interactions with high risk and protected species, and prevent discarding of target species. The Workplan defines a range of actions to be undertaken within the fishery to respond to the outcomes of the ERA and ERM processes.

The Workplan outlines a number of projects aimed at reducing bycatch across the fishery. Projects will incorporate a focus on reducing the impact on priority species for the fishery, as well as reducing the overall bycatch to the fishery. A main component of the second iteration of the Workplan is to undertake a review of the effectiveness of BRD's currently approved for use in the fishery and to further review the types of BRDs currently being used in the fishery. In addition, an extension program on the most effective BRD's and how best to use them will be conducted.

Another key component of the Workplan is to improve reporting in the NPF. There are a range of reasons why species can be assessed as at risk or high risk in a fishery, including a lack of information. For example, the impact of the fishery on invertebrates is not well understood. There are critical information gaps on this group of species that when filled will inform the risk assessment process. Projects listed in the Workplan will focus on gathering information on catch rates and biology for key bycatch species.

Monitoring programs including the AFMA Scientific Observer and CMO Programs will also focus on filling these information gaps.



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**Actions:** All operators will adhere to current BRD and turtle exclusion devices (TEDs) requirements.

A contractor to run a desktop evaluation of the information available on currently approved BRD's and the types of BRDs currently being used in the NPF.

Conduct an extension program on the effectiveness of BRDs approved for use in the NPF, targeting both owners and skippers.

CMO and Scientific Observers to continue to collect data on bycatch of trawl operations, with some focus on high priority species identified through the ERA.

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### ***Protected (TEP) species***

NPF operations interact with several groups of TEP species including sawfish, sea snakes, turtles, sharks, syngnathids and to a limited extent marine mammals and birds. Theoretically, there are 128 TEP species that occur within the waters of the NPF. These include eight species of sharks/rays, 12 species of seabirds, 23 species of marine mammals, 41 species of marine reptiles and 44 species of bony fish. Consistent with good fisheries management practices and the specific requirements of the EPBC Act, AFMA will take all reasonable steps to ensure that interactions with these TEP species are minimised. All TEP species to be addressed in the NPF are listed in Attachment 3.

All TEP species identified through the ERA process (as occurring in the area of the fishery) will automatically be a priority for the fishery. Many of these species are already managed under various plans of action including the:

- Recovery Plan for Marine Turtles in Australia;
- National Plan of Action and Conservation and Management of Sharks, and
- National Recovery Plan for Whale Sharks.

Turtle mitigation has been successfully addressed with the mandatory introduction of TEDs into the fishery in 2000. Development of TEDs will continue to pursue minimal interactions with marine turtles. BRDs have also been mandated into the fishery and are aimed at reducing fish bycatch. A new BRD that was legislated as an approved device has also shown excellent results in allowing the escapement of sea snakes from nets.

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**Actions:** Operators to continue to report all interactions with TEP species to AFMA.

AFMA to report all interactions to SEWPaC.

All operators to adhere to current BRD and TED requirements, and continue to minimise interactions with all TEP species.

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### ***Additional fishery specific management arrangements***

In addition to the policies and measures detailed above, the NPF has also implemented a number of monitoring programs including Logbooks, the AFMA Scientific Observer and CMO Programs, and an independent Integrated Monitoring Program. These programs are designed to address deficiencies in scientific knowledge highlighted in the ERA process.

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**Actions:** CSIRO and AFMA to continue to monitor and analyse data collected through the AFMA Scientific Observer and CMO Programs, with specific attention to filling knowledge gaps for bycatch species.

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## Reporting and Review

The reporting mechanisms and frameworks that are in place within each of the policies and measures detailed above will form the principal ERM strategy review components for the fishery. These individual mitigation measures will also be used when providing input to annual reporting requirements for SEWPaC.

Fisheries are encouraged to consider “cross” fishery solutions when implementing measures for species that are identified as at risk across more than one fishery and/or where fishing methods cross fishery boundaries.

Individual fishery Harvest Strategies and Bycatch and Discarding Workplans contain annual and longer term review timeframes and it is expected that the Byproduct Species Policy will do likewise.

A full review of the risk assessments undertaken for each Commonwealth managed fishery will be completed periodically. Outcomes of the ERM strategies and measures described in each fishery’s various work plans and Harvest Strategies will flow into a number of processes including annual reporting to SEWPaC.

On a broader scale the outputs from the annual reviews will be used to form the response to any WTO accreditation or exemption in place in the fishery. It is expected that each fishery will be reassessed against the ERA methodology on a periodic basis in line with the review of any WTO accreditation in place in the fishery.



## Glossary

AFMA	Australian Fisheries Management Authority
Attribute	A general term for a set of properties relating to the productivity or susceptibility of a particular unit of analysis.
Bycatch	That part of fisher's catch which is returned to the sea either because it has no commercial value or regulations preclude it from being retained and;  that part of the catch that does not reach the deck of the fishing vessel but is affected by the interaction with the fishing gear.
Byproduct	A non-target species captured in a fishery that has value to the fisher and may be retained for sale.
Component	The marine ecosystem is broken down into five components for the risk assessment: target species (TA); byproduct (BP) and bycatch species (DI); protected (TEP) species; habitats; and ecological communities.
CSIRO	Commonwealth Scientific and Industrial Research Organisation
EBFM	Ecosystem-based fisheries management considers the impact that fishing has on all of the aspects of the broader marine ecosystem, not just the target species.
ERA	Ecological risk assessment for the effects of fishing as developed by AFMA and CSIRO.
Gear	The equipment used for fishing, e.g. gillnet, Danish seine, pelagic longline, trawl, purse seine, trap etc.
MAC	Management Advisory Committee
RAG	Resource Assessment Group

### Level 2.5 SAFE risk categories

Low risk	where the fishing mortality rate is less than the maximum fishing mortality rate
Medium risk	where the fishing mortality rate is greater than or equal to the maximum fishing mortality rate but less than the minimum biomass limit (where the biomass limit is defined as half of the biomass that supports a maximum sustainable mortality)
Precautionary Medium risk	where the fishing mortality rate is greater than or equal to the minimum sustainable fishing mortality or the fishing mortality rate plus a 90% confidence interval is greater than or equal to maximum fishing mortality
High risk	where the fishing mortality rate is greater than or equal to the minimum biomass limit (where the biomass limit is defined as half of the biomass



that supports a maximum sustainable mortality) but less than the minimum unsustainable fishing mortality rate that, in theory, may lead to population extinction

Precautionary  
High risk

where the fishing mortality rate is greater than or equal to the minimum biomass limit (where the biomass limit is defined as half of the biomass that supports a maximum sustainable mortality) or where the fishing mortality rate plus a 90% confidence interval is greater than or equal to a fishing mortality rate corresponding to limit biomass

Extreme high risk

where the fishing mortality rate is greater than or equal to the minimum unsustainable fishing mortality rate that, in theory, may lead to population extinction (fishing mortality rates that exceed the intrinsic reproductive rate for the species, and as such does represent risk of extinction (in the longer term)).

Precautionary  
Extreme high risk

where the fishing mortality rate is greater than or equal to the minimum unsustainable fishing mortality rate that, in theory, may lead to population extinction or where the fishing rate plus a 90% confidence interval is greater than or equal to the minimum unsustainable fishing mortality rate that, in theory, may lead to population extinction

Precautionary categories (for medium, high and extreme risk) take uncertainty into account from the analyses.

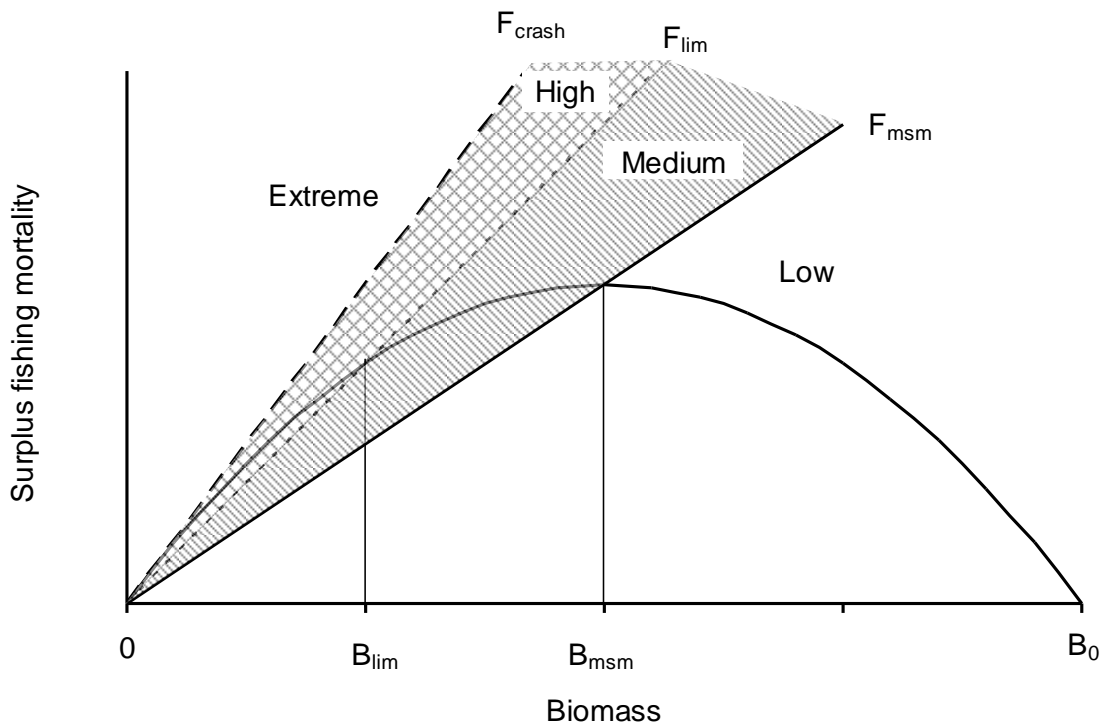


Figure 3: Graphical Representation of the Level 2.5 Assessment Risk Definitions (Dr Tony Smith, 2009)

## **Level 2 PSA**

Residual Risk	In the context of this document residual risk means the residual risk after the Level 2 PSA assessment.
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.
Susceptibility	Used in Level 2 PSA assessment to calculate the impact on an ecological component due to a fishing activity. The extent of the impact due to the fishing activity, determined by the affect of the fishing activities on the unit.





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## Attachment 1

### Summary of ERA results for the NPF

Table 1. Results at each level of assessment for the Tiger prawn sub-fishery.

Level of assessment and risk levels attributed	Target Species	Byproduct Species	Bycatch Species	TEP Species
<b>Level 1 SICA Assessment</b>				
Consequence score (for each species component)	4	4	4	5
Proceeded to Level 2 PSA Assessment (scores $\geq 3$ )	9	135	0	128
<b>Level 2 PSA Assessment</b>				
High Risk		16	N/A	9
Medium Risk	2	19	N/A	62
Low Risk	7	100	N/A	57
<b>Level 2 PSA Residual Risk Assessment</b>				
High Risk	0	14	N/A	9
Medium Risk	2	21	N/A	62
Low Risk	7	100	N/A	57
<b>Level 2.5 SAFE Assessment (updated February 2011)</b>				
Extreme High Risk	N/A	0	0	0
Precautionary Extreme High Risk	N/A	0	0	0
High Risk	N/A	0	0	0
Precautionary High Risk	N/A	0	5	0
Medium Risk	N/A	0	0	0
Precautionary Medium Risk	N/A	0	7	0
Low Risk	N/A	56	406	5
Overlap with Level 2 PSA Residual Risk Assessment	N/A	56	0	5

Table 2. Details the results at each level of assessment for the Banana prawn sub-fishery.

Level of assessment and risk levels attributed	Target Species	Byproduct Species	Bycatch Species	TEP Species
<b>Level 1 SICA Assessment</b>				
Consequence score (for each species component)	4	4	4	5
Proceeded to Level 2 PSA Assessment (scores $\geq 3$ )	9	135	0	128
<b>Level 2 PSA Assessment</b>				
High Risk	0	15	N/A	12
Medium Risk	2	19	N/A	58
Low Risk	7	101	N/A	58
<b>Level 2 PSA Residual Risk Assessment</b>				
High Risk	0	13	N/A	12
Medium Risk	2	21	N/A	58
Low Risk	7	101	N/A	58



## Attachment 2

### ***Highest level of assessment in NPF***

This list below describes the highest level of assessment undertaken for the fishery thus far and included:

- all teleost or chondrichthyan species identified as high risk or above under the Level 2.5 Assessment (SAFE methodology);
- all other non-TEP species identified as high risk under the Level 2 PSA Residual Risk.

Noting that of the 128 TEP species thought to occur within the area of the fishery, seven seasnake species were identified at high risk through these processes.

The list contained a total of 27 species comprising of five chondrichthyans, nine teleosts, six invertebrates and seven marine reptiles; comprising:

- five species identified through the level 2.5 assessment as extreme high risk;
- five species identified through the level 2.5 assessment as precautionary extreme high risk;
- two TEP species identified through the level 2.5 assessment as high risk;
- four species identified through the level 2.5 assessment as precautionary high risk; and
- 11 species (five of which are TEP species) have not undergone a further rapid quantitative risk assessment and are identified as high risk.
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**Table 1: Combined results following the outcomes of the highest level of assessment for the fishery and justifications for species removal**

Taxonomic Group	Scientific Name	Common Name	Role in Fishery	Highest Level of Assessment	Risk Score	Comments	Reference
Chondrichthyan	<i>Orcectolobus ornatus</i>	Banded wobbegong	DI	SAFE	Precautionary Extreme High Risk	Distribution across eastern Australian coast, reef associated. Experts agreed species was not at risk as it did not occur in area of the fishery.	Expert opinion provided by Chondrichthyan Technical Working Group; May 2009. See Last and Stevens (2009), Fishbase (2009) and Fry et al (2009).
	<i>Urogymnus asperrimus</i>	Porcupine ray	DI	SAFE	Precautionary High Risk	To remain on list and continue to be addressed as part of the current monitoring program.	D. Brewer, CSIRO Brisbane, personal communications as referenced in Zhou (2011).
	<i>Carcharhinus albimarginatus</i>	Silvertip shark	DI	SAFE	Precautionary Extreme High Risk	Widely distributed outside of NPF; species has extensive distribution across tropical Indo-Pacific coastal waters; including Indonesian waters. Caught once in the fishery.	See Last and Stevens (2009), Fishbase (2009), Brewer et al 2007 and Fry et al 2009.
	<i>Carcharhinus leucas</i>	Bull shark	DI	SAFE	Precautionary Extreme High Risk	This species was only caught once in a survey trawl, resulting in an estimated 100% of the population affected by tiger prawn fishing. It is very likely that the fishing mortality for this species is over estimated and should not be listed as at risk from NPF activity.	See Zhou (2011)
	<i>Galeocerdo cuvier</i>	Tiger shark	DI	SAFE	Precautionary Extreme High Risk	There is high uncertainty in the estimated fishing mortality and the estimated natural mortality is low, resulting in the high risk score. This tiger shark is widely distributed outside the NPF, and its large size means it should be easily excluded by TEDs.	See Zhou (2011)

Taxonomic Group	Scientific Name	Common Name	Role in Fishery	Highest Level of Assessment	Risk Score	Comments	Reference
	<i>Sphyrna mokarran</i>	Great hammerhead	DI	SAFE	Precautionary Extreme High Risk	There is high uncertainty in the estimated fishing mortality resulting in it being just higher than the natural mortality. The great hammerhead is a highly migratory species, distributed throughout temperate and tropical seas. Its large size should see it easily excluded by TEDs.	See Zhou (2011)
Invertebrate	<i>Euprymna hoylei</i>	Cuttlefish (Bobtail squid)	BP	Level 2 PSA	High	Extremely rare in trawl catches. David Milton examined family level assessment and they were never caught. Reported around the Philippines and northwestern Australia (max 3-4 cm ML). Unlikely to be retained in prawn trawl nets.	Expert opinion provided by Malcolm Dunning and David Milton; May 2009.
	<i>Metasepia pfefferi</i>	Cuttlefish (Flamboyant cuttlefish)	BP	Level 2 PSA	High	Widespread but nowhere abundant in trawl catches throughout northern Australian waters to at least Moreton Bay, on the east coast. Occurs from shallow coral and rocky reefal areas to mid shelf depths. This is a small species (max ~10 cm ML) that probably only lives for a few months.	Expert opinion provided by Malcolm Dunning; May 2009.
	<i>Solenocera australiana</i>	A prawn	BP	Level 2 PSA	High	Species has widespread distribution across northern Australia, consistently caught in significant numbers in trawls. Species unlikely to be at true risk and can be removed.	Expert opinion from Fry <i>et al</i> 2009, Assessing the sustainability of the Northern Prawn Fishery bycatch from annual monitoring data.

Taxonomic Group	Scientific Name	Common Name	Role in Fishery	Highest Level of Assessment	Risk Score	Comments	Reference
	<i>Photololigo sp. 3 and sp 4 of Yeatman (1993)</i>	Broad squid and slender squid	BP	Level 2 PSA	High	Major squid species in trawl byproduct. Species are wide spread across northern Australia (central NSW to Shark Bay WA); catchability in prawn trawls lower at night when squid move up into the water column. However, egg clusters and adults highly susceptible to trawling in spawning grounds (Dunning et al (2000). Current catch at acceptable biological catch limit; see Milton Byproduct Assessment (FRDC 2006/008).	Expert opinion provided by Malcolm Dunning; May 2009. Expert opinion provided by Milton. See Byproduct Assessment (FRDC 2006/008). See Dunning et al (2000).
	<i>Dictyosquilla tuberculata</i>	Mantis shrimp	BP	Level 2 PSA	High	To remain on list and continue to be addressed as part of the current monitoring program.	
	<i>Harpisquilla stephensoni</i>	Mantis shrimp	BP	Level 2 PSA	High	To remain on list and continue to be addressed as part of the current monitoring program.	
Marine Reptile	<i>Hydrophis belcheri</i>	A seasnake	TEP	Level 2 PSA	High	One individual found in northern Papua New Guinea and not found in Australia.	Expert opinion provided by David Milton; May 2009. See Cogger (1992).
	<i>Parahydrophis mertoni</i>	Northern mangrove seasnake	TEP	Level 2 PSA	High (Tiger only)	Found in Mudflats and mangroves and not in depth zone of NPF.	Expert opinion provided by David Milton; May 2009. See Cogger (1992)
	<i>Hydrophis ornatus</i>	A seasnake	TEP	SAFE	Fished less than maximum sustainable mortality (MSM)	Trawl mortality was below reference points. Remove from list as per Milton seasnake assessment (FRDC 2005/051).	Expert opinion provided by David Milton; May 2009. See Seasnake Assessment (FRDC 2005/051).
	<i>Hydrophis pacificus</i>	Large-headed seasnake	TEP	SAFE	Fished less than maximum sustainable mortality (MSM)	Remove from list as per Milton seasnake assessment (FRDC 2005/051).	Expert opinion provided by David Milton; May 2009. See Seasnake Assessment (FRDC 2005/051).

Taxonomic Group	Scientific Name	Common Name	Role in Fishery	Highest Level of Assessment	Risk Score	Comments	Reference
	<i>Hydrophis vorisi</i>	A seasnake	TEP	Level 2 PSA	High (Banana only)	Trawl mortality was below reference points. Remove from list as per Milton seasnake assessment (FRDC 2005/051).	Expert opinion provided by David Milton; May 2009. See Cogger (1992).
	<i>Ephalophis greyi</i>	North-western Mangrove seasnake	TEP	Level 2 PSA	High	Found in eastern Torres Strait only and not in NPF.	Expert opinion provided by David Milton; May 2009. See Cogger (1992).
	<i>Hydrophis coggeri</i>	Slender-necked seasnake	TEP	Level 2 PSA	High	Found in mudflats and mangroves along WA coast and not in depth zone or distributed within NPF.	Expert opinion provided by David Milton; May 2009. See Cogger (1992).

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**TEP Species**

**Table 1: TEP species identified through the ERA process for the NPF**

Taxonomic Group	Scientific Name	Common Name	Role in Fishery	Highest Level of Assessment	Risk Score
Chondrichthyan	<i>Anoxypristis cuspidata</i>	Narrow Sawfish	TEP	SAFE	Fished less than maximum sustainable mortality (MSM)
Chondrichthyan	<i>Glyphis sp C</i>	Speartooth Shark	TEP	Level 2 PSA	Medium
Chondrichthyan	<i>Glyphis sp. A [in Last &amp; Stevens, 1994]</i>	Speartooth Shark	TEP	Level 2 PSA	Medium
Chondrichthyan	<i>Pristis clavata</i>	Dwarf Sawfish	TEP	SAFE	Fished less than MSM
Chondrichthyan	<i>Pristis microdon</i>	Freshwater Sawfish	TEP	SAFE	Fished less than MSM
Chondrichthyan	<i>Pristis pectinata</i>	Wide Sawfish	TEP	SAFE	Fished less than MSM
Chondrichthyan	<i>Pristis zijsron</i>	Green Sawfish	TEP	SAFE	Fished less than MSM
Chondrichthyan	<i>Rhincodon typus</i>	Whale shark	TEP	Level 2 PSA	Medium
Marine bird	<i>Anous minutus</i>	Black noddy	TEP	Level 2 PSA	Low
Marine bird	<i>Anous stolidus</i>	Common noddy	TEP	Level 2 PSA	Low

Marine bird	<i>Calonectris leucomelas</i>	Streaked shearwater	TEP	Level 2 PSA	Medium
Marine bird	<i>Fregata ariel</i>	Lesser frigatebird	TEP	Level 2 PSA	Low
Marine bird	<i>Fregata minor</i>	Great Frigatebird	TEP	Level 2 PSA	Low
Marine bird	<i>Larus novaehollandiae</i>	Silver Gull	TEP	Level 2 PSA	Low
Marine bird	<i>Sterna anaethetus</i>	Bridled Tern	TEP	Level 2 PSA	Low
Marine bird	<i>Sterna bengalensis</i>	Lesser crested tern	TEP	Level 2 PSA	Low
Marine bird	<i>Sterna bergii</i>	Crested Tern	TEP	Level 2 PSA	Low
Marine bird	<i>Sterna dougallii</i>	Roseate tern	TEP	Level 2 PSA	Low
Marine bird	<i>Sterna sumatrana</i>	Black-naped tern	TEP	Level 2 PSA	Low
Marine bird	<i>Sula leucogaster</i>	Brown boobies	TEP	Level 2 PSA	Low
Marine mammal	<i>Balaenoptera bonaerensis</i>	Antarctic Minke Whale	TEP	Level 2 PSA	Medium
Marine mammal	<i>Balaenoptera edeni</i>	Bryde's Whale	TEP	Level 2 PSA	Medium
Marine mammal	<i>Balaenoptera musculus</i>	Blue Whale	TEP	Level 2 PSA	Medium
Marine mammal	<i>Delphinus delphis</i>	Common Dolphin	TEP	Level 2 PSA	Low
Marine mammal	<i>Dugong dugon</i>	Dugong	TEP	Level 2 PSA	Medium

Marine mammal	<i>Feresa attenuata</i>	Pygmy Killer Whale	TEP	Level 2 PSA	Medium
Marine mammal	<i>Globicephala macrorhynchus</i>	Short-finned Pilot Whale	TEP	Level 2 PSA	Medium
Marine mammal	<i>Grampus griseus</i>	Risso's Dolphin	TEP	Level 2 PSA	Medium
Marine mammal	<i>Kogia breviceps</i>	Pygmy Sperm Whale	TEP	Level 2 PSA	Medium
Marine mammal	<i>Kogia simus</i>	Dwarf Sperm Whale	TEP	Level 2 PSA	Medium
Marine mammal	<i>Orcaella brevirostris</i>	Irrawaddy dolphin	TEP	Level 2 PSA	Medium
Marine mammal	<i>Orcinus orca</i>	Killer Whale	TEP	Level 2 PSA	Medium
Marine mammal	<i>Peponocephala electra</i>	Melon-headed Whale	TEP	Level 2 PSA	Medium
Marine mammal	<i>Physeter catodon</i>	Sperm Whale	TEP	Level 2 PSA	Medium
Marine mammal	<i>Pseudorca crassidens</i>	False Killer Whale	TEP	Level 2 PSA	Medium
Marine mammal	<i>Sousa chinensis</i>	Indo-Pacific Humpback Dolphin	TEP	Level 2 PSA	Medium
Marine mammal	<i>Stenella attenuata</i>	Spotted Dolphin	TEP	Level 2 PSA	Medium
Marine mammal	<i>Stenella coeruleoalba</i>	Striped Dolphin	TEP	Level 2 PSA	Medium
Marine mammal	<i>Stenella longirostris</i>	Long-snouted Spinner Dolphin	TEP	Level 2 PSA	Medium
Marine mammal	<i>Steno bredanensis</i>	Rough-toothed Dolphin	TEP	Level 2 PSA	Medium

Marine mammal	<i>Tursiops aduncus</i>	Indian Ocean bottlenose dolphin	TEP	Level 2 PSA	Medium
Marine mammal	<i>Tursiops truncatus</i>	Bottlenose Dolphin	TEP	Level 2 PSA	Medium
Marine mammal	<i>Ziphius cavirostris</i>	Cuvier's Beaked Whale	TEP	Level 2 PSA	Medium
Marine reptile	<i>Acalyptophis peronii</i>	Horned Seasnake	TEP	Level 2 PSA	Medium
Marine reptile	<i>Aipysurus apraefrontalis</i>	Short-nosed Seasnake	TEP	Level 2 PSA	Medium
Marine reptile	<i>Aipysurus duboisii</i>	Dubois' Seasnake	TEP	Level 2 PSA	Medium
Marine reptile	<i>Aipysurus eydouxii</i>	Spine-tailed Seasnake	TEP	SAFE	Medium
Marine reptile	<i>Aipysurus foliosquama</i>	Leaf-scaled Seasnake	TEP	Level 2 PSA	Medium
Marine reptile	<i>Aipysurus fuscus</i>	Dusky Seasnake	TEP	Level 2 PSA	Medium
Marine reptile	<i>Aipysurus laevis</i>	Olive Seasnake, Golden Seasnake	TEP	SAFE	Medium
Marine reptile	<i>Aipysurus tenuis</i>	Brown-lined Seasnake	TEP	Level 2 PSA	Medium
Marine reptile	<i>Astrotia stokesii</i>	Stokes' seasnake	TEP	SAFE	Medium
Marine reptile	<i>Caretta caretta</i>	Loggerhead	TEP	SAFE	Medium
Marine reptile	<i>Chelonia mydas</i>	Green turtle	TEP	SAFE	Medium
Marine reptile	<i>Crocodylus johnstoni</i>	Freshwater crocodile	TEP	Level 2 PSA	Medium

Marine reptile	<i>Crocodylus porosus</i>	Saltwater crocodile	TEP	Level 2 PSA	Medium
Marine reptile	<i>Dermochelys coriacea</i>	Leathery turtle	TEP	SAFE	Medium
Marine reptile	<i>Disteira kingii</i>	Spectacled seasnake	TEP	SAFE	Medium
Marine reptile	<i>Disteira major</i>	Olive-headed Seasnake	TEP	SAFE	Medium
Marine reptile	<i>Emydocephalus annulatus</i>	Turtle-headed Seasnake	TEP	Level 2 PSA	Medium
Marine reptile	<i>Enhydrina schistosa</i>	Beaked Seasnake	TEP	Level 2 PSA	Low
Marine reptile	<i>Ephalophis greyi</i>	North-western Mangrove Seasnake	TEP	SAFE	Fished less than MSM
Marine reptile	<i>Eretmochelys imbricata</i>	Hawksbill turtle	TEP	SAFE	Medium
Marine reptile	<i>Hydrelaps darwiniensis</i>	Black-ringed Seasnake	TEP	Level 2 PSA	Medium
Marine reptile	<i>Hydrophis atriceps</i>	Black-headed seasnake	TEP	Level 2 PSA	Medium
Marine reptile	<i>Hydrophis belcheri</i>	A seasnake	TEP	SAFE	Fished less than MSM
Marine reptile	<i>Hydrophis caeruleus</i>	Dwarf seasnake	TEP	Level 2 PSA	Medium
Marine reptile	<i>Hydrophis coggeri</i>	Slender-necked Seasnake	TEP	SAFE	Fished less than MSM
Marine reptile	<i>Hydrophis czebalukovi</i>	Fine-spined seasnake	TEP	Level 2 PSA	Medium
Marine reptile	<i>Hydrophis elegans</i>	Elegant seasnake	TEP	SAFE	Low

Marine reptile	<i>Hydrophis gracilis</i>	Slender seasnake	TEP	Level 2 PSA	Medium
Marine reptile	<i>Hydrophis inornatus</i>	Plain seasnake	TEP	Level 2 PSA	Medium
Marine reptile	<i>Hydrophis mcdowelli</i>	A seasnake	TEP	SAFE	Medium
Marine reptile	<i>Hydrophis melanosoma</i>	Black-banded robust seasnake	TEP	Level 2 PSA	Medium
Marine reptile	<i>Hydrophis ornatus</i>	A seasnake	TEP	SAFE	Fished less than MSM
Marine reptile	<i>Hydrophis pacificus</i>	Large-headed Seasnake	TEP	SAFE	Fished less than MSM
Marine reptile	<i>Hydrophis vorisi</i>	A seasnake	TEP	SAFE	Fished less than MSM
Marine reptile	<i>Lapemis hardwickii</i>	Spine-bellied Seasnake	TEP	SAFE	Medium
Marine reptile	<i>Laticauda colubrina</i>	Banded wide faced Sea krait	TEP	Level 2 PSA	Medium
Marine reptile	<i>Laticauda laticaudata</i>	Large scaled sea krait	TEP	Level 2 PSA	Medium
Marine reptile	<i>Lepidochelys olivacea</i>	Olive Ridley turtle	TEP	SAFE	Medium
Marine reptile	<i>Natator depressus</i>	Flatback turtle	TEP	SAFE	Medium
Marine reptile	<i>Parahydrophis mertoni</i>	Northern mangrove seasnake	TEP	SAFE	High
Marine reptile	<i>Pelamis platurus</i>	Yellow-bellied seasnake	TEP	Level 2 PSA	Medium
Teleost	<i>Acentronura breviperula</i>	Hairy Pygmy Pipehorse	TEP	SAFE	Low

Teleost	<i>Bhanotia fasciolata</i>	Corrugated Pipefish, Barbed Pipefish	TEP	SAFE	Low
Teleost	<i>Campichthys tricarinatus</i>	Three-keel Pipefish	TEP	SAFE	Low
Teleost	<i>Choeroichthys brachysoma</i>	Pacific Short-bodied Pipefish, Short-bodied pipefish	TEP	SAFE	Low
Teleost	<i>Choeroichthys suillus</i>	Pig-snouted Pipefish	TEP	SAFE	Low
Teleost	<i>Corythoichthys amplexus</i>	Fijian Banded Pipefish, Brown-banded Pipefish	TEP	SAFE	Low
Teleost	<i>Corythoichthys conspicillatus</i>	Yellow-banded Pipefish, Network Pipefish	TEP	SAFE	Low
Teleost	<i>Corythoichthys haematopterus</i>	A pipefish	TEP	SAFE	Low
Teleost	<i>Corythoichthys intestinalis</i>	Australian Messmate Pipefish, Banded Pipefish	TEP	SAFE	Low
Teleost	<i>Corythoichthys ocellatus</i>	Orange-spotted Pipefish, Ocellated Pipefish	TEP	SAFE	Low
Teleost	<i>Corythoichthys schultzi</i>	Schultz's Pipefish	TEP	SAFE	Low
Teleost	<i>Cosmocampus banneri</i>	Roughridge Pipefish	TEP	SAFE	Low
Teleost	<i>Cosmocampus maxweberi</i>	A pipefish	TEP	SAFE	Low
Teleost	<i>Doryrhamphus janssi</i>	Cleaner Pipefish, Janss' Pipefish	TEP	SAFE	Low
Teleost	<i>Doryrhamphus melanopleura</i>	Bluestripe Pipefish	TEP	SAFE	Low
Teleost	<i>Dunckerocampus dactyliophorus</i>	Ringed Pipefish	TEP	SAFE	Low



Teleost	<i>Festucalex cinctus</i>	Girdled Pipefish	TEP	SAFE	Low
Teleost	<i>Filicampus tigris</i>	Tiger Pipefish	TEP	SAFE	Low
Teleost	<i>Halicampus brocki</i>	Brock's Pipefish	TEP	SAFE	Low
Teleost	<i>Halicampus dunckeri</i>	Red-hair Pipefish, Duncker's Pipefish	TEP	SAFE	Low
Teleost	<i>Halicampus grayi</i>	Mud Pipefish, Gray's Pipefish	TEP	SAFE	Low
Teleost	<i>Halicampus macrorhynchus</i>	A pipefish	TEP	SAFE	Low
Teleost	<i>Halicampus spinirostris</i>	Spiny-snout Pipefish	TEP	SAFE	Low
Teleost	<i>Haliichthys taeniophorus</i>	Ribboned Seadragon, Ribboned Pipefish	TEP	SAFE	Low
Teleost	<i>Hippichthys cyanospilos</i>	Blue-speckled Pipefish, Blue-spotted Pipefish	TEP	SAFE	Low
Teleost	<i>Hippichthys heptagonus</i>	Madura Pipefish	TEP	SAFE	Low
Teleost	<i>Hippichthys parvicarinatus</i>	Short-keeled Pipefish	TEP	SAFE	Low
Teleost	<i>Hippichthys penicillus</i>	Beady Pipefish, Steep- nosed Pipefish	TEP	SAFE	Low
Teleost	<i>Hippichthys spicifer</i>	A pipefish	TEP	SAFE	Low
Teleost	<i>Hippocampus angustus</i>	Western Spiny Seahorse	TEP	SAFE	Low
Teleost	<i>Hippocampus jugumus</i>	Spiny Seahorse	TEP	SAFE	Low

Teleost	<i>Hippocampus planifrons</i>	Flat-face Seahorse	TEP	SAFE	Low
Teleost	<i>Hippocampus spinosissimus</i>	Hedgehog Seahorse	TEP	SAFE	Low
Teleost	<i>Hippocampus taeniopterus</i>	Spotted Seahorse, Yellow Seahorse	TEP	SAFE	Low
Teleost	<i>Hippocampus zebra</i>	A pipefish	TEP	SAFE	Low
Teleost	<i>Micrognathus micronotopterus</i>	Tidepool Pipefish	TEP	SAFE	Low
Teleost	<i>Micrognathus pygmaeus</i>	A pipefish	TEP	SAFE	Low
Teleost	<i>Microphis brachyurus</i>	A pipefish	TEP	SAFE	Low
Teleost	<i>Solegnathus guentheri</i>	Indonesian Pipefish, Gunther's Pipehorse	TEP	SAFE	Low
Teleost	<i>Solegnathus sp. 1 [in Kuitert, 2000]</i>	Pipehorse	TEP	SAFE	Low
Teleost	<i>Solenostomus cyanopterus</i>	Blue-finned Ghost Pipefish, Robust Ghost	TEP	SAFE	Low
Teleost	<i>Syngnathoides biaculeatus</i>	Double-ended Pipehorse, Alligator Pipefish	TEP	SAFE	Low
Teleost	<i>Trachyrhamphus bicoarctatus</i>	Bend Stick Pipefish, Short-tailed Pipefish	TEP	SAFE	Low
Teleost	<i>Trachyrhamphus longirostris</i>	Long-nosed Pipefish, Straight Stick Pipefish	TEP	SAFE	Low