Ecological Risk Management

REPORT FOR THE EASTERN TUNA AND BILLFISH FISHERY

May 2009

Summary of priority issues for managing the ecological effects of fishing in the ETBF

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, habitats and 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 Eastern Tuna and Billfish Fishery (ETBF) are largely due to the incidental capture of non-target species (including the capture of protected species). The methods of fishing employed in the ETBF (pelagic longline, handline, trolling, polling and rod and reel) were found to have little to no direct impact on the physical marine environment.

The ETBF is a fishery which targets tuna and tuna-like species; however historical observer and logbook data show that around 103 species are 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 ETBF, 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 highest level of assessment conducted on the ETBF was a quantitative Level 3 assessment. The ERA identified nine species at high risk to the effects of fishing in the ETBF (Table 1).

Table 1 Details the priority species list from the ERA process for the ETBF on which AFMA will focus ERM efforts.

Taxonomic Group	Scientific Name	Common Name	Role in Fishery	Highest Level of Assessment	Risk Score
Chondrichthyan	*Isurus paucus*	Longfin Mako	Byproduct	Level 3	Precautionary high risk
Chondrichthyan	*Pseudocarcharias kamoharai*	Crocodile Shark	Byproduct	Level 3	Precautionary high risk
Chondrichthyan	*Alopias pelagicus*	Pelagic Thresher	Byproduct	Level 3	Precautionary high risk
Teleost	*Mola mola*	Ocean Sunfish	Bycatch	Level 3	Precautionary extreme high risk
Teleost	*Mola ramsayi*	An Ocean Sunfish	Byproduct	Level 3	Precautionary extreme high risk
Chondrichthyan	*Carcharhinus obscurus*	Dusky Shark	Byproduct	Level 3	High
Cetacean	*Globicephala macrorhynchos*	Short-finned Pilot Whale	Bycatch	Residual risk assessment	High
Marine reptile	*Dermochelys coriacea*	Leatherback Turtle	Bycatch	Residual risk assessment	High
Cetacean	*Pseudorca crassidens*	False Killer Whale	Bycatch	Residual risk assessment	High

No target species, ecological communities or habitats were assessed to be at high risk from the effects of fishing in the ETBF.

The ERM for the ETBF will reduce the effects of fishing on the species in the above priority list. No individual species of seabird is considered to be at high risk however consistent with

AFMA's ERM process; all protected species that come into contact with the fishery are managed to minimise interactions and fatalities.

Priority issues for managing the ecological effects of fishing in the ETBF 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 ETBF, these include;

- *Eastern Tuna and Billfish Fishery Management Plan 2005*
- Eastern 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 (currently under review)

1. CONTENTS

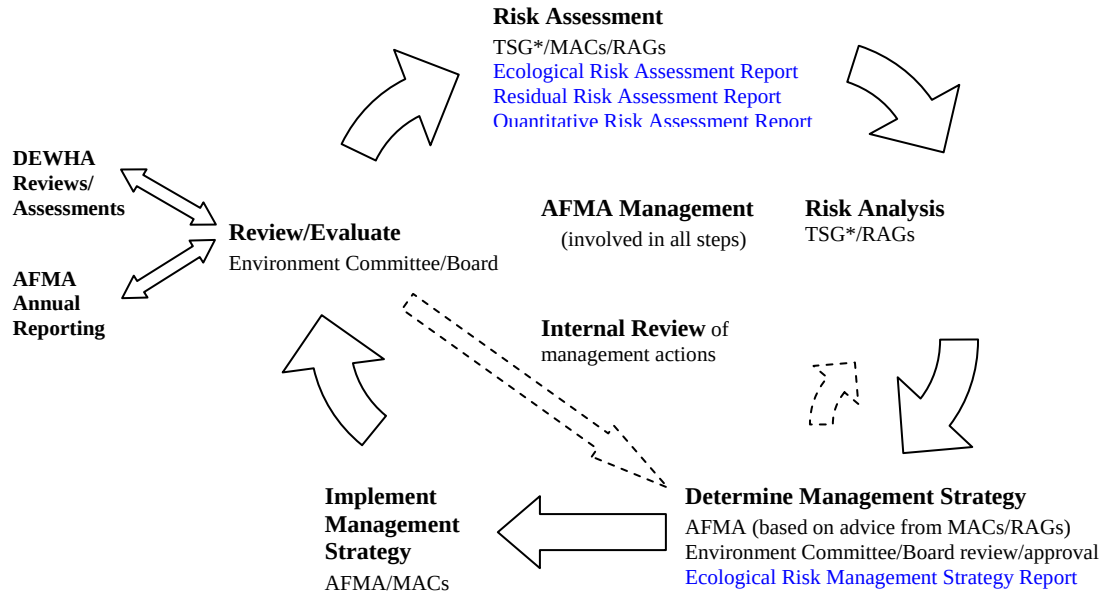
2. OVERVIEW OF THE ERA PROCESS

- **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

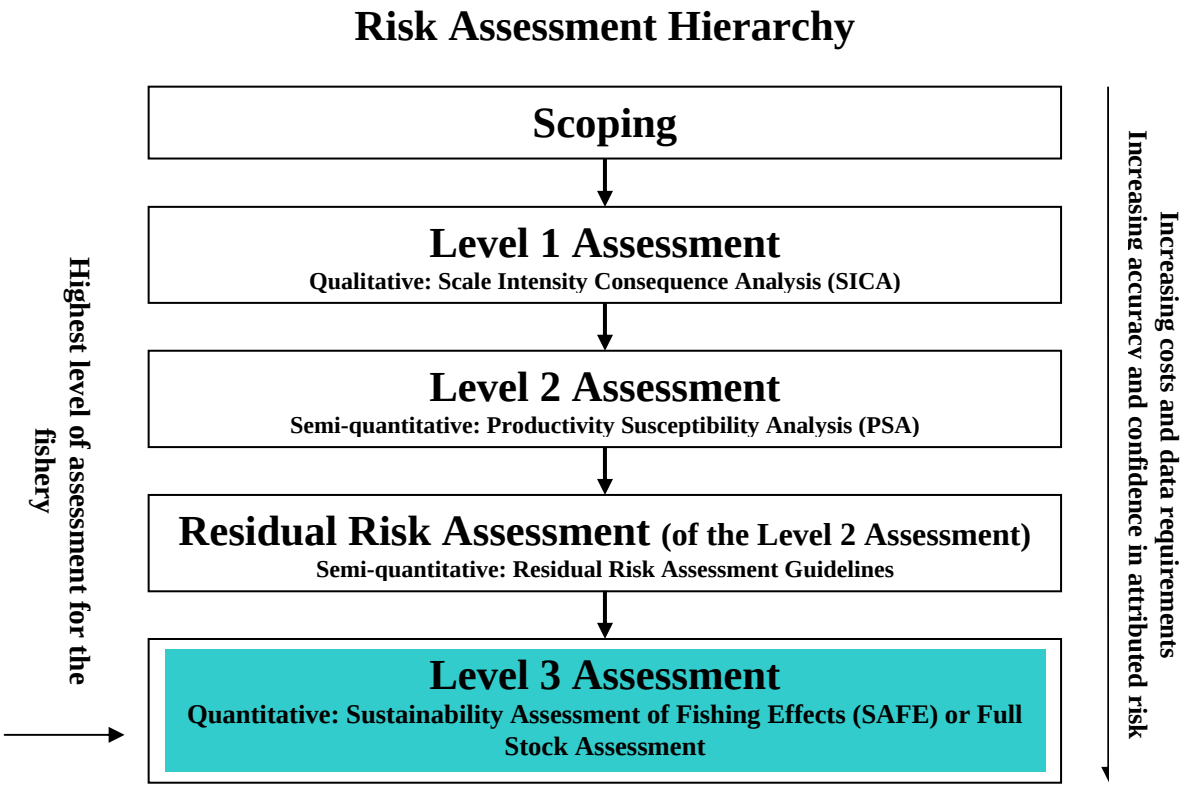


*TSG – Technical Support Group – currently provided by CSIRO

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 ETBF was developed using:

- The SAFE methodology for any teleost or chondrichthyan species identified as precautionary high risk or higher risk category; 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 protected species which have been identified through the ERA process.

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

- Harvest Strategy Policy and Guidelines;
- Non-key Commercial Species (byproduct) Policy;
- Bycatch and Discard Program;
- Shark Policy and the Chondrichthyan Guide for Fisheries Managers; 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 ETBF 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.

3. DESCRIPTION OF THE EASTERN TUNA AND BILLFISH FISHERY

The ETBF extends from the tip of Cape York to the South Australia/Victoria borders and includes waters around Lord Howe Island and the area of the high seas under the region of concern of the Western and Central Pacific Fisheries Commission. The target species of the fishery are yellowfin tuna, albacore tuna, bigeye tuna, broadbill swordfish and striped marlin which are taken predominately by pelagic longline. The smaller minor line sector of this fishery also employs trolling, hand lining and rod and reel fishing to target these species.

The fishery is currently managed by the Australian Fisheries Management Authority (AFMA) according to transitional arrangements provided for in the Eastern Tuna and Billfish Fishery Management Plan 2005 until hook Statutory Fishing Rights (SFRs) are granted (expected to be effective during 2009). 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, the area of operations, and impose limits on the take of bycatch species and the fishing gear which may be employed in the fishery.

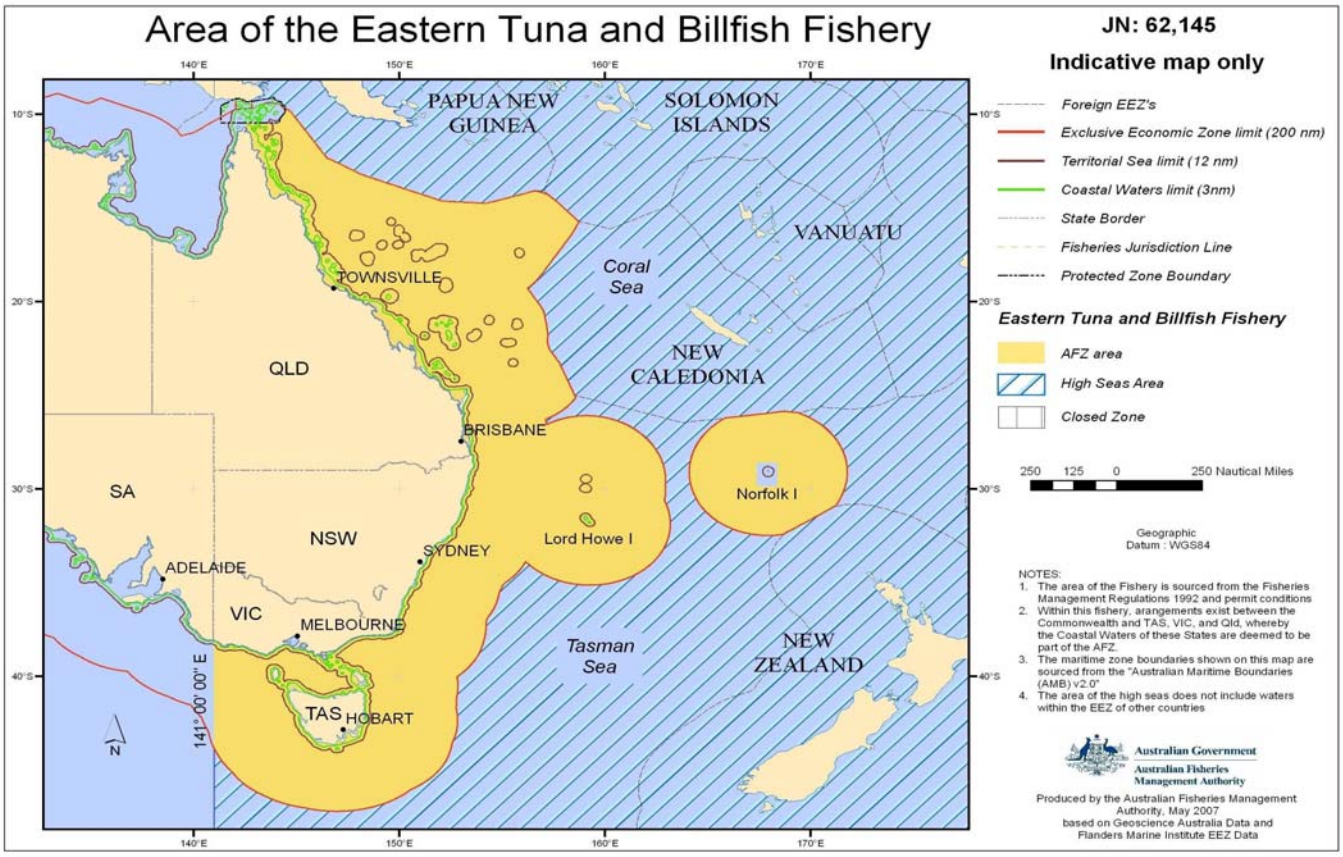


Figure 1 Map of the area of the ETBF

- **International context and obligations**

The Convention on the Conservation and Management of Highly Migratory Fish Stocks in the Western and Central Pacific Ocean applies to most of the area of the ETBF. As a signatory to this convention Australia is obliged to abide by the conditions that the Western and Central Pacific Fisheries Commission (WCPFC) place on these fisheries. The WCPFC is set up through the Convention on the Conservation and Management of Highly Migratory Fish Stocks in the Western and Central Pacific Ocean, and is aimed at sustainably managing and conserving migratory fish stocks in the Western and Central Pacific region.

The WCPFC has adopted measures and resolutions to deal with the capture and interaction with sharks, turtles and birds which include the following;

- Conservation and Management Measure to mitigate the impact of fishing for highly migratory fish stocks on seabirds
- Conservation and Management Measure for sharks in the Western and Central Pacific Ocean
- Conservation and Management Measure for Striped Marlin in the Southwest Pacific
- Conservation and Management Measures for South Pacific Albacore
- Conservation and Management Measures for Bigeye and Yellowfin Tuna in the Western and Central Pacific Ocean
- Conservation and Management Measure for Swordfish in the South West Pacific
- Resolution on non-target fish species
- Resolution to mitigate the impact of fishing for highly migratory fish species on sea turtles

The full list of Conservation and Management Measures and Resolutions as well as the actual documents can be seen at the WCPFC website (http://www.wcpfc.int/).

Due to some fisherman holding quota for and targeting Southern Bluefin Tuna (SBT) in the ETBF it is also necessary that measures in place from the Commission for the Conservation of Southern Bluefin Tuna (CCSBT) are also abided by. These measures can be found at the CCSBT website (http://www.ccsbt.org/). The measures imposed by CCSBT simply state that Members should implement national plans of action to reduce the interactions between the fishery and non-target species, namely seabirds, sharks and turtles.

Management plans and other policy measures for Commonwealth fisheries incorporate the conservation measures adopted by both CCSBT and WCPFC.

4. ECOLOGICAL RISK MANAGEMENT PRIORITY LIST

The risks that the ETBF poses 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 completed in December 2008 for all species occurring in the fishery; and,
- a rapid quantitative risk assessment completed in December 2007 for teleost and chondrichthyan species.

The results of these risk assessments have been consolidated to form a priority list for the fishery comprised of:

- 5 species identified at precautionary high risk or above, through the rapid quantitative risk assessment; plus
- 5 species identified at high risk through the Residual Risk Assessment, including 2 byproduct, and 3 protected (TEP) species.

The Longfin Mako shark was assessed as being at high risk through both the Residual Risk and Rapid Quantitative Risk Assessments.

In addition to the nine species identified through the ERA process, the risk assessment identified that 284 protected (TEP) species occur within the area of the fishery (Level 2 PSA). Of these 284 protected (TEP) species the seabirds and marine turtle groups are those that have the greatest number of interactions with the ETBF. The marine mammal group experienced sporadic interactions with the ETBF. On most occasions these animals are alive and vigorous when cut free of the line. However, consistent with good fisheries management and the specific requirements of the EPBC Act, all reasonable steps will be taken to ensure that interactions with these protected species are minimised.

The priority list of species that the ERM strategy will address is provided in groups rather than individual species. As well as reducing interactions with marine turtles, seabirds and whales due to their protected (TEP) status, the ERM will also aim to decrease the capture and mortality of sharks; due to their ecological status and results from the ERA process where several species of shark have been identified as high risk.

5. 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. The aim of the ERM is thus to mitigate against the capture of entire groups of like-species.

- **Sea Birds**

Seabirds are attracted to fishing vessels by discarded offal and baits and on occasion ingest baited hooks during the setting or, less commonly, hauling of the longline.

Oceanic longline fishing is listed as a key threatening process for seabirds under the *EPBC Act 1999* requiring the development of a Threat Abatement Plan (TAP). The current TAP (2006) requires the ETBF to significantly reduce the bycatch of seabirds in oceanic longline operations and maintain a bycatch rate of less than 0.05 birds per 1000 hooks in all fishing areas (by 5 degree latitudinal bands) and all seasons (1 September – 30 April; 1 May – 31 August).

AFMA has implemented fishing permit conditions that are designed to avoid the capture of seabirds. Conditions to fish south of 25°S include the mandatory use of bird scaring tori lines to scare birds away from the line and weighted swivels to sink the line out of reach of birds.

In 2006 and 2008 a number of bird interactions were recorded in a relatively small part of the fishery. In both years fishing in the area of high bird interactions was restricted to night setting and mitigation measures were reviewed. The captures in winter season of 2008 resulted in a bird interaction rate of 0.06 birds per 1000 hooks in the area between 30° -35° S, in excess of the TAP trigger limit. The fishery has remained closed to daylight setting in this area.

The responses to interactions with seabirds are mandated in the TAP and AFMA and the fishing industry have proven the current TAP is capable of minimising interactions and dealing with the occurrence of any unusual issues.

Actions:

All longline operators when fishing south of 25 degrees must;

- deploy a tori line (of specific design requirements)
- use a line weighting system and thawed baits
- have nil offal discharge while setting and avoiding discharge during hauling

All longline operators when fishing north of 25 degrees must;

- carry a tori line (of specific design requirements)
- have nil offal discharge while setting and avoiding discharge during hauling

In addition to these compulsory measures some operators in the ETBF have adopted voluntary measures from their respective fishery's *Industry Code of Practice* to reduce seabird bycatch including:

- Using a tori line north of 25 degrees in the ETBF
- Puncturing of the swim bladders of thawed baits to assist in sinking rate
- The use of bait casting machines
- Gear selection that minimises the probability of seabird bycatch
- Promoting safe handling and release of all seabirds caught alive on longlines
- Promoting night setting

AFMA undertook an extensive seabird bycatch education program in 2005 with interactive workshops at key ETBF ports. Participants were provided with information about the implementation of new fishing practices designed to minimise seabird bycatch, including highlighting the effectiveness of line weighting and how to correctly assemble and deploy tori lines. A similar education program will be undertaken in 2009, this program will include information on mitigation measures for seabirds as well as information on both turtles and sharks.

AFMA is currently contributing funds towards the testing of a new hook termed the 'smarthook' which is aimed at mitigating the catch of seabirds. If this new hook proves effective it will also be implemented as a conservation measure in the ETBF.

- **Marine Turtles**

Of the seven existing species of marine turtle, six are found in Australian waters, including the loggerhead turtle *Caretta caretta*, green sea turtle *Chelonia mydas*, hawksbill sea turtle *Eretmochelys imbricata*, olive ridley sea turtle *Lepidochelys olivacea*, flatback sea turtle *Natator depressus* and leatherback sea turtle *Dermochelys coriacea*.

Even though the estimated marine turtle bycatch in Australian longline fisheries is less than other foreign longline fisheries, most species of turtle are considered vulnerable to local and even global extinction due to declining numbers. As a result, reductions in mortality from all sources is important for the long-term viability of these species.

Historically the majority of interactions that have occurred in ETBF have been with green and leatherback turtles. In 2008 there were a total of 8 interactions with marine turtles reported through AFMA observers, with 6 released alive. In 2007 there were an observed 8 interactions, with 3 released alive, 3 dead and 2 unknown.

As part of a concerted measure in the WCPFC to decrease turtle mortality associated with fishing, AFMA is developing a mitigation plan to reduce the level of interaction with marine turtles in pelagic longline fisheries. This will be considered by the Western and Central Pacific Fisheries Commission at its meeting in December 2009 and released publicly when completed.

Actions:

All boats in the ETBF were supplied with de-hookers and line cutters in 2005 and as part of the Bycatch and Discarding Workplan these will be made compulsory on boats during 2010.

- **Sharks**

    - **Great White Shark and Grey Nurse Shark**

Under the *EPBC Act 1999*, the great white and grey nurse sharks are listed as protected species. In the ETBF since 1999/2000 there have been a total of five great white shark interactions with two released alive and there have been a total of 11 grey nurse shark interactions, with all released alive.

Grey nurse sharks are typically an inshore reef associated species and there is thus little likelihood of interactions with the offshore pelagic tuna fisheries.

    - **Other Sharks**

Of the 166 species of sharks that occur in Australian waters, fewer than 12 are commonly caught by pelagic longliners. A recent estimate of the average catch rate of all shark species on Australia's east coast was 5.5 per 1000 hooks (Gilman et al 2007). Blue sharks are caught in greatest numbers, with oceanic whitetips, shortfin mako, bronze whaler and thresher spp. also frequently caught. Less frequently caught are hammerhead, tiger, crocodile, silky, porbeagle sharks and longfin mako sharks. There is a large amount of uncertainty in the species composition of shark catch due to identification issues that can arise due to similarities between certain species.

In 2000, a retention limit of 20 sharks per trip was imposed in the ETBF. Any sharks caught in excess of 20 are no longer classified as byproduct but become bycatch and must be discarded whether alive or dead. The limit is designed to make it unfeasible for fisher's to target sharks.

Most sharks which are captured in pelagic longline fisheries are still alive and vigorous when the longline is retrieved and are thus released relatively unharmed. It is general practice by fisher's to cut free big sharks at the waterline well before they reach the deck of the vessel.

Wire Trace was banned across the entire ETBF in July 2005. Prior to the ban wire was used by up to 40% of operators or maximums of 25 and 22 boats for the years 2000 and 2002. Research conducted off north-eastern Australia comparing the catch rates of nylon monofilament traces to wire traces found that the catch rates of sharks using mono were 30% less than when using wire, therefore reducing the selectivity of gear to sharks.

Actions:

- Banning of wire trace in 2005 to reduce the capture of sharks
- Implementation of 20 carcass limit in 2000
- Banning on shark fining in 2000

Research conducted off north-eastern Australia comparing the catch rates of nylon monofilament traces to wire traces found that the catch rates of sharks were lower on nylon than on wire leaders. With a few exceptions, more bycatch was taken on wire than on

monofilament, with the data suggesting that the five boats involved in the study would catch an extra 679 sharks and over 3,000 additional lancetfish and snake mackerel per year if they were permitted to use 100% wire traces.

- **Chondrichthyan Guide for Fisheries Managers**

A practical guide is currently being developed to assist fishery managers and stakeholders to adopt and implement management arrangements for Chondrichthyan species. The Chondrichthyan Working Group will utilise expert based advice to suggest possible mitigation strategies and to identify gaps in research and data.

The Chondrichthyan guide is currently in draft form. This document is designed at giving managers a range of mitigation measures that could be used in the fishery and the possible outcomes on species of these mitigation measures.

- **Whales**

Under the *EPBC Act 1999* all whale species are protected. Recent data summaries for the ETBF show few interactions occurring with whales, and in most cases only experience light contact with gear or are easily cut free from tangles. It is rare that animals experience immediate mortality due to these interactions.

Actions:

Line cutters and de-hookers were supplied to all ETBF vessels in 2005 and will be made compulsory sometime in 2010.

- **Sunfish**

Sunfish are largely a bycatch species in the ETBF which historically have had a low level of catch and retention. Currently there are no management arrangements particularly targeted at managing the catch of Sunfish. It is likely that the yet to be developed Non-key commercial (byproduct) species policy will implement arrangements to deal with the catch of Sunfish. At this stage the ETBF will seek to input the following actions to deal with the catch of this species;

Actions:

- Trigger limit of 750 fish. If reached a review of interactions will occur within 6 months.
- Data collection to enable research into the biology and ecology of these species.

- **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 ETBF has a bycatch and discarding workplan in the form of the *Australian Tuna and Billfish Longline Fisheries bycatch and discarding workplan* agreed on November 1st 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 ETBF (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 ETBF. In the form of the education program (Action 6) and the provision of bycatch recording device (Action 4) AFMA is trying to re-enhance efforts to improve the recording of bycatch by fishers to improve the bycatch data that we are receiving.

6. REPORTING AND REVIEW

Each of the policies and measures above dealing with target, bycatch, byproduct and protected species produce the ERM reporting mechanisms and framework. There are other measures yet to be implemented which may also provide for the ERM reporting mechanisms and framework; such as the Chondrichthyan Guide for Fisheries Managers and the Non-key Commercial Species Policy. Review of the ERM strategy will be based around review of these policies and of the ERA. The above policies and measures will also be used when providing input to annual reporting requirements for the Department of the Environment, Water, Heritage and the Arts (DEWHA).

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 DEWHA. Individual fishery Harvest Strategies and Bycatch and Discard Work Plans contain annual and longer term review timeframes and it is expected that the Non-key Commercial Species Policy will do likewise. The Chondrichthyan Working Group has met once with its goal being to produce a generic guide of mitigation measures suitable for use across all Commonwealth managed fisheries.

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

- **Measuring individual mitigation strategies**

Individual mitigation strategies in the ETBF will come from the different management measures implemented in the ETBF to deal with the seabird, marine turtle and shark groups.

The Bycatch and Discarding Workplan and the Threat Abatement Plan (TAP) deal with the ERM priority species in the ETBF. As well as these under the WCPFC, Australia is required to have a turtle mitigation plan, which is currently under development. Each of these documents has individual measurements;

- AFMA is required to report results of the TAP to the Australian Antarctic Division
- The Bycatch and Discarding Workplan will be reviewed annually to measure the response to actions from this document and renewed biennially to update actions
- It is envisaged that the AFMA will be required to report results of the turtle mitigation plan to the Scientific Committee and the Technical and Compliance Committee of the WCPFC annually

It is expected that each fishery will be reassessed against the ERA methodology on a periodic basis in line with the review of any Wildlife Trade Operation (WTO) accreditation in place in the fishery.

7. 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.
ATBLF	The Australian Tuna and Billfish Longline Fishery
ETBF	Eastern Tune and billfish Fishery
TAP	Threat Abatement Plan
TEP	Threatened, Endangered and Protected species
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*

Level 3 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
Precautionary Extreme high risk	where the fishing mortality rate is grater 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
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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Appendix 2

Table 3 Protected species which were assessed as occurring in the area of the ETBF through the level 2 PSA ERA. Rows which are highlighted show species which have had regular (>1) interactions with the fishery in the period from 2003 to 2008.

Group	Scientific name	Common name
Chondrichthyans		
	Carcharias taurus	Grey nurse shark
	Carcharodon carcharias	White shark
	Rhincodon typus	Whale shark
Seabirds		
	Eudyptula minor	Little Penguin
	Thalassarche bulleri	Buller's Albatross
	Thalassarche cauta	Shy Albatross
	Thalassarche chlororhynchos	Yellow-nosed Albatross, Atlantic Yellow-
	Thalassarche chrysostoma	Grey-headed Albatross
	Diomedea epomophora	Southern Royal Albatross
	Diomedea exulans	Wandering Albatross
	Thalassarche melanophrys	Black-browed Albatross
	Phoebetria fusca	Sooty Albatross
	Phoebetria palpebrata	Light-mantled Albatross
	Diomedea gibsoni	Gibson's Albatross
	Diomedea antipodensis	Antipodean Albatross
	Diomedea sanfordi	Northern Royal Albatross
	Thalassarche impavida	Campbell Albatross
	Thalassarche carteri	Indian Yellow-nosed Albatross
	Thalassarche salvini	Salvin's albatross
	Thalassarche eremita	Chatham albatross
	Diomedea amsterdamensis	Amsterdam Albatross
	Diomedea dabbenena	Tristan Albatross
	Calonectris leucomelas	streaked shearwater
	Daption capense	Cape Petrel
	Fulmarus glacialoides	Southern fulmar
	Halobaena caerulea	Blue Petrel
	Lugensa brevirostris	Kerguelen Petrel
	Macronectes giganteus	Southern Giant-Petrel
	Macronectes halli	Northern Giant-Petrel
	Pachyptila turtur	Fairy Prion
	Pelecanoides urinatrix	Common Diving-Petrel
	Procellaria aequinoctialis	White-chinned Petrel
	Procellaria cinerea	Grey petrel
	Procellaria parkinsoni	Black Petrel
	Procellaria westlandica	Westland Petrel
	Pseudobulweria rostrata	Tahiti Petrel
	Pterodroma cervicalis	White-necked Petrel
	Pterodroma lessoni	White-headed petrel
	Pterodroma leucoptera	Gould's Petrel
	Pterodroma macroptera	Great-winged Petrel
	Pterodroma mollis	Soft-plumaged Petrel
	Pterodroma neglecta	Kermadec Petrel (western)
	Pterodroma nigripennis	Black-winged Petrel
	Pterodroma solandri	Providence Petrel
	Puffinus assimilis	Little Shearwater (Tasman Sea)
	Puffinus bulleri	Buller's Shearwater
	Puffinus carneipes	Flesh-footed Shearwater
	Puffinus creatopus	Pink-footed Shearwater
	Puffinus gavia	Fluttering Shearwater

	Puffinus griseus	Sooty Shearwater
	Puffinus huttoni	Hutton's Shearwater
	Puffinus pacificus	Wedge-tailed Shearwater
	Puffinus tenuirostris	Short-tailed Shearwater
	Fregetta grallaria	White-bellied Storm-Petrel (Tasman Sea),
	Fregetta tropica	Black-bellied Storm-Petrel
	Garrodia nereis	Grey-backed storm petrel
	Oceanites oceanicus	Wilson's storm petrel (subantarctic)
	Pelagodroma marina	White-faced Storm-Petrel
	Phaethon rubricauda	Red-tailed Tropicbird
	Morus capensis	Cape gannet
	Morus serrator	Australasian Gannet
	Sula dactylatra	Masked Booby
	Sula leucogaster	Brown boobies
	Sula sula	Red-footed Booby
	Phalacrocorax fuscescens	Black faced cormorant
	Fregata ariel	Lesser frigatebird
	Fregata minor	Great Frigatebird, Greater Frigatebird
	Anous minutus	Black Noddy
	Anous stolidus	Common noddy
	Catharacta maccormicki	South Polar skua
	Catharacta skua	Great Skua
	Larus dominicanus	Kelp Gull
	Larus novaehollandiae	Silver Gull
	Larus pacificus	Pacific Gull
	Procelsterna cerulea	Grey ternlet
	Stercorarius longicaudus	Long-tailed jaeger
	Sterna albifrons	Little tern
	Sterna anaethetus	Bridled Tern
	Sterna bengalensis	Lesser crested tern
	Sterna bergii	Crested Tern
	Sterna caspia	Caspian Tern
	Sterna dougallii	Roseate tern
	Sterna fuscata	Sooty tern
	Sterna hirundo	Common tern
	Sterna paradisaea	Arctic tern
	Sterna striata	White-fronted Tern
	Sterna sumatrana	Black-naped tern
	Thalassarche platei	Pacific albatross
	Thalassarche steadi	White-capped Albatross
	Pterodroma heraldica	Herald Petrel
Marine Mammals		
	Eubalaena australis	Southern Right Whale
	Caperea marginata	Pygmy Right Whale
	Balaenoptera acutorostrata	Minke Whale
	Balaenoptera borealis	Sei Whale
	Balaenoptera edeni	Bryde's Whale
	Balaenoptera musculus	Blue Whale
	Balaenoptera physalus	Fin Whale
	Megaptera novaeangliae	Humpback Whale
	Balaenoptera bonaerensis	Antarctic Minke Whale
	Delphinus delphis	Common Dolphin
	Feresa attenuata	Pygmy Killer Whale
	Globicephala macrorhynchus	Short-finned Pilot Whale
	Globicephala melas	Long-finned Pilot Whale

	Grampus griseus	Risso's Dolphin
	Lagenodelphis hosei	Fraser's Dolphin
	Lagenorhynchus cruciger	Hourglass dolphin
	Lagenorhynchus obscurus	Dusky Dolphin
	Lissodelphis peronii	Southern Right Whale Dolphin
	Orcaella brevirostris	Irrawaddy dolphin
	Orcinus orca	Killer Whale
	Peponocephala electra	Melon-headed Whale
	Pseudorca crassidens	False Killer Whale
	Sousa chinensis	Indo-Pacific Humpback Dolphin
	Stenella attenuata	Spotted Dolphin
	Stenella coeruleoalba	Striped Dolphin
	Stenella longirostris	Long-snouted Spinner Dolphin
	Steno bredanensis	Rough-toothed Dolphin
	Tursiops truncatus	Bottlenose Dolphin
	Tursiops aduncus	Indian Ocean bottlenose dolphin
	Kogia breviceps	Pygmy Sperm Whale
	Kogia simus	Dwarf Sperm Whale
	Physeter catodon	Sperm Whale
	Berardius arnuxii	Arnoux's Beaked Whale
	Hyperoodon planifrons	Southern Bottlenose Whale
	Indopacetus pacificus	Longman's Beaked Whale
	Mesoplodon bowdoini	Andrew's Beaked Whale
	Mesoplodon densirostris	Blainville's Beaked Whale
	Mesoplodon gingkodens	Gingko Beaked Whale
	Mesoplodon grayi	Gray's Beaked Whale
	Mesoplodon hectori	Hector's Beaked Whale
	Mesoplodon layardii	Strap-toothed Beaked Whale
	Mesoplodon mirus	True's Beaked Whale
	Tasmacetus shepherdi	Tasman Beaked Whale
	Ziphius cavirostris	Cuvier's Beaked Whale
	Arctocephalus forsteri	New Zealand Fur-seal
	Arctocephalus pusillus doriferus	Australian Fur Seal
	Arctocephalus tropicalis	Subantarctic fur seal
	Neophoca cinerea	Australian Sea-lion
	Hydrurga leptonyx	Leopard seal
	Mirounga leonina	Elephant seal
	Dugong dugon	Dugong
	Delphinus capensis	Common dolphin, long-beaked
Marine Reptiles		
	Caretta caretta	Loggerhead
	Chelonia mydas	Green turtle
	Eretmochelys imbricata	Hawksbill turtle
	Lepidochelys olivacea	Olive Ridley turtle
	Natator depressus	Flatback turtle
	Dermochelys coriacea	Leatherback turtle
	Laticauda colubrina	Banded wide faced Sea krait
	Laticauda laticaudata	Large scaled sea krait
	Acalyptophis peronii	Horned Seasnake
	Aipysurus apraefrontalis	Short-nosed Seasnake
	Aipysurus duboisii	Dubois' Seasnake
	Aipysurus eydouxii	Spine-tailed Seasnake
	Aipysurus foliosquama	Leaf-scaled Seasnake
	Aipysurus fuscus	Dusky Seasnake
	Aipysurus laevis	Olive Seasnake, Golden Seasnake
	Aipysurus tenuis	Brown-lined Seasnake

	Astrotia stokesii	Stokes' seasnake
	Disteira kingii	Spectacled seasnake
	Disteira major	Olive-headed Seasnake
	Emydocephalus annulatus	Turtle-headed Seasnake
	Enhydrina schistosa	Beaked Seasnake
	Ephalophis greyi	North-western Mangrove Seasnake
	Hydrelaps darwiniensis	Black-ringed Seasnake
	Hydrophis atriceps	Black-headed seasnake
	Hydrophis belcheri	a seasnake
	Hydrophis caerulescens	Dwarf seasnake
	Hydrophis coggeri	Slender-necked Seasnake
	Hydrophis czeblukovi	Fine-spined seasnake
	Hydrophis elegans	Elegant seasnake
	Hydrophis gracilis	Slender seasnake
	Hydrophis inornatus	Plain seasnake
	Hydrophis mcdowelli	seasnake
	Hydrophis melanosoma	Black-banded robust seasnake
	Hydrophis ornatus	seasnake
	Hydrophis pacificus	Large-headed Seasnake
	Hydrophis vorisi	A seasnake
	Lapemis hardwickii	Spine-bellied Seasnake
	Parahydrophis mertoni	Northern mangrove seasnake
	Pelamis platurus	Yellow-bellied seasnake
Syngnathids		
	Solenostomus cyanopterus	Blue-finned Ghost Pipefish, Robust Ghost
	Solenostomus paradoxus	Harlequin Ghost Pipefish, Ornate Ghost Pipefish
	Phycodurus eques	Leafy Seadragon
	Phyllopteryx taeniolatus	Weedy Seadragon, Common Seadragon
	Solegnathus robustus	Robust Spiny Pipehorse, Robust Pipehorse
	Hippocampus angustus	Western Spiny Seahorse
	Trachyrhamphus bicoarctatus	Bend Stick Pipefish, Short-tailed Pipefish
	Haliichthys taeniophorus	Ribboned Seadragon, Ribboned Pipefish
	Urocampus carinirostris	Hairy Pipefish
	Lissocampus runa	Javelin Pipefish
	Hippocampus bleekeri	Pot bellied seahorse
	Histiogamphelus briggsii	Briggs' Crested Pipefish, Briggs' Pipefish
	Hypselognathus rostratus	Knife-snouted Pipefish
	Leptoichthys fistularius	Brushtail Pipefish
	Kaupus costatus	Deep-bodied Pipefish
	Mitotichthys semistriatus	Half-banded Pipefish
	Lissocampus caudalis	Australian Smooth Pipefish, Smooth Pipefish
	Stigmatopora argus	Spotted Pipefish
	Stigmatopora nigra	Wide-bodied Pipefish, Black Pipefish
	Stipecampus cristatus	Ring-backed Pipefish
	Pugnaso curtirostris	Pug-nosed Pipefish
	Mitotichthys mollisoni	Mollison's Pipefish
	Vanacampus phillipi	Port Phillip Pipefish
	Vanacampus poecilolaemus	Australian Long-snout Pipefish, Long-snouted Pipefish
	Mitotichthys tuckeri	Tucker's Pipefish
	Hippocampus breviceps	Short-head Seahorse, Short-snouted Seahorse
	Hippocampus whitei	white's seahorse
	Solegnathus spinosissimus	spiny pipehorse
	Halicampus grayi	Mud Pipefish, Gray's Pipefish
	Corythoichthys conspicillatus	Yellow-banded Pipefish, Network Pipefish
	Hippocampus taeniopterus	Spotted Seahorse, Yellow Seahorse

Acentronura breviperula	Hairy Pygmy Pipehorse
Bulbonaricus davaoensis	[a pipefish]
Campichthys tricarinatus	Three-keel Pipefish
Campichthys tryoni	Tryon's Pipefish
Choeroichthys brachysoma	Pacific Short-bodied Pipefish, Short-bodied pipefish
Choeroichthys cinctus	[a pipefish]
Choeroichthys sculptus	[a pipefish]
Choeroichthys suillus	Pig-snouted Pipefish
Corythoichthys amplexus	Fijian Banded Pipefish, Brown-banded Pipefish
Corythoichthys haematopterus	[a pipefish]
Corythoichthys intestinalis	Australian Messmate Pipefish, Banded Pipefish
Corythoichthys ocellatus	Orange-spotted Pipefish, Ocellated Pipefish
Corythoichthys paxtoni	[a pipefish]
Corythoichthys schultzi	Schultz's Pipefish
Cosmocampus darrosanus	[a pipefish]
Cosmocampus howensis	Lord Howe Pipefish
Cosmocampus maxweberi	[a pipefish]
Dunckerocampus dactyliophorus	Ringed Pipefish
Doryrhamphus melanopleura	Bluestripe Pipefish
Doryrhamphus janssi	Cleaner Pipefish, Janss' Pipefish
Doryrhamphus malus	Flagtail Pipefish, Negros Pipefish
Festucalex cinctus	Girdled Pipefish
Festucalex gibbsi	[a pipefish]
Filicampus tigris	Tiger Pipefish
Halicampus brocki	Brock's Pipefish
Halicampus dunckeri	Red-hair Pipefish, Duncker's Pipefish
Halicampus macrorhynchus	[a pipefish]
Halicampus mataafae	[a pipefish]
Halicampus nitidus	Glittering Pipefish
Halicampus spinirostris	Spiny-snout Pipefish
Heraldia nocturna	Upside-down Pipefish
Hippichthys cyanospilos	Blue-speckled Pipefish, Blue-spotted Pipefish
Hippichthys heptagonus	Madura Pipefish
Hippichthys penicillus	Beady Pipefish, Steep-nosed Pipefish
Hippichthys spicifer	[a pipefish]
Hippocampus planifrons	Flat-face Seahorse
Hippocampus zebra	[a pipefish]
Histiogamphelus cristatus	Rhino Pipefish, Macleay's Crested Pipefish
Kimblaeus bassensis	Trawl Pipefish, Kimbla Pipefish
Maroubra perserrata	Sawtooth Pipefish
Micrognathus andersonii	Anderson's Pipefish, Shortnose Pipefish
Micrognathus pygmaeus	[a pipefish]
Micrognathus micronotopterus	Tidepool Pipefish
Micrognathus natans	[a pipefish]
Microphis brachyurus	[a pipefish]
Microphis manadensis	Manado River Pipefish, Manado Pipefish
Nannocampus lindemanensis	[a pipefish]
Notiocampus ruber	Red Pipefish
Phoxocampus diacanthus	[a pipefish]
Siokunichthys breviceps	[a pipefish]
Solegnathus dunckeri	Duncker's Pipehorse
Solegnathus sp. 1 [in Kuiter, 2000]	Pipehorse
Syngnathoides biaculeatus	Double-ended Pipehorse, Alligator Pipefish
Trachyrhamphus longirostris	Long-nosed Pipefish, Straight Stick Pipefish
Vanacampus margaritifer	Mother-of-pearl Pipefish

Hippocampus minotaur	Bullneck Seahorse
Hippocampus bargibanti	Pygmy seahorse
Halicampus boothae	[a pipefish]
Hippocampus queenslandicus	Kellogg's Seahorse
Hippocampus dahli	[a pipefish]
Hippocampus tristis	[a pipefish]
Hippocampus alatus	[a pipefish]
Hippocampus abdominalis	Big-bellied / southern potbellied seahorse
Hippocampus procerus	[a pipefish]
Hippocampus multispinus	[a pipefish]
Hippocampus hendriki	[a pipefish]
Heraldia sp. 1 [in Kuiter, 2000]	Western upsidedown pipefish
Heteroclinus perspicillatus	Common weedfish
Hippocampus spinosissimus	Hedgehog Seahorse
Hippocampus histrix	Spiny Seahorse
Hippocampus kelloggi	Kellogg's Seahorse
Hippocampus kuda	Spotted Seahorse, Yellow Seahorse