Australian Government
Australian Fisheries Management Authority

Ecological Risk Management

REPORT FOR THE WESTERN TUNA AND BILLFISH FISHERY

MARCH 2010

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Summary of priority issues for managing the ecological effects of fishing in the Western Tuna and Billfish Fishery

The Ecological Risk Assessment (ERA) process was designed to assess and rank the ecological effects of fishing in Commonwealth fisheries. The process provided a list of species and habitats or ecological communities that are at risk of ecological damage from the effects of fishing. This Ecological Risk Management (ERM) report provides how AFMA will respond to these high risk environmental components.

The ecological effects of fishing in the Western Tuna and Billfish Fishery (WTBF) are currently minimal, which is in part due to the small amount of effort that is currently exercised in the fishery. The WTBF employs the same method to target species as in the Eastern Tuna and Billfish Fishery. As such there are similar management arrangements in place to deal with the incidental capture of non-target species and ecological effects.

The methods of fishing employed in the WTBF (pelagic longline, handline, trolling, polling and rod and reel) were found to have little or no direct impact on the physical marine environment.

The WTBF is a fishery which targets tuna and tuna-like species; however historical observer and logbook data show that between 30 and 40 species have been taken, many in small amounts, each year. AFMA aims to implement measures which ensure that the take of commercial species is sustainable and minimises the interactions and mortality of species that are not commercially utilised.

The ERA process analysed the effect of commercial fishing in the WTBF, based on the effects on five ecological components: protected species, bycatch, byproduct and target species, habitats and ecological communities that occur in the area of the fishery. The highest level of assessment conducted on the WTBF was a quantitative Level 3 Sustainability Assessment for Fishing Effects (SAFE) assessment.

The Level 3 SAFE assessment on chondrichthyans and teleosts identified no species to be at high risk to the effects of fishing. The Level 2 PSA identified 29 species at high risk (including 2 discard species, 1 byproduct species and 26 protected species) all of which were reduced to either low or medium risk through the Level 2 Residual Risk process.

Two hundred and sixty four protected (TEP) species have been identified as occurring in the area of the fishery. Of these 107 are teleosts, 28 are reptiles, 50 marine mammals, 76 are seabirds and 3 are chondrichthyans. No threatened, endangered and protected (TEP) species were found to be at high risk through the ERA process, however consistent with AFMA's objectives and good fisheries management practices all steps will be taken to minimise interactions with these species within the fishery.

The priority for the WTBF is to maintain the monitoring already conducted in the fishery even while effort is minimal. By continuing to monitor aspects of the fishery such as bycatch, discarding, interactions with TEP species and changes in effort, AFMA will be able to adequately respond to issues in the fishery in an effective and timely manner.

Priority issues for managing the ecological effects of fishing in the WTBF will largely be captured by the actions of the *Australian Tuna and Billfish Longline Fisheries bycatch and discard workplan 2008*. There are however other documents aimed at managing the ecological effects of fishing in the WTBF, these include;

- *Western Tuna and Billfish Fishery Management Plan 2005*
- Western Tuna and Billfish Fishery Harvest Strategy
- Threat Abatement Plan: for the incidental catch (or bycatch) of seabirds during oceanic longline operations
- Recovery Plan for Marine Turtles in Australia (under review as at December 2009)
- Recovery Plans for the Grey Nurse and White Sharks

- ERM action - AFMA to monitor the level of catch and interaction with shark species in the WTBF. If the landed amount of any one shark species reaches a predetermined level AFMA will review its management of shark interactions in this fishery.

Contents

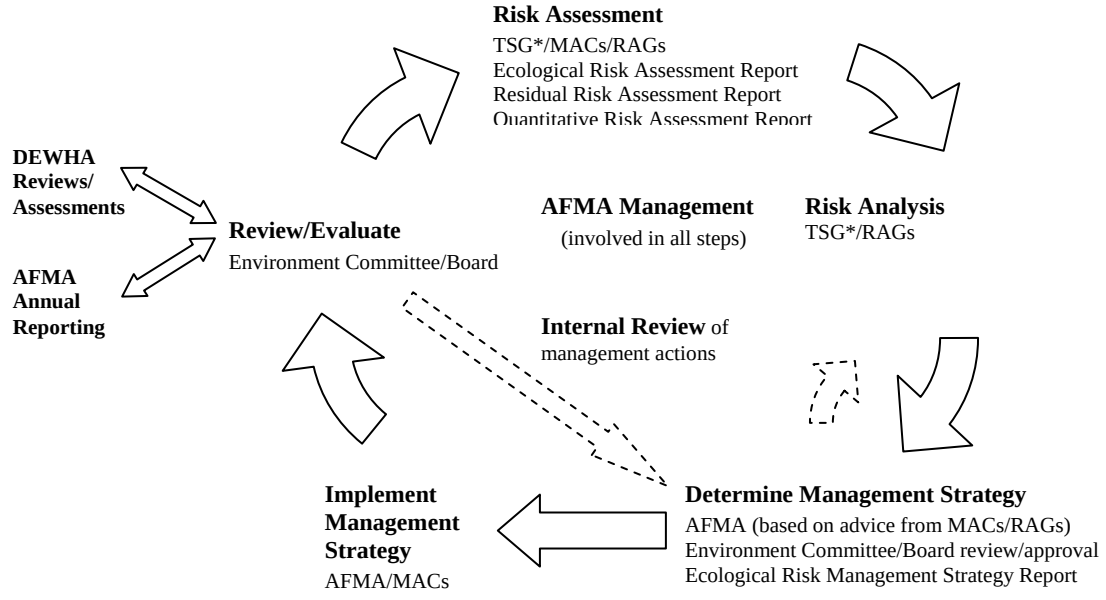
1. Overview of the ERA process

- **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, protected (TEP) species, habitats, and communities.

Key to AFMA's implementation of the ecological component of ESD has been to develop and implement an ecological risk management (ERM) framework (refer to **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

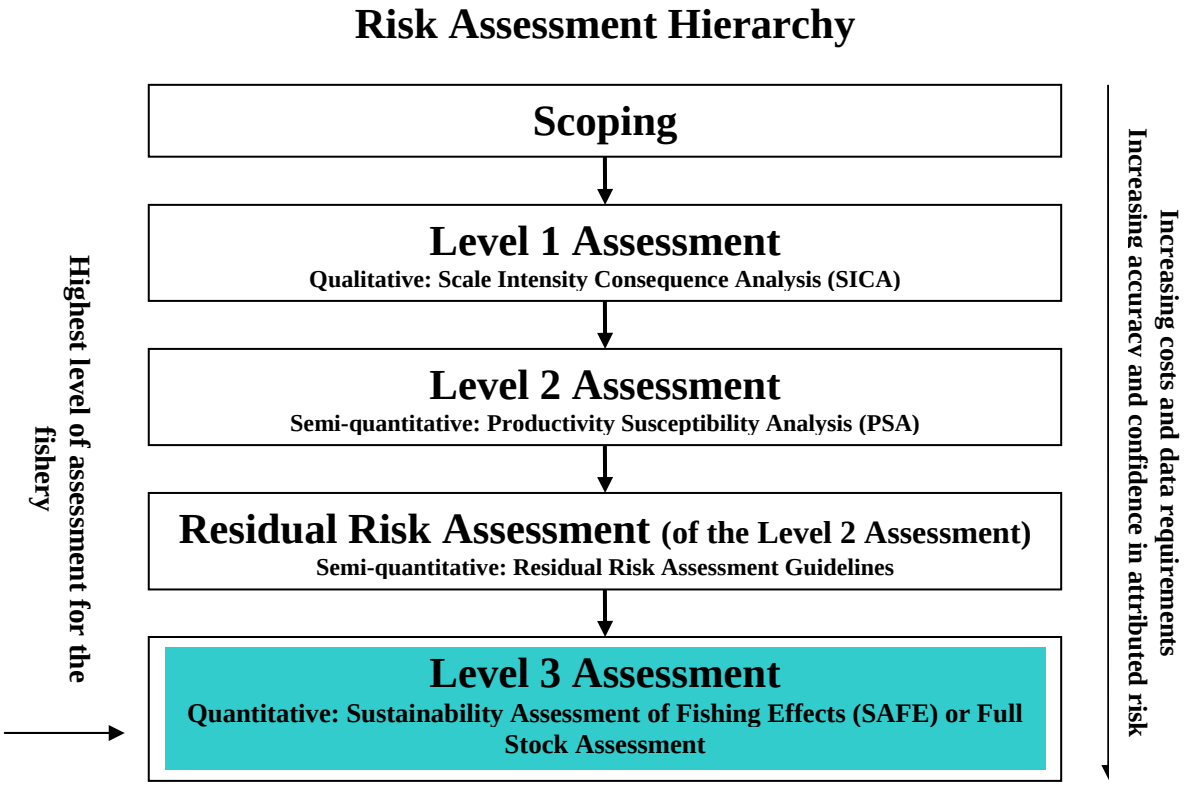


*TSG – Technical Support Group – currently provided by CSIRO

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 (refer to **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.

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.

Figure 2: Risk assessment hierarchy



The 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 strategy**

The priority list for the WTBF was developed using:

- The SAFE methodology for any teleost or chondrichthyan species identified as being fished at a rate above maximum sustainable mortality; and
- Level 2 PSA Residual Risk for all other non protected 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 the WTBF will be managed either through fishery specific arrangements or one of the following policies or measures:

- WTBF Harvest Strategy;
- Non-key Commercial Species (byproduct) Policy;
- Australian Tuna and Billfish Longline Fisheries Bycatch and Discard workplan; and
- Protected species under various international plans of action, and recovery plans including;

- the Threat Abatement Plan (2006) for the incidental catch (or bycatch) of seabirds during oceanic longline fishing operations (TAP),
- Recovery Plan for Marine Turtles in Australia
- Recovery Plans for the Grey Nurse and White Sharks

The WTBF 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.

2. Description of the Western Tuna and Billfish Fishery

- **Area of the fishery**

The Western Tuna and Billfish Fishery (WTBF) extends westward from Cape York Peninsula (142°30'E) off Queensland around the west coast of Western Australia and from there extends eastward across the Great Australian Bight to 141°E at the South Australian/Victorian border.

The WTBF also includes Australian waters outside of 12 nm off Christmas Island and Cocos Keeling Islands. The WTBF Management Plan also applies to Australian vessels fishing in the high seas within the IOTC's Area of Competence, which includes;

  - the area of the Indian ocean west of longitude 150^{o}E off the south coast of Australia and west of longitude 129^{o}E off the northern coast of Australia and bound east of the line 29^{o}E off south Africa.

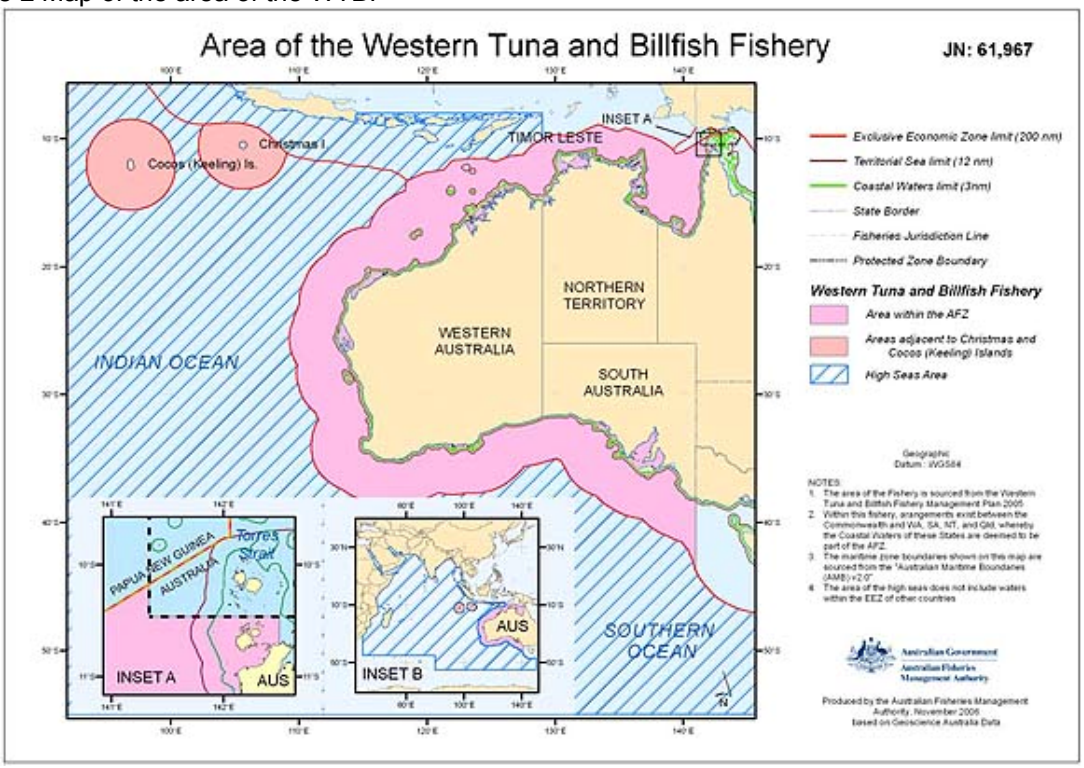
- **Fishing Methods**

Target species in the WTBF are predominantly Broadbill Swordfish, Bigeye Tuna, and to a lesser extend Yellowfin Tuna. These species are predominantly taken using the pelagic longline method, however the minor line methods (pole, troll, hand line and rod and reel) are also permitted in the WTBF.

- **Management arrangements**

The WTBF is currently managed by the Australian Fisheries Management Authority (AFMA) according to transitional arrangements provided for in the *Western Tuna and Billfish Fishery Management Plan 2005* until Individual Transferrable Quota (ITQ) output controls in the form of Statutory Fishing Rights (SFRs) are granted. Under the transitional arrangements, commercial fishing is managed through a system of input controls based upon annually granted fishing permits which limit entry to the fishery, describe the area of operations, and impose limits on the take of bycatch species and the fishing gear which may be employed in the fishery.

Figure 1 Map of the area of the WTBF



- **International context and obligations**

Australia has been a member of the Indian Ocean Tuna Commission (IOTC) since 1996 and as such is obliged to work by the management measures defined by IOTC, under resolutions adopted by IOTC.

A list of the resolutions adopted by the IOTC can be found at (www.iotc.org). Management plans, permit conditions and other associated policy documents incorporate management measures adopted by the IOTC.

3. Ecological Risk Management Priority List

The risks that the WTBF pose to the sustainability of the marine ecosystem have been assessed through the application of a progression of risk assessment methodologies as listed below:

- a Level 2 PSA Risk Assessment completed in June 2007;
- a Level 2 PSA Residual Risk assessment finalised in November 2009 for all species occurring in the fishery; and,
- Level 3 Sustainability Assessment for Fishing Effects (SAFE) assessment completed in April 2009.

The results of these risk assessments have been consolidated with no species listed as being a high priority for management from the ERA process.

The risk assessment identified that 264 protected species occur within the area of the fishery (Level 2 PSA). In recent times there have been few interactions reported with protected species in the WTBF fishery. Of the TEP species; 107 are teleosts, 28 are reptiles, 50 marine mammals, 76 are seabirds and 3 are chondrichthyans. No protected species were found to be at high risk through the ERA process, however consistent with AFMA's objectives and good fisheries management practices all steps will be taken to minimise interactions between these species and the fishery.

The priority for the ERM is to maintain monitoring of the fishery and respond to any interactions with protected species or increases in interaction rates with bycatch or byproduct species. Effort will continue to be monitored and AFMA will respond accordingly with management measures if effort increases significantly.

Table 1 details the results at each level of assessment. Further information and reports for each level of assessment can be found on AFMA's website.

Level of assessment and risk levels attributed	Target Species	Byproduct Species	Bycatch Species	Protected (TEP) Species
Level 1 SICA Assessment				
Consequence score (for each species component)	4	4	4	3
Proceeded to Level 2 PSA Assessment (scores ≧ 3)	Y	Y	Y	Y
Level 2 PSA Assessment				
High Risk	0	1	2	26
Medium Risk	1	8	26	115
Low Risk	13*	14	20	123
Level 2 PSA Residual Risk Assessment				
High Risk	0	0	0	0
Medium Risk	1	7	26	130
Low Risk	13*	16	22	134
Level 3 SAFE Assessment				
$F_{cur} > F_{msm}$	0	0	0	0
$F_{cur} < F_{msm}$	6	23	48	110

*There were 7 targeted bait species included in the assessment which have here been classified as target species.

4. Ecological Risk Management Strategy

The nature of pelagic fishing operations means that it is difficult to design measures which mitigate the capture of a single species. No species were found to be at high risk to the effects of fishing in the WTBF; hence the ERM strategy for the WTBF will address the 264 protected (TEP) species identified as occurring within the area of the fishery.

- **Harvest Strategies for key commercial (target and some 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 some byproduct species). Individual fishery specific Harvest Strategies will set out clear decision rules to manage fisheries in an environmentally sustainable manner while also ensuring maximum economic returns.

Testing and verification of the Harvest Strategy for the WTBF is currently being conducted and results of this will be used when the fishery moves to quota based management.

Effort within the WTBF is very low, and as such there is not enough data available to conduct the Harvest Strategy. The Harvest Strategy contains rules to deal with low effort in the fishery and has an effort trigger for when the Harvest Strategy will be implemented.

The straddling stock nature of target species and the lack of full understanding of the connectivity of local populations to the broader Indian Ocean mean that there are issues utilising broad scale stock assessments in the Harvest Strategy. The draft Harvest Strategy for the WTBF sets out relatively simple decision rules based on data inputs currently collected from the domestic fishery including Catch per Unit Effort and size class information.

- **Management of non-key commercial (byproduct) species**

AFMA is currently developing a policy to address any gaps in the management of byproduct species in Commonwealth fisheries. As there are no byproduct species taken in the WBTF and any other species taken must be covered by a separate fishing permit, the management of non-key commercial species is not an issue in this fishery.

The catch of sharks in longline fisheries is of a worldwide concern, and as such AFMA sees the management of these in the sense of byproduct, bycatch and discarding is important. Currently in the WTBF there is little concern in relation to the capture and discarding of sharks, again mainly due to the low level of effort. However if effort increases in the fishery then there is potential for the level of interaction to increase.

Action: AFMA to monitor the level of catch and interaction with shark species in the WTBF. If the landed amount of any one species reaches 50 tonnes AFMA will review its management of shark interactions in this fishery.

- **Managing bycatch and discarding**

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 protected species as well as strategies to minimise the discarding of target and quota species.

The WTBF has a bycatch and discarding workplan in the form of the *Australian Tuna and Billfish Longline Fisheries bycatch and discarding workplan* agreed on November 1 2008. The main features of the work plan are to develop management measures to monitor and reduce interactions with high risk and protected species and discarding of key target species.

The workplan defines a range of actions to be undertaken specifically within the ATBLF (Table 6) to respond to the outcomes of the ERA/M process.

Table 2 Actions of the Bycatch and Discard Workplan and how they relate to the ERA/M process

	Action	How does this respond to the outcomes of the ERM process?
1.	Make the carriage of line cutters and de-hookers compulsory on ATBLF vessels	To help in the release of hooked and tangled sharks, whales and turtles
2.	Analysis of the impacts of making circle hooks compulsory in the ATBLF (eg: quantifying the catch rates of turtles and sharks).	Possible reduction in risk to turtles and marlins, but one study indicates an increase in capture of sharks.
3.	Investigate the variance in bycatch composition between “deep set” (albacore) and “shallow set” longline operations	Deep setting technique has the possibility of decreasing interactions with birds and turtles. However it is not understood how it might affect catches of other bycatch or non-target species.
4.	Provision of a weather proof bycatch recording device (with attached identification guide) to all ATBLF vessels to provide convenient facility to record bycatch during hauling operations	Address operational requirements to provide aids to recording accuracy of data to determine bycatch & discarding issues.
5.	Review outcomes and recommendations from the Chondrichthyan Technical Working Group (CTWG) and implement formal CTWG recommendations.	Address shark mitigation on an all fisheries/all jurisdictions basis. Has relevance to the high risk species associated with this fishery.
6.	Develop and implement an education strategy for crew to be made aware of bycatch and discarding obligations	More accurate reporting by crew. Develop an understanding of bycatch & protected species issues and address misreporting of interactions.
7.	Analysing observer data in an attempt to quantify weight of discarded target species	Improves understanding of discarding issues in ALTBF particularly with regard quantity of released juveniles and damaged catch.

A key component to the bycatch and discarding work plan is to improve the reporting of bycatch in the ATBLF.

- **Chondrichthyan Guide for Fisheries Managers**

A guide has been developed to assist fishery managers and stakeholders to adopt and implement management arrangements for Chondrichthyan species. A Chondrichthyan Technical Working Group was formed and worked with the objective of providing practical advice on mitigation measures between shark species and Australian fisheries. They produced a guide for fisheries managers which is designed to be utilised as a tool in the decision making process. The guide contains a list of practical measures that could be used for the mitigation of shark mortality.

- **Protected**

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

- Threat Abatement Plan 2006: for the incidental catch (or bycatch) of seabirds during oceanic longline fishing operations;

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

There are very few interactions reported between the WTBF and protected species, however consistent with AFMA's objectives and obligations all steps will be taken to minimise the chance of interactions occurring. Two hundred and sixty four TEP species have been identified as occurring in the area of the fishery under the level 2 PSA ERA analysis (Table 3).

Table 3 List of protected (TEP) species which were not found to be at high ecological risk, but which were considered to overlap with the area of the fishery. All reasonable steps will be taken to minimise interactions with these species.

Taxanomic Group	Scientific Name	Common Name	Role in fishery	Highest level of Assessment	Risk Score
Chondrichthyan	Carcharodon carcharias	White Shark	TEP	Level 3 SAFE	Low
Chondrichthyan	Carcharias taurus	Grey Nurse Shark	TEP	Level 3 SAFE	Low
Chondrichthyan	Rhincodon typus	Whale Shark	TEP	Level 3 SAFE	Low
Marine bird	Phoebetria fusca	Sooty Albatross	TEP	Level 2 residual risk	Low
Marine bird	Thalassarche cauta	Shy Albatross	TEP	Level 2 residual risk	Low
Marine bird	Thalassarche melanophrys	Black-browed Albatross	TEP	Level 2 residual risk	Low
Marine bird	Thalassarche bulleri	Buller's Albatross	TEP	Level 2 residual risk	Low
Marine bird	Puffinus pacificus	Wedge-tailed Shearwater	TEP	Level 2 residual risk	Low
Marine bird	Oceanites oceanicus	Wilson's storm petrel (subantarctic)	TEP	Level 2 residual risk	Low
Marine bird	Pelagodroma marina	White-faced Storm-Petrel	TEP	Level 2 residual risk	Low
Marine bird	Larus novaehollandiae	Silver Gull	TEP	Level 2 residual risk	Low
Marine bird	Larus pacificus	Pacific Gull	TEP	Level 2 residual risk	Low
Marine bird	Sterna albifrons	Little tern	TEP	Level 2 residual risk	Low
Marine bird	Sterna anaethetus	Bridled Tern	TEP	Level 2 residual risk	Low
Marine bird	Sterna dougallii	Roseate tern	TEP	Level 2 residual risk	Low
Marine bird	Eudyptula minor	Little Penguin	TEP	Level 2 residual risk	Low
Marine bird	Thalassarche chlororhynchos	Yellow-nosed Albatross, Atlantic Yellow-	TEP	Level 2 residual risk	Med
Marine bird	Thalassarche chrysostoma	Grey-headed Albatross	TEP	Level 2 residual risk	Med
Marine bird	Phoebetria palpebrata	Light-mantled Albatross	TEP	Level 2 residual risk	Med
Marine bird	Thalassarche carteri	Indian Yellow-nosed Albatross	TEP	Level 2 residual risk	Med
Marine bird	Puffinus carneipes	Flesh-footed	TEP	Level 2	Med

		Shearwater		residual risk	
Marine bird	Diomedea exulans	Wandering Albatross	TEP	Level 2 residual risk	Med
Marine bird	Diomedea antipodensis	Antipodean Albatross	TEP	Level 2 residual risk	Med
Marine bird	Diomedea epomophora	Southern Royal Albatross	TEP	Level 2 residual risk	Med
Marine bird	Diomedea gibsoni	Gibson's Albatross	TEP	Level 2 residual risk	Med
Marine bird	Diomedea sanfordi	Northern Royal Albatross	TEP	Level 2 residual risk	Med
Marine bird	Thalassarche eremita	Chatham albatross	TEP	Level 2 residual risk	Med
Marine bird	Thalassarche platei	Pacific albatross	TEP	Level 2 residual risk	Med
Marine bird	Thalassarche salvini	Salvin's albatross	TEP	Level 2 residual risk	Med
Marine bird	Thalassarche impavida	Campbell Albatross	TEP	Level 2 residual risk	Med
Marine bird	Diomedea amsterdamensis	Amsterdam Albatross	TEP	Level 2 residual risk	Med
Marine bird	Diomedea dabbenena	Tristan Albatross	TEP	Level 2 residual risk	Med
Marine bird	Fregata andrewsi	Christmas frigatebird	TEP	Level 2 residual risk	Med
Marine bird	Fregata ariel	Lesser frigatebird	TEP	Level 2 residual risk	Med
Marine bird	Fregata minor	Great Frigatebird, Greater Frigatebird	TEP	Level 2 residual risk	Med
Marine bird	Garrodia nereis	Grey-backed storm petrel	TEP	Level 2 residual risk	Med
Marine bird	Fregetta tropica	Black-bellied Storm-Petrel	TEP	Level 2 residual risk	Med
Marine bird	Fregetta grallaria	White-bellied Storm-Petrel (Tasman Sea),	TEP	Level 2 residual risk	Med
Marine bird	Anous tenuirostris	Lesser noddy	TEP	Level 2 residual risk	Med
Marine bird	Anous stolidus	Common noddy	TEP	Level 2 residual risk	Med
Marine bird	Catharacta skua	Great Skua	TEP	Level 2 residual risk	Med
Marine bird	Sterna bengalensis	Lesser crested tern	TEP	Level 2 residual risk	Med
Marine bird	Sterna bergii	Crested Tern	TEP	Level 2 residual risk	Med
Marine bird	Sterna caspia	Caspian Tern	TEP	Level 2 residual risk	Med
Marine bird	Sterna fuscata	Sooty tern	TEP	Level 2 residual risk	Med
Marine bird	Sterna hirundo	Common tern	TEP	Level 2 residual risk	Med
Marine bird	Sterna paradisaea	Arctic tern	TEP	Level 2 residual risk	Med

Marine bird	Sterna sumatrana	Black-naped tern	TEP	Level 2 residual risk	Med
Marine bird	Phaethon lepturus	White-tailed Tropicbird	TEP	Level 2 residual risk	Med
Marine bird	Anous minutus	Black Noddy	TEP	Level 2 residual risk	Med
Marine bird	Phaethon rubricauda	Red-tailed Tropicbird	TEP	Level 2 residual risk	Med
Marine bird	Phalacrocorax fuscescens	Black faced cormorant	TEP	Level 2 residual risk	Med
Marine bird	Macronectes giganteus	Southern Giant-Petrel	TEP	Level 2 residual risk	Med
Marine bird	Fulmarus glacialoides	Southern fulmar	TEP	Level 2 residual risk	Med
Marine bird	Procellaria cinerea	Grey petrel	TEP	Level 2 residual risk	Med
Marine bird	Pterodroma lessoni	White-headed petrel	TEP	Level 2 residual risk	Med
Marine bird	Daption capense	Cape Petrel	TEP	Level 2 residual risk	Med
Marine bird	Halobaena caerulea	Blue Petrel	TEP	Level 2 residual risk	Med
Marine bird	Macronectes halli	Northern Giant-Petrel	TEP	Level 2 residual risk	Med
Marine bird	Pachyptila turtur	Fairy Prion	TEP	Level 2 residual risk	Med
Marine bird	Procellaria aequinoctialis	White-chinned Petrel	TEP	Level 2 residual risk	Med
Marine bird	Procellaria parkinsoni	Black Petrel; Parkinsons Petrel	TEP	Level 2 residual risk	Med
Marine bird	Pterodroma leucoptera	Gould's Petrel	TEP	Level 2 residual risk	Med
Marine bird	Pterodroma macroptera	Great-winged Petrel	TEP	Level 2 residual risk	Med
Marine bird	Pterodroma mollis	Soft-plumaged Petrel	TEP	Level 2 residual risk	Med
Marine bird	Puffinus assimilis	Little Shearwater (Tasman Sea)	TEP	Level 2 residual risk	Med
Marine bird	Puffinus gavia	Fluttering Shearwater	TEP	Level 2 residual risk	Med
Marine bird	Puffinus griseus	Sooty Shearwater	TEP	Level 2 residual risk	Med
Marine bird	Puffinus huttoni	Hutton's Shearwater	TEP	Level 2 residual risk	Med
Marine bird	Puffinus tenuirostris	Short-tailed Shearwater	TEP	Level 2 residual risk	Med
Marine bird	Calonectris leucomelas	streaked shearwater	TEP	Level 2 residual risk	Med
Marine bird	Pterodroma arminjoniana	Round Island Petrel	TEP	Level 2 residual risk	Med
Marine bird	Pterodroma baraui	Barau's Petrel	TEP	Level 2 residual risk	Med
Marine bird	Papasula abbotti	Abbots	TEP	Level 2	Med

		booby		residual risk	
Marine bird	Sula leucogaster	Brown boobies	TEP	Level 2 residual risk	Med
Marine bird	Morus serrator	Australasian Gannet	TEP	Level 2 residual risk	Med
Marine bird	Sula dactylatra	Masked Booby	TEP	Level 2 residual risk	Med
Marine bird	Sula sula	Red-footed Booby	TEP	Level 2 residual risk	Med
Marine bird	Morus capensis	Cape gannet	TEP	Level 2 residual risk	Med
Marine mammal	Globicephala melas	Long-finned Pilot Whale	TEP	Level 2 residual risk	Low
Marine mammal	Mesoplodon bowdoini	Andrew's Beaked Whale	TEP	Level 2 residual risk	Low
Marine mammal	Mesoplodon gingkodens	Gingko Beaked Whale	TEP	Level 2 residual risk	Low
Marine mammal	Mesoplodon mirus	True's Beaked Whale	TEP	Level 2 residual risk	Low
Marine mammal	Delphinus delphis	Common Dolphin	TEP	Level 2 residual risk	Low
Marine mammal	Delphinus capensis	Common dolphin, long-beaked	TEP	Level 2 residual risk	Low
Marine mammal	Lagenorhynchus obscurus	Dusky Dolphin	TEP	Level 2 residual risk	Low
Marine mammal	Indopacetus pacificus	Longman's Beaked Whale	TEP	Level 2 residual risk	Low
Marine mammal	Caperea marginata	Pygmy Right Whale	TEP	Level 2 residual risk	Med
Marine mammal	Eubalaena australis	Southern Right Whale	TEP	Level 2 residual risk	Med
Marine mammal	Balaenoptera bonaerensis	Antarctic Minke Whale	TEP	Level 2 residual risk	Med
Marine mammal	Balaenoptera acutorostrata	Minke Whale	TEP	Level 2 residual risk	Med
Marine mammal	Balaenoptera borealis	Sei Whale	TEP	Level 2 residual risk	Med
Marine mammal	Balaenoptera edeni	Bryde's Whale	TEP	Level 2 residual risk	Med
Marine mammal	Balaenoptera musculus	Blue Whale	TEP	Level 2 residual risk	Med
Marine mammal	Balaenoptera physalus	Fin Whale	TEP	Level 2 residual risk	Med
Marine mammal	Megaptera novaeangliae	Humpback Whale	TEP	Level 2 residual risk	Med
Marine mammal	Lissodelphis peronii	Southern Right Whale Dolphin	TEP	Level 2 residual risk	Med
Marine mammal	Orcaella brevirostris	Irrawaddy dolphin	TEP	Level 2 residual risk	Med
Marine mammal	Feresa attenuata	Pygmy Killer Whale	TEP	Level 2 residual risk	Med
Marine mammal	Globicephala macrorhynchus	Short-finned Pilot Whale	TEP	Level 2 residual risk	Med

Marine mammal	Grampus griseus	Risso's Dolphin	TEP	Level 2 residual risk	Med
Marine mammal	Lagenodelphis hosei	Fraser's Dolphin	TEP	Level 2 residual risk	Med
Marine mammal	Orcinus orca	Killer Whale	TEP	Level 2 residual risk	Med
Marine mammal	Peponocephala electra	Melon-headed Whale	TEP	Level 2 residual risk	Med
Marine mammal	Pseudorca crassidens	False Killer Whale	TEP	Level 2 residual risk	Med
Marine mammal	Sousa chinensis	Indo-Pacific Humpback Dolphin	TEP	Level 2 residual risk	Med
Marine mammal	Stenella attenuata	Spotted Dolphin	TEP	Level 2 residual risk	Med
Marine mammal	Stenella coeruleoalba	Striped Dolphin	TEP	Level 2 residual risk	Med
Marine mammal	Stenella longirostris	Long-snouted Spinner Dolphin	TEP	Level 2 residual risk	Med
Marine mammal	Steno bredanensis	Rough-toothed Dolphin	TEP	Level 2 residual risk	Med
Marine mammal	Tursiops truncatus	Bottlenose Dolphin	TEP	Level 2 residual risk	Med
Marine mammal	Tursiops aduncus	Indian Ocean bottlenose dolphin	TEP	Level 2 residual risk	Med
Marine mammal	Dugong dugon	Dugong	TEP	Level 2 residual risk	Med
Marine mammal	Arctocephalus forsteri	New Zealand Fur-seal	TEP	Level 2 residual risk	Med
Marine mammal	Arctocephalus pusillus doriferus	Australian Fur Seal	TEP	Level 2 residual risk	Med
Marine mammal	Arctocephalus tropicalis	Subantarctic fur seal	TEP	Level 2 residual risk	Med
Marine mammal	Neophoca cinerea	Australian Sea-lion	TEP	Level 2 residual risk	Med
Marine mammal	Hydrurga leptonyx	Leopard seal	TEP	Level 2 residual risk	Med
Marine mammal	Kogia breviceps	Pygmy Sperm Whale	TEP	Level 2 residual risk	Med
Marine mammal	Kogia simus	Dwarf Sperm Whale	TEP	Level 2 residual risk	Med
Marine mammal	Physeter catodon	Sperm Whale	TEP	Level 2 residual risk	Med
Marine mammal	Berardius arnuxii	Arnoux's Beaked Whale	TEP	Level 2 residual risk	Med
Marine mammal	Hyperoodon planifrons	Southern Bottlenose Whale	TEP	Level 2 residual risk	Med
Marine mammal	Mesoplodon densirostris	Blainville's Beaked Whale	TEP	Level 2 residual risk	Med
Marine mammal	Mesoplodon grayi	Gray's Beaked	TEP	Level 2 residual risk	Med

		Whale			
Marine mammal	Mesoplodon hectori	Hector's Beaked Whale	TEP	Level 2 residual risk	Med
Marine mammal	Mesoplodon layardii	Strap-toothed Beaked Whale	TEP	Level 2 residual risk	Med
Marine mammal	Tasmacetus shepherdi	Tasman Beaked Whale	TEP	Level 2 residual risk	Med
Marine mammal	Ziphius cavirostris	Cuvier's Beaked Whale	TEP	Level 2 residual risk	Med
Marine reptile	Hydrophis elegans	Elegant seasnake	TEP	Level 2 residual risk	Low
Marine reptile	Aipysurus laevis	Olive Seasnake, Golden Seasnake	TEP	Level 2 residual risk	Low
Marine reptile	Emydocephalus annulatus	Turtle-headed Seasnake	TEP	Level 2 residual risk	Low
Marine reptile	Enhydrina schistosa	Beaked Seasnake	TEP	Level 2 residual risk	Low
Marine reptile	Lapemis hardwickii	Spine-bellied Seasnake	TEP	Level 2 residual risk	Low
Marine reptile	Caretta caretta	Loggerhead	TEP	Level 2 residual risk	Med
Marine reptile	Chelonia mydas	Green turtle	TEP	Level 2 residual risk	Med
Marine reptile	Eretmochelys imbricata	Hawksbill turtle	TEP	Level 2 residual risk	Med
Marine reptile	Lepidochelys olivacea	Olive Ridley turtle	TEP	Level 2 residual risk	Med
Marine reptile	Natator depressus	Flatback turtle	TEP	Level 2 residual risk	Med
Marine reptile	Dermochelys coriacea	Leathery turtle	TEP	Level 2 residual risk	Med
Marine reptile	Acalyptophis peronii	Horned Seasnake	TEP	Level 2 residual risk	Med
Marine reptile	Aipysurus apraefrontalis	Short-nosed Seasnake	TEP	Level 2 residual risk	Med
Marine reptile	Aipysurus duboisii	Dubois' Seasnake	TEP	Level 2 residual risk	Med
Marine reptile	Aipysurus eydouxii	Spine-tailed Seasnake	TEP	Level 2 residual risk	Med
Marine reptile	Aipysurus fuscus	Dusky Seasnake	TEP	Level 2 residual risk	Med
Marine reptile	Aipysurus tenuis	Brown-lined Seasnake	TEP	Level 2 residual risk	Med
Marine reptile	Disteira major	Olive-headed Seasnake	TEP	Level 2 residual risk	Med
Marine reptile	Hydrelaps darwiniensis	Black-ringed Seasnake	TEP	Level 2 residual risk	Med
Marine reptile	Hydrophis coggeri	Slender-necked Seasnake	TEP	Level 2 residual risk	Med
Marine reptile	Hydrophis mcdowelli	seasnake	TEP	Level 2 residual risk	Med

Marine reptile	Hydrophis ornatus	seasnake	TEP	Level 2 residual risk	Med
Marine reptile	Disteira kingii	Spectacled seasnake	TEP	Level 2 residual risk	Med
Marine reptile	Hydrophis czeblukovi	Fine-spined seasnake	TEP	Level 2 residual risk	Med
Marine reptile	Hydrophis atriceps	Black-headed seasnake	TEP	Level 2 residual risk	Med
Marine reptile	Hydrophis melanosoma	Black-banded robust seasnake	TEP	Level 2 residual risk	Med
Marine reptile	Hydrophis pacificus	Large-headed Seasnake	TEP	Level 2 residual risk	Med
Marine reptile	Parahydrophis mertoni	Northern mangrove seasnake	TEP	Level 2 residual risk	Med
Teleost	Heteroclinus perspicillatus	Common weedfish	TEP	Level 3 SAFE	Low
Teleost	Solenostomus cyanopterus	Blue-finned Ghost Pipefish, Robust Ghost	TEP	Level 3 SAFE	Low
Teleost	Corythoichthys intestinalis	Australian Messmate Pipefish, Banded Pipefish	TEP	Level 3 SAFE	Low
Teleost	Bulbonaricus brauni	Braun's Pughead Pipefish, Pug-headed Pipefish	TEP	Level 3 SAFE	Low
Teleost	Halicampus brocki	Brock's Pipefish	TEP	Level 3 SAFE	Low
Teleost	Doryrhamphus janssi	Cleaner Pipefish, Janss' Pipefish	TEP	Level 3 SAFE	Low
Teleost	Bhanotia fasciolata	Corrugated Pipefish, Barbed Pipefish	TEP	Level 3 SAFE	Low
Teleost	Halicampus nitidus	Glittering Pipefish	TEP	Level 3 SAFE	Low
Teleost	Acentronura australe	Southern Pygmy Pipehorse	TEP	Level 3 SAFE	Low
Teleost	Acentronura breviperula	Hairy Pygmy Pipehorse	TEP	Level 3 SAFE	Low
Teleost	Campichthys galei	Gale's Pipefish	TEP	Level 3 SAFE	Low
Teleost	Campichthys tryoni	Tryon's Pipefish	TEP	Level 3 SAFE	Low
Teleost	Hippocampus spinosissimus	Hedgehog Seahorse	TEP	Level 3 SAFE	Low

Teleost	Acentronura larsonae	Helen's Pygmy Pipehorse	TEP	Level 3 SAFE	Low
Teleost	Solegnathus guentheri	Indonesian Pipefish, Gunther's Pipehorse	TEP	Level 3 SAFE	Low
Teleost	Festucalex scalaris	Ladder Pipefish	TEP	Level 3 SAFE	Low
Teleost	Trachyrhamphus longirostris	Long-nosed Pipefish, Straight Stick Pipefish	TEP	Level 3 SAFE	Low
Teleost	Halicampus dunckeri	Red-hair Pipefish, Duncker's Pipefish	TEP	Level 3 SAFE	Low
Teleost	Haliichthys taeniophorus	Ribboned Seadragon, Ribboned Pipefish	TEP	Level 3 SAFE	Low
Teleost	Dunckerocampus dactyliophorus	Ringed Pipefish	TEP	Level 3 SAFE	Low
Teleost	Phoxocampus belcheri	Rock Pipefish	TEP	Level 3 SAFE	Low
Teleost	Dunckerocampus pessuliferus	Many-banded Pipefish	TEP	Level 3 SAFE	Low
Teleost	Choeroichthys latispinosus	Muiron Island Pipefish	TEP	Level 3 SAFE	Low
Teleost	Choeroichthys brachysoma	Pacific Short-bodied Pipefish, Short-bodied pipefish	TEP	Level 3 SAFE	Low
Teleost	Choeroichthys suillus	Pig-snouted Pipefish	TEP	Level 3 SAFE	Low
Teleost	Lissocampus fatiloquus	Prophet's Pipefish	TEP	Level 3 SAFE	Low
Teleost	Cosmocampus banneri	Roughridge Pipefish	TEP	Level 3 SAFE	Low
Teleost	Corythoichthys schultzi	Schultz's Pipefish	TEP	Level 3 SAFE	Low
Teleost	Halicampus spinirostris	Spiny-snout Pipefish	TEP	Level 3 SAFE	Low
Teleost	Campichthys tricarinatus	Three-keel Pipefish	TEP	Level 3 SAFE	Low
Teleost	Micrognathus micronotopterus	Tidepool Pipefish	TEP	Level 3 SAFE	Low
Teleost	Hippocampus subelongatus	West Australian Seahorse	TEP	Level 3 SAFE	Low
Teleost	Hippocampus angustus	Western Spiny Seahorse	TEP	Level 3 SAFE	Low
Teleost	Corythoichthys amplexus	Fijian Banded Pipefish, Brown-	TEP	Level 3 SAFE	Low

		banded Pipefish			
Teleost	Corythoichthys conspicillatus	Yellow-banded Pipefish, Network Pipefish	TEP	Level 3 SAFE	Low
Teleost	Doryrhamphus malus	Flagtail Pipefish, Negros Pipefish	TEP	Level 3 SAFE	Low
Teleost	Doryrhamphus melanopleura	Bluestripe Pipefish	TEP	Level 3 SAFE	Low
Teleost	Corythoichthys ocellatus	Orange-spotted Pipefish, Ocellated Pipefish	TEP	Level 3 SAFE	Low
Teleost	Festucalex cinctus	Girdled Pipefish	TEP	Level 3 SAFE	Low
Teleost	Filicampus tigris	Tiger Pipefish	TEP	Level 3 SAFE	Low
Teleost	Halicampus grayi	Mud Pipefish, Gray's Pipefish	TEP	Level 3 SAFE	Low
Teleost	Heraldia nocturna	Upside-down Pipefish	TEP	Level 3 SAFE	Low
Teleost	Hippichthys cyanospilos	Blue-speckled Pipefish, Blue-spotted Pipefish	TEP	Level 3 SAFE	Low
Teleost	Hippichthys heptagonus	Madura Pipefish	TEP	Level 3 SAFE	Low
Teleost	Hippichthys penicillus	Beady Pipefish, Steep-nosed Pipefish	TEP	Level 3 SAFE	Low
Teleost	Hippocampus bleekeri	Pot bellied seahorse	TEP	Level 3 SAFE	Low
Teleost	Hippocampus breviceps	Short-head Seahorse, Short-snouted Seaho	TEP	Level 3 SAFE	Low
Teleost	Hippocampus taeniopterus	Spotted Seahorse, Yellow Seahorse	TEP	Level 3 SAFE	Low
Teleost	Hippocampus planifrons	Flat-face Seahorse	TEP	Level 3 SAFE	Low
Teleost	Histiogamphelus briggsii	Briggs' Crested Pipefish, Briggs' Pipefish	TEP	Level 3 SAFE	Low
Teleost	Histiogamphelus cristatus	Rhino Pipefish, Macleay's	TEP	Level 3 SAFE	Low

		Crested Pipefish			
Teleost	Hypselognathus horridus	Shaggy Pipefish, Prickly Pipefish	TEP	Level 3 SAFE	Low
Teleost	Hypselognathus rostratus	Knife-snouted Pipefish	TEP	Level 3 SAFE	Low
Teleost	Kaupus costatus	Deep-bodied Pipefish	TEP	Level 3 SAFE	Low
Teleost	Leptoichthys fistularius	Brushtail Pipefish	TEP	Level 3 SAFE	Low
Teleost	Lissocampus caudalis	Australian Smooth Pipefish, Smooth Pipefish	TEP	Level 3 SAFE	Low
Teleost	Lissocampus runa	Javelin Pipefish	TEP	Level 3 SAFE	Low
Teleost	Maroubra perserrata	Sawtooth Pipefish	TEP	Level 3 SAFE	Low
Teleost	Mitotichthys semistriatus	Half-banded Pipefish	TEP	Level 3 SAFE	Low
Teleost	Mitotichthys tuckeri	Tucker's Pipefish	TEP	Level 3 SAFE	Low
Teleost	Notiocampus ruber	Red Pipefish	TEP	Level 3 SAFE	Low
Teleost	Phycodurus eques	Leafy Seadragon	TEP	Level 3 SAFE	Low
Teleost	Phyllopteryx taeniolatus	Weedy Seadragon, Common Seadragon	TEP	Level 3 SAFE	Low
Teleost	Stigmatopora argus	Spotted Pipefish	TEP	Level 3 SAFE	Low
Teleost	Stigmatopora nigra	Wide-bodied Pipefish, Black Pipefish	TEP	Level 3 SAFE	Low
Teleost	Stipecampus cristatus	Ring-backed Pipefish	TEP	Level 3 SAFE	Low
Teleost	Syngnathoides biaculeatus	Double-ended Pipehorse, Alligator Pipefish	TEP	Level 3 SAFE	Low
Teleost	Pugnaso curtirostris	Pug-nosed Pipefish	TEP	Level 3 SAFE	Low
Teleost	Solegnathus sp. 1 [in Kuiter, 2000]	Pipehorse	TEP	Level 3 SAFE	Low
Teleost	Solegnathus robustus	Robust Spiny Pipehorse, Robust Pipehorse	TEP	Level 3 SAFE	Low
Teleost	Solegnathus spinosissimus	Spiny pipehorse	TEP	Level 3 SAFE	Low
Teleost	Trachyrhamphus bicoarctatus	Bend Stick Pipefish, Short-tailed	TEP	Level 3 SAFE	Low

		Pipefish			
Teleost	Urocampus carinirostris	Hairy Pipefish	TEP	Level 3 SAFE	Low
Teleost	Vanacampus margaritifer	Mother-of-pearl Pipefish	TEP	Level 3 SAFE	Low
Teleost	Vanacampus phillipi	Port Phillip Pipefish	TEP	Level 3 SAFE	Low
Teleost	Vanacampus poecilolaemus	Australian Long-snout Pipefish, Long-snouted Pipefish	TEP	Level 3 SAFE	Low
Teleost	Vanacampus vercoi	Verco's Pipefish	TEP	Level 3 SAFE	Low
Teleost	Nannocampus subosseus	Bony-headed Pipefish	TEP	Level 3 SAFE	Low
Teleost	Mitotichthys meraculus	Western Crested Pipefish	TEP	Level 3 SAFE	Low
Teleost	Heraldia sp. 1 [in Kuiter, 2000]	Western upsidedown pipefish	TEP	Level 3 SAFE	Low
Teleost	Choeroichthys cinctus	[a pipefish]	TEP	Level 3 SAFE	Low
Teleost	Corythoichthys haematopterus	[a pipefish]	TEP	Level 3 SAFE	Low
Teleost	Cosmocampus maxweberi	[a pipefish]	TEP	Level 3 SAFE	Low
Teleost	Halicampus macrorhynchus	[a pipefish]	TEP	Level 3 SAFE	Low
Teleost	Halicampus mataafae	[a pipefish]	TEP	Level 3 SAFE	Low
Teleost	Hippichthys spicifer	[a pipefish]	TEP	Level 3 SAFE	Low
Teleost	Hippocampus alatus	[a pipefish]	TEP	Level 3 SAFE	Low
Teleost	Hippocampus bargibanti	Pygmy seahorse	TEP	Level 3 SAFE	Low
Teleost	Hippocampus dahli	[a pipefish]	TEP	Level 3 SAFE	Low
Teleost	Hippocampus multispinus	[a pipefish]	TEP	Level 3 SAFE	Low
Teleost	Hippocampus zebra	[a pipefish]	TEP	Level 3 SAFE	Low
Teleost	Micrognathus pygmaeus	[a pipefish]	TEP	Level 3 SAFE	Low
Teleost	Micrognathus natans	[a pipefish]	TEP	Level 3 SAFE	Low
Teleost	Microphis brachyurus	[a pipefish]	TEP	Level 3 SAFE	Low
Teleost	Nannocampus lindemanensis	[a pipefish]	TEP	Level 3 SAFE	Low
Teleost	Phoxocampus diacanthus	[a pipefish]	TEP	Level 3 SAFE	Low
Teleost	Siokunichthys breviceps	[a pipefish]	TEP	Level 3 SAFE	Low
Teleost	Hippocampus abdominalis	Big-bellied / southern potbellied seahorse	TEP	Level 3 SAFE	Low
Teleost	Hippocampus histrix	Spiny Seahorse	TEP	Level 3 SAFE	Low
Teleost	Hippocampus kuda	Spotted Seahorse,	TEP	Level 3 SAFE	Low

		Yellow Seahorse			
Teleost	Hippocampus subelongatus	West Australian Seahorse	TEP	Level 3 SAFE	Low
Teleost	Idiotropiscis larsonae	Helen's Pygmy Pipehorse	TEP	Level 3 SAFE	Low
Teleost	Hippichthys parvicarinatus	Short-keeled Pipefish	TEP	Level 3 SAFE	Low
Teleost	Hippocampus biocellatus	False-eyed seahorse	TEP	Level 3 SAFE	Low
Teleost	Hippocampus tuberculatus	Knobby Seahorse	TEP	Level 3 SAFE	Low
Teleost	Hippocampus grandiceps	Bighead Seahorse	TEP	Level 3 SAFE	Low
Teleost	Idiotropiscis australe	Southern Pygmy Pipehorse	TEP	Level 3 SAFE	Low

In recent times there have been very few interactions reported with protected species in the WTBF (4 turtles, 2 released alive, and one Toothed whale released alive in 2008). Again this is due to the low level of effort; AFMA will maintain adequate levels of monitoring of interactions with protected species to ensure compliance with relevant documents and the EPBC Act.

Action: AFMA will maintain the prescribed level of observer coverage in the fishery to continue to monitor the impacts of the fishery on TEP species.

5. 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 each fishery. They will also be used when providing input to annual reporting requirements for the Department of the Environment, Water, Heritage and the Arts. Review of the ERM policy will be based around review of the above documents, including review of the ERA.

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 the Department of the Environment, Water, Heritage and the Arts.

On a broader scale the outputs from the annual reviews will be used to form the response to any Wildlife Trade Operation (WTO) accreditation or exemption in place in the fishery.

The ERA process for the WTBF will be reviewed if effort in the fishery reaches 2 million hooks per annum, up from current levels of around 200,000 to 400,000 hooks per annum. This is around 30% of the historical peak effort and around 25% of the current Eastern Tuna and Billfish Fishery effort. A review at this level of effort will be precautionary, providing data to better enable the analysis of the effect of the fishery on species that occur in the area of the fishery as effort increases.

6. GLOSSARY

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 (BI) and bycatch species (DI); protected species; habitats; and ecological communities.
ESD	Ecologically Sustainable Development is the ecological component of the development of a resource, based around the precautionary principle. In implementing the ecological component of ESD AFMA considers the impact that fishing has on the following ecosystem elements; target and byproduct species, bycatch, protected species, and community and habitat interactions.
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, midwater trawl, purse seine, trap etc.
TEP	Threatened, Endangered and Protected species
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
WTBF	Western Tuna and Billfish Fishery
ATBLF	Australian Tuna and Billfish Longline Fishery

Level 3 SAFE risk categories

F_{msm}	"instantaneous fishing mortality corresponding to the maximum sustainable death due to fishing (maximum sustainable mortality of fishing, *MSM*) at B_{msm} (biomass that supports *MSM*). This is similar to the F_{msy} that supports a maximum sustainable yield for target species. For simplicity we call F_{msm} "maximum sustainable (instantaneous) fishing mortality (rate)";"(Zhou *et al* 2009)
F_{lim}	"instantaneous fishing mortality corresponding to limit biomass B_{lim}, where B_{lim} is defined as half of the biomass that supports a maximum sustainable fishing mortality ($0.5B_{msm}$). We refer F_{lim} as "limit fishing mortality (rate)"" (Zhou *et al* 2009)

F_{rash}	"minimum unsustainable fishing mortality that, in theory, will lead to population extinction in the longer term." (Zhou *et al* 2009)
F_{cur}	estimated current fishing mortality (Zhou *et al* 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.

7. References

AFMA (2008) AFMA's Program for Addressing Bycatch and Discarding in Commonwealth Fisheries: an Implementation Strategy. Australian Fisheries Management Authority, Canberra, Australia.

AFMA (2008) Ecological Risk Assessment: Residual Risk Assessment for Eastern Tuna and Billfish Fishery

DAFF (2006) National Strategy to Address Interactions between Humans and Seals: Fisheries, Aquaculture and Tourism. Australian Government Department of Agriculture, Fisheries and Forestry, Canberra, Australia.

DAFF (2007) Commonwealth Fisheries Harvest Strategy: Policy and Guidelines. Australian Government Department of Agriculture, Fisheries and Forestry, Canberra, Australia.

Environment Australia (2003) Recovery Plan for Marine Turtles in Australia. Approvals and Wildlife Division, Environment Australia, Canberra, Australia.

Evans, S (2007) Eastern Tuna and Billfish Fishery Data summary 2005-2006, Australian Fisheries Management Authority, Canberra, Australia

Gilman, E., Clarke, S., Brothers, N., Alfaro-Shigueto-J., Mandelman, J., Mangel, J., Petersen, S., Piovano, S., Thomson, N., Dalzell, P., Donoso, M., Goren, M., Werner, T. (2007) *Shark Depredation and Unwanted Bycatch in Pelagic Longline Fisheries: Industry Practices and Attitudes, and Shark Avoidance Strategies.* Western Pacific Regional Fishery

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

Hobday, A. J., J. Dowdney, C. Bulman, M. Sporcic, M. Fuller, S. Ling (2007) Ecological Risk Assessment for the Effects of Fishing: Southern Bluefin Tuna Purse Seine Fishery. Report for the Australian Fisheries Management Authority.

Zhou, S., Smith, T., Fuller, M. (2007) Rapid Quantitative Risk Assessment for Fish Species in Selected Commonwealth Fisheries. Report for the Australian Fisheries Management Authority, Canberra, Australia.

Zhou, S., Smith, T., Fuller, M. (2009) Rapid Quantitative Risk Assessment for Fish Species in Additional Seven Commonwealth Fisheries. Report for the Australian Fisheries Management Authority, Canberra, Australia.