Australian Government

Australian Fisheries Management Authority

Residual Risk Assessment of the Level 2 Ecological Risk Assessment Species Results

Report for the Small Pelagic Fishery – Purse Seine

March 2010

EXECUTIVE SUMMARY

The Australian Fisheries Management Authority (AFMA) has undertaken detailed ecological risk assessments (ERAs) for all major Commonwealth managed fisheries as a key part of the implementation of the ecological component of Ecologically Sustainable Development (ESD). ERAs assess the risks that fishing poses to the ecological sustainability of the marine environment by considering the impact of fishing on all components of the marine environment. The main purpose of ERAs is to prioritise the management, research, data collection and monitoring needs for each fishery.

The ecological risk management (ERM) framework has been developed to ensure that a consistent process is followed across fisheries when responding to the ERA outcomes. This framework ties into current fishery management processes and structures so that it can be easily implemented by fisheries. To support implementation of the ERM framework, AFMA will fully document the risk management for each fishery. This will ensure transparency in the process and allow for easier co-ordination within and between fisheries. Using the results presented in this report, along with the results from any subsequent levels of assessment, appropriate management arrangements will be developed to address the high priority species as part of the ERM framework.

Due to the semi-quantitative nature of the risk assessment, the Level 2 PSA results do not directly account for all management measures, resulting in an over-estimation of the actual risk for some species. To better encompass this, the Level 2 PSA analysis has undergone further refinement by applying a set of residual risk guidelines.

In early 2007, the residual risk guidelines were developed in consultation with CSIRO and stakeholders to assist AFMA managers in refining the Level 2 PSA results. They have been developed to maintain the key features of objectivity and consistency from the ERA process, and to ensure a repeatable and transparent assessment process. These guidelines take into account methodology related matters and the most current management arrangements. To assist managers, a clear set of decision rules are outlined that are to be applied to individual species.

For the Purse Seine sub-fishery of the Small Pelagic Fishery, the results from the Level 2 PSA table are used here to determine the residual risk at this level of assessment. Overall 108 high risk species were assessed of which 29 remained high risk after applying the residual risk guidelines. These included 107 marine mammals and one shark species. The primary reason for the reduction of 79 species from high risk was because AFMA expert advice is that sea birds are able to escape from purse seine nets as they are top opening.

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1. OVERVIEW

1.1. Ecological Risk Management Process

A key component in the Australian Fisheries Management Authority's (AFMA's) implementation of the ecological component of ESD has been the undertaking of ecological risk assessments (ERAs) for all major Commonwealth managed fisheries. By assessing the impacts of fishing on all parts of the marine environment, the ERAs encompass an ecosystem-based assessment approach. The ERAs will help to prioritise research, data collection monitoring needs and management actions for fisheries and provide information to assist the decision making process so that they can be managed both sustainably and efficiently.

To assist with the implementation of the ecological component of ESD across all fisheries AFMA has established an ecological risk management (ERM) framework (see **Figure 1**). This framework ensures that a consistent process is followed across fisheries when responding to the ERA outcomes. While this framework focuses on responding to the results of ERAs, it acknowledges that there are other initiatives contributing to the achievement of the ecological component of ESD. The ERM framework will streamline fishery's responses to the results of ERAs and incorporate other initiatives such as harvest strategies and bycatch and discard programs.

Due to the semi-quantitative nature of the level 2 ERAs, not all risk scores are an accurate representation of actual risk. The Level 2 PSA residual risk process is used to incorporate the effects of current management measures which impact on the level of risk posed by a fishery to species and adjust risk scores where appropriate. From a detailed methodology review, AFMA found that some ERAs did not include all existing management arrangements at the time of assessment. Furthermore, since the initial ERAs were conducted in 2005, the management of some fisheries has changed and additional data and information may have become available.
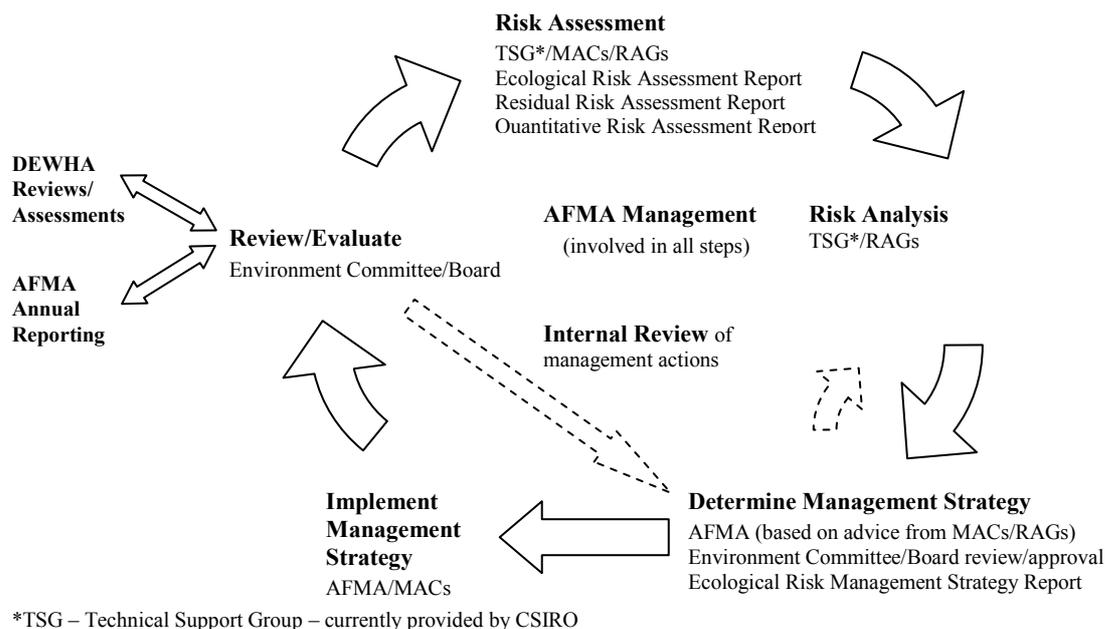
Figure 1 Ecological Risk Management framework

1.2. ERA Project

Since 2001, AFMA has been implementing ERAs. AFMA in collaboration with CSIRO developed the ERA methodology which has now been applied to all major Commonwealth managed fisheries. The aim of the ERA project is to assess both the direct and indirect impacts of a fishery's activity on *all* aspects of the marine ecosystem.

1.3. ERA Methodology

The ERA methodology is an adaptation of a traditional risk assessment to suit commercial fishing operations. The assessment evaluates the impact of fishing activities on all five major components of the marine ecosystem:

- target species (including bait species);
- byproduct and bycatch (discarded) species;
- threatened, endangered and protected (TEP) species;
- habitats ; and
- ecological communities.

The ERA assessment adopts a hierarchical approach (refer to **Figure 2**). With every progressive level, the precision increases along with confidence in the risk scores (noting that not all components progress all the way through the assessment hierarchy). Each of these levels is outlined in more detail below.

Risk Assessment Hierarchy
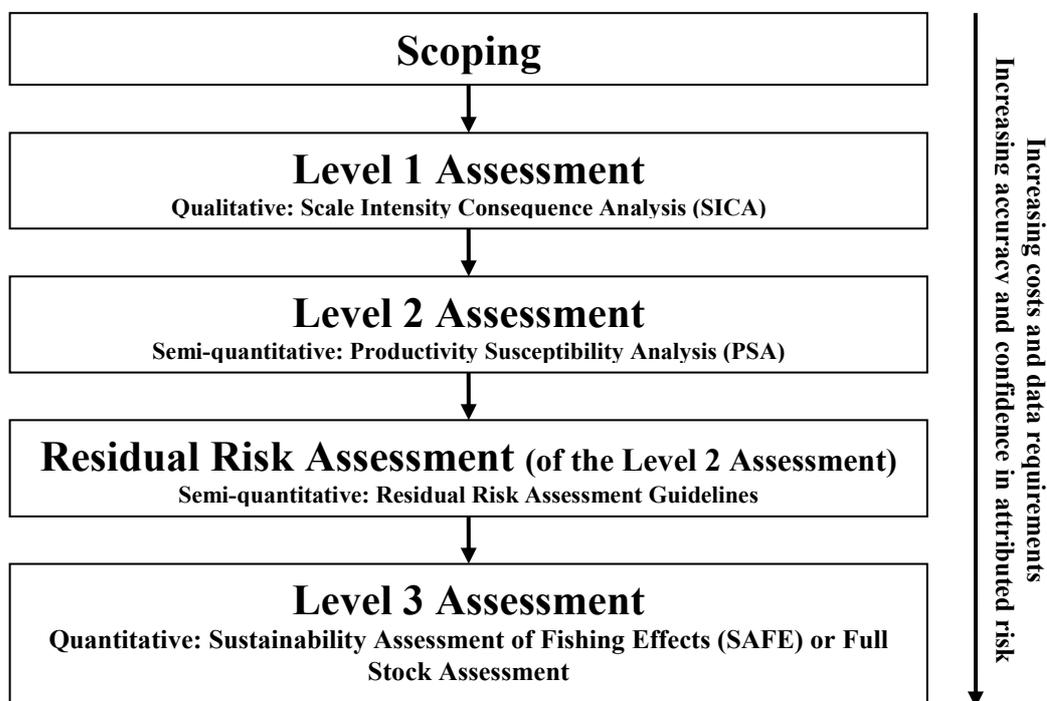
Figure 2 The different levels of risk assessment and the trend in confidence and cost

Scoping

At the **scoping** stage, a profile is developed for each of the fisheries being assessed. This includes gathering the information needed to complete more detailed level one and two assessments. Analysis focuses on the characteristics of the individual fishery, which may be divided into sub-fisheries based on fishing method and/or spatial coverage if this is more appropriate for assessment. At this stage, the general fishery characteristics are documented, and a list of all "units of analysis" (all species, habitat types and communities present in the fishery) is generated. Hazards and objectives for the fishery are also identified (for more detail refer to Hobday *et al.*, 2007).

Level 1 – Scale, Intensity, Consequence Analysis

Level 1 is a qualitative assessment of scale, intensity, consequence analysis **(SICA)** that identifies which hazards (activities) lead to a significant impact on any species, habitat or community. This involves an assessment of the risk posed by each identified fishing **activity** on each of the ecosystem components. At this level, analysis is conducted on whole ecosystem components (target; bycatch and byproduct; TEP species; habitats and communities), not at the individual species level. Level 1 is used as a rapid screening tool, with a "worst case" approach used to ensure only genuine low risk elements (either activities or ecosystem components) are screened out. This analysis uses the most vulnerable sub-component and the most vulnerable unit of analysis within each component (e.g. the most vulnerable species, habitat type or community). Further to this, where judgements about risk are uncertain, the highest level of risk regarded as plausible is used (for more detail refer to Hobday *et al.*, 2007).

Level 2 – Productivity Susceptibility Analysis

Level 2 PSA is a semi-quantitative analysis of the risk posed by fishing to all individual species, habitats and communities identified in the scoping stage. Level 2 PSA allows all **units** (species, habitats or communities) within any of the ecological components to be effectively and comprehensively screened for risk. Level 2 PSA assesses the direct impact of fishing and is based on the assumption that risk to an individual unit is based on two characteristics of the unit:

- **Susceptibility:** where the extent of the impact on an ecological unit is determined by the susceptibility of the unit to the fishing activities; and
- **Productivity:** which determines the rate at which the unit can recover after potential depletion or damage by fishing activities.

For the Level 2 assessment, each unit within the ecological component is assessed for the risk it faces from the fishery. The Level 2 PSA approach examines a number of **attributes** of each unit that contribute to or reflect its *susceptibility* or *productivity*. A score on a three point scale (low, medium, high) is determined for each unit for both productivity and susceptibility which combined provides a relative measure of risk for each unit. The attributes used to assess productivity and susceptibility is given in **Appendix A**. The Level 2 PSA risk scoring system is precautionary in that, where there is no information known on a specific productivity or susceptibility attribute for a unit, it is given a default score of 'high risk'.

Level 2 PSA Residual Risk Assessment

Further information on the Level 2 PSA residual risk process is detailed later in this document.

Level 3 – Quantitative Risk Assessment

At the conclusion of the Level 2 PSA assessment, a number of units may have been identified as being at high risk because of the activities of the fishery. At this stage a Level 3 analysis may be warranted. This can take various forms including a quantitative sustainability assessment for fishing effects (SAFE) recently developed by CSIRO to assess multiple species or a fully quantitative assessment of a specific species (similar to a standard stock assessment). Quantitative risk assessments constituting the equivalent of a Level 3 risk analysis currently exist for many species. Before proceeding to a fully quantitative Level 3 assessment, investigation of suitable existing information to further understand the risk scores for high risk units should be identified. This may help to overcome some of the constraints of the Level 2 PSA results (outlined below) prior to proceeding to more costly Level 3 analysis for the remaining high risk units.

Constraints of Level 2 PSA Results

The methodology used in the Level 2 PSA assessment results in risk scores of high, medium or low to reflect potential rather than actual risk. Quantifying the actual risk for any species requires a Level 3 assessment. Due to the semi-quantitative nature of the Level 2 PSA risk assessment, analysis does not take into account all management measures currently in place in fisheries, which may result in an over-estimate of the actual risk for some species. The management arrangements that are not accounted for in the Level 2 assessment include:

- Limits to fishing effort;
- Catch limits (such as Total Allowable Catches – TACs); and
- Other controls such as seasonal closures.

Management arrangements that *are* accounted for in the assessment include:

- Spatial management that limits the range of the fishery (affecting availability);
- Gear limits that affect the size of animals that are captured (selectivity); and
- Handling practices that may affect the survival of species after capture (post capture mortality).

As a result, the Level 2 PSA is intentionally designed to generate more **false positives** for high risk (species assessed have a high risk when they are actually low risk) than **false negatives** (species assessed to be low vulnerability when they are actually high vulnerability). This is due to the Level 2 PSA methodology adopting a **precautionary** approach to uncertainty. An example of this is when a species is missing information on its productivity and susceptibility attributes the risk score defaults to a higher risk.

In addition, TEP species are included within the assessment on the basis that they occur in the area of the fishery, whether or not there has been a recorded interaction with the fishery. For this reason there may be a higher proportion of false positives for high risk TEP species, unless there is a robust observer program that can verify that species do not interact with the fishing gear.

When AFMA reviewed the methodology using example fisheries, some additional concerns arose. Since the original Level 2 PSA results were produced there is now an improved understanding of: new or updated catch data available from log books and catch records; advances in scientific knowledge that may have become available; and more resolution on the spatial distribution of species etc. Each of these issues is discussed below.

Improved data

The ERA process adopts a precautionary approach if there is uncertainty about an attribute the higher risk score is used. At the Level 2 PSA when a species is missing either a productivity or susceptibility attribute the score defaults to a high risk category. Furthermore, species attributes that were originally calculated for the fishery may be out-of-date because additional or more precise information has become available.

Additional information

Since the time of the original ERA assessment, additional information may now be available as a result of other investigations and research etc.

Spatial assumptions

The Level 2 PSA utilises a precautionary approach when calculating susceptibility by assuming species distribution is only within the jurisdictional boundary of the fishery. While this is appropriate for species that form discrete populations or stocks, the risk score for species that extend beyond the boundary of the fishery such as pelagic and migratory species is not.

Interaction and catch data

Some species have a low to negligible level of interaction with the fishing gear. Species with very low biological productivity may however still be scored high or medium risk irrespective of their low susceptibility. Considering that the likelihood of interaction is already low there is little additional management that a fishery can introduce to mitigate the risk. Therefore the level of interaction or capture should be included as part of the Level 2 PSA residual risk process.

Management arrangements

As stated above, effort and catch limits for target and byproduct species are not taken into account in the ERA even though these arrangements may mitigate risk for some species. The Level 2 PSA residual risk process allows many of these management arrangements to be incorporated into the assessment.

Some management arrangements concerning the mitigation of bycatch have been incorporated into the initial ERA process; however, they may now be out-of-date since the initial ERA assessment. The Level 2 PSA residual risk process incorporates some of these management arrangements into the results to better represent the overall risk for a species.

There may be a beneficial overlap of management arrangements for individual species that were not a specific target of that arrangement if there is a high degree of association between the species. In some instances the initial ERA may not have considered the benefit of management arrangements between associated species.

Although seasonal, spatial and depth closures have been considered in the initial ERA, more recent management measures have not been accounted for. The Level 2 PSA residual risk process will consider some of these arrangements and will bring the assessment up-to-date.

2. LEVEL 2 ERA RESIDUAL RISK PROCESS

2.1. Level 2 ERA Residual Risk

All major fisheries have been assessed to Level 2 PSA where applicable. Before moving to a Level 3 assessment, the residual risk guidelines have been applied to account for some of the constraints of the Level 2 PSA assessment. The Level 2 PSA residual risk process (**Figure 3**) incorporates some of the concepts of a Level 3 assessment and is more cost effective than a full Level 3 assessment. Furthermore, the Level 2 PSA residual risk results more accurately represent overall risk within a fishery and will help clarify if further (Level 3) assessment is necessary.
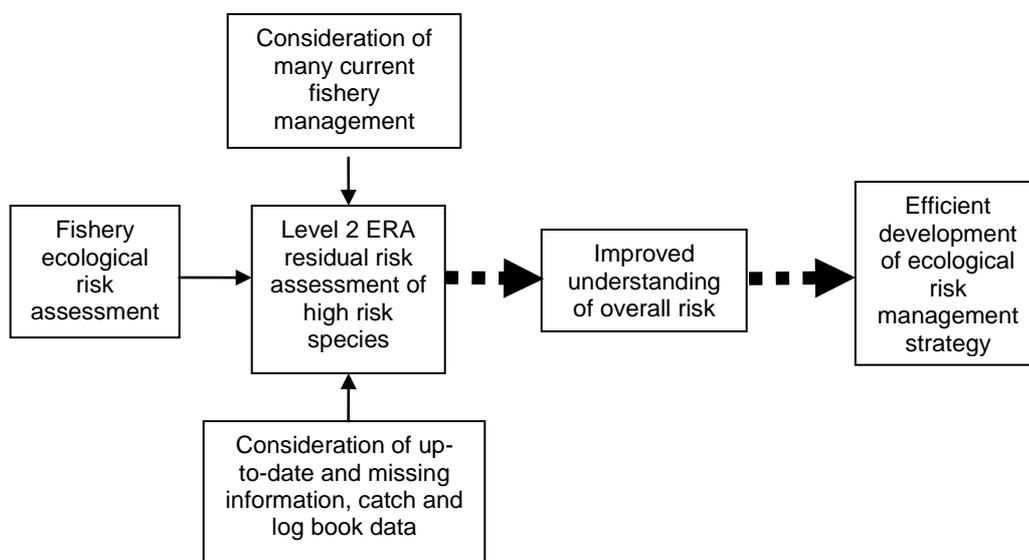
Figure 3 Flow diagram of the Level 2 ERA residual risk process

2.2. Level 2 PSA Residual Risk Process

In 2007 AFMA, with input from CSIRO and stakeholders, developed a set of guidelines to assess the residual risk for species identified as having a high potential risk based on the Level 2 analysis. The guidelines have been designed to ensure that a consistent, transparent and repeatable process is adopted across all fisheries. A summary of the guidelines is given in **Table 1**. Within each category there are clear decision rules that can be applied to a species (if relevant) to calculate Level 2 PSA residual risk. Each of the guidelines was applied on a species-by-species basis to determine the Level 2 PSA residual risk within the fishery.

When determining the Level 2 PSA residual risk, all considerations included in the calculation process must be recorded, along with the guidelines applied with a detailed justification clearly stated. This ensures that a transparent process is maintained. In review of the ERA results, the guidelines have been applied to all high risk species by managers in consultation with MAC members and experts. Broadly the application processes involved the following steps:

- Sorting the ERA result by high risk, then grouping the high risk species by role within the fishery, then by taxonomic group;

- Creating a list of all management arrangements not included in the Level 2 PSA results for reference when applying the guidelines;

- Considering each management arrangement to relevant high risk species;

- Collating spatial information from experts, observer and logbook data for all high risk species for reference when applying the guidelines;

- Deciding if and what guideline applies to each of the high risk species by conducting a species-by-species application;

- Making changes to the necessary attributes, productivity and susceptibility scores to calculate the Level 2 PSA residual risk score;

- Recording all workings, guidelines used, how they have been applied and a justification for the Level 2 PSA residual risk score;

- Providing preliminary Level 2 PSA residual risk results to MACs for feedback; and

- Finalising the Level 2 PSA residual risk results for release.

Before the Level 2 PSA residual risk process was applied to all fisheries the guidelines were trialled in three fisheries, the Eastern Tuna and Billfish Fishery (ETBF), Southern and Eastern Scalefish and Shark Fishery (SESSF), and the Northern Prawn Fishery (NPF). These fisheries were selected for the Level 2 PSA residual risk pilot because they are key fisheries and provide a template for other fisheries. Developments in the application of the Level 2 PSA residual risk process are outlined in **Table 2**.

Table 1 Summary of Level 2 ERA Residual Risk Guidelines*

Guideline Number	Summary
Guideline 1. Risk rating due to missing/incorrect information.	Considers if susceptibility and/or productivity attribute data for a species is missing or incorrect for the fishery assessment, and is corrected using data from a trusted source or another fishery.
Guideline 2. Additional scientific assessment.	Considers any additional rigorous scientific assessment (i.e. rapid Level 3 risk assessment, population viability analysis) that calculates the species level of risk from fishing, or considers any other scientific published assessments or results.
Guideline 3. At risk due to missing attributes.	When there are three or more missing productivity attributes, considers closely related species within a fishery that have those productivity attributes known.
Guideline 4. At risk with spatial assumptions.	Uses additional information on spatial distribution of species populations to better represent the species distribution overlap with the fishery.
Guideline 5. At risk in regards to level of interaction/capture with a zero or negligible level of susceptibility.	Considers observer or expert information to better calculate susceptibility for those species known to have a low likelihood or no record of interaction or capture with the fishery.
Guideline 6. Effort and catch management arrangements for target and byproduct species.	Considers current management arrangements based on effort and catch limits set using a scientific assessment for key species.
Guideline 7. Management arrangements to mitigate against the level of bycatch.	Considers management arrangements in place that mitigate against bycatch by the use of gear modifications, mitigation devices and catch limits.
Guideline 8. Limits on associated species through other management arrangements.	Considers the implications of management arrangements for a particular species on other associated species.
Guideline 9. Management arrangements relating to seasonal, spatial and depth closures.	Considers management arrangements based on seasonal, spatial and/or depth closures.

- For the complete Residual Risk Guidelines, refer to
http://www.afma.gov.au/environment/eco_based/eras/reports.htm

Table 2 Stakeholder Engagement

Guideline stage	Stakeholder interaction	Date of interaction	Stakeholder group	Summary of outcome
Level 1, qualitative assessment of the SPF	AFMA workshop	September 2005	SPFMAC & RAG	Review of Level 1 qualitative assessment
Draft Level 2 ERA residual risk assessment trial in SESSF	AFMA workshop	12 December 2006	Trial application of draft Level 2 ERA residual risk guidelines	Agreement much further work was needed
Trial Level 2 ERA residual risk assessment using draft ERA results in the ETBF, SESSF and NPF	AFMA workshop	21 May 2007	Fisheries managers in ETBF, SESSF and NPF and AFMA environment section	Draft Level 2 ERA results presented and application of guidelines discussed. Catalyst for major revision of multiple areas in guidelines by AFMA
Review of the draft residual risk report by the Residual Risk Review Group	Residual Risk review Group	13 March 2008	Fisheries managers, BRS, DEWHA & an environment NGO representatives	Reviewed the consistency of, and sought clarification on aspects of, application of the Residual Risk Guidelines across 12 major fisheries and sub fisheries.
Review of the final residual risk report.	AFMA Workshop	21 April 2010	SPFRAG	TBA
Review of the final residual risk report.	AFMA Workshop	5 May 2010	SPFMAC	TBA

3. RESULTS

3.1. ERA Results

Fishery Description

Gear:	Purse seine
Area:	AFZ waters from Queensland border out to 154° 29' 54" S up to 24° 29' 54" S then south around Tasmania along to the west coast of Western Australia. Divided into eastern and western sub-areas at 146° 30' 00" E
Depth range:	30 to 3000 m; no real offshore depth limit as surface gear fishes the upper 20 meters
Fleet size:	45 permits, but only 4 vessels were active in the fishery in 2008-2009.
Effort:	224 shots in 2008/09 compared to peak of 270 shots in 2005/06.
Landings:	3,277 tonnes in 2008/09 compared to peak of 3,761 tonnes in 1005/06
Discard rate:	Unknown, presumed to be very low
Main target species:	Jack mackerels (*Trachurus declivis and T. murphyi*) and Blue Mackerel (*Scomber australasicus*)
Management:	Transitional phase – *Small Pelagic Fishery Management Plan 2009* has been determined, currently limited entry permits but will move to quota statutory fishing rights once the grant is completed.
Observer program:	Limited coverage – 10 days in Jan 2010, none in 2007-08 or 2008-09, 10 days in 2006-07 and 24 days in 2005-06

Ecological Units Assessed

Target species:	5 species
By-product and bycatch species:	9 and 3 respectively
TEP species:	218 in fishery jurisdiction

Level 1 Results

One ecological component (habitat) was eliminated at Level 1. There was at least one risk score of 3 – moderate – for each remaining component.

All but one hazard (fishing activities) was eliminated at Level 1 (risk scores 1 or 2). The remaining hazard was:

- Fishing (direct impacts on four ecological components)

Significant external hazards included other fisheries in the region and coastal development.

Level 2 Results

Of the 235 species assessed at Level 2 using the PSA analysis, expert/observer over-rides were used on 4 species. A total of 108 species were found to be at high risk. Of these, 2 species had more than 3 missing attributes.

The 108 high risk species were all in the TEP species component. By taxa, the high risk TEP species comprised 1 chondrichthyan (sharks and rays), 78 marine birds and 29 marine mammals. In the absence of information from any observer program, many of these may be false positives, but cannot be eliminated from the assessment.

No target, bycatch or byproduct species were found to be of risk. The majority were at low risk, in part because of their high productivity, and medium susceptibility (e.g. wide distribution).

Of the TEP species assessed to be at high risk, the birds are at high risk due to lack of information on presence in the area of the fishery; thus, without more information on encounter rates with the fishery, they remain at high risk. Many of the marine mammals of risk, such as the beaked whales, fall into the same situation.

White Sharks are also considered at high risk and are known to feed among schools of pelagic fishes. White Sharks have been observed among salmon schools in SA and southwest WA as well as among sardine schools off South Africa, and there are records of sardines in the stomach contents of White Sharks (Klimely 1985; Malcolm et al 2001). Observer data may reduce this risk score.

The high risk species that are of more concern are the seals and dolphins, and in the absence of any observer data for this fishery, risk estimates are difficult to revise. These species will remain a concern until additional data is collected. For example, Australian fur seals may be captured by the fishery, but the species is also known to be increasing quite rapidly. The issue with fur seals is one of capturing a protected species, not one of ecological sustainability. Dolphins have been captured in the south Australian purse seine fishery, resulting in a temporary closure in 2005. Lack of information in the SPF fishery means these species may also be an issue here. However, in most cases most marine mammals are able to move freely into and out of the purse-seine net as it is top-opening.

Summary

3.2. Level 2 PSA Residual Risk Results

The Level 2 PSA residual risk assessment summary for the Small Pelagic Fishery is given in **Table 3.** Overall 235 species were assessed: 5 target, 3 bycatch (discard), 9 byproduct and 218 TEP species. A summary of the number of species in each category of risk and the guidelines used for each component are given in **Table 4**. Seventy-nine species were reduced from the high risk category because AFMA expert advice is that sea birds are able to escape as a purse seine net is top opening. Overall there has been a change from 108 high risk species prior to the Level 2 PSA residual risk assessment to 29 high residual risk species.

Table 3 Level 2 PSA Residual Risk Results

Taxonomic Group	Scientific Name	Common Name	Role in Fishery*	Productivity	Susceptibility	Level 2 ERA Risk Category Score	Current and Planned Management/ Assessment	Level 2 ERA Residual Risk Guideline(s) Applied	Justification	Level 2 ERA Residual Risk Score
Teleost	Macruronus novaezelandiae	Blue Grenadier	BP	1.71	1.89	Low 2.55				Low 2.55
Teleost	Sardinops neopilchardus	Pilchard	BP	1.00	2.33	Low 2.54				Low 2.54
Teleost	Hyperoglyphe antarctica	Blue Eye Trevalla	BP	2.00	1.44	Low 2.47				Low 2.47
Teleost	Seriola lalandi	Yellowtail Kingfish	BP	1.71	1.67	Low 2.39				Low 2.39
Teleost	Thyrsites atun	Barracouta	BP	1.57	1.44	Low 2.13				Low 2.13
Teleost	Pseudocaranx dentex	Silver Trevally	BP	1.57	1.22	Low 1.99				Low 1.99
Teleost	Seriolella brama	Blue Warehou	BP	1.29	1.44	Low 1.93				Low 1.93
Teleost	Decapterus russelli	Red-tailed Round Scad	BP	1.43	1.22	Low 1.88				Low 1.88
Teleost	Seriolella punctata	Spotted Warehou	BP	1.43	1.22	Low 1.88				Low 1.88
Teleost	Lepidopus caudatus	Southern Frostfish	DI	1.71	1.44	Low 2.24				Low 2.24
Teleost	Centroberyx lineatus	Swallowtail	DI	1.71	1.22	Low 2.11				Low 2.11
Teleost	Nelusetta ayraudi	Chinaman-Leatherjacket	DI	1.29	1.67	Low 2.10				Low 2.10
Teleost	Trachurus novaezelandiae	Yellow-tail scad	TA	1.29	1.67	Low 2.10				Low 2.10
Teleost	Trachurus declivis	Jack Mackerel	TA	1.29	1.67	Low 2.10				Low 2.10
Teleost	Emmelichthys nitidus	Redbait	TA	1.57	1.67	Low 2.29				Low 2.29
Teleost	Trachurus murphyi	Peruvian Jack Mackerel	TA	1.29	1.67	Low 2.10				Low 2.10
Teleost	Scomber australasicus	Blue Mackerel	TA	1.29	1.67	Low 2.10				Low 2.10
Chondrichthyan	Carcharodon carcharias	White Shark	TEP	2.86	1.44	High 3.20		Guideline 2	This species has been assessed through a SAFE Rapid Level 3, and was found to be at low risk given the current fishing intensity from	Low

Taxonomic Group	Scientific Name	Common Name	Role in Fishery*	Productivity	Susceptibility	Level 2 ERA Risk Category Score	Current and Planned Management/ Assessment	Level 2 ERA Residual Risk Guideline(s) Applied	Justification	Level 2 ERA Residual Risk Score
									the SPF purse seine fishery.	Low
Chondrichthyan	Carcharias taurus	Grey Nurse Shark	TEP	2.71	1.44	Med 3.07			This species has been assessed through a SAFE Rapid Level 3, and was found to be at low risk given the current fishing intensity from the SPF purse seine fishery.	Low
Chondrichthyan	Rhincodon typus	Whale Shark	TEP	2.71	1.30	Med 3.01			This species has been assessed through a SAFE Rapid Level 3, and was found to be at low risk given the current fishing intensity from the SPF purse seine fishery.	Low
Marine Bird	Diomedea epomophora	Southern Royal Albatross	TEP	2.57	3.00	High 3.95			AFMA has applied an expert override and reduced the selectivity score as purse seine gear is top opening allowing birds to escape.	Med
Marine Bird	Diomedea exulans	Wandering Albatross	TEP	2.57	3.00	High 3.95			AFMA has applied an expert override and reduced the selectivity score as purse seine gear is top opening allowing birds to escape.	Med
Marine Bird	Diomedea gibsoni	Gibson's Albatross	TEP	2.57	3.00	High 3.95			AFMA has applied an expert override and reduced the selectivity score as purse seine gear is top opening allowing birds to escape.	Med
Marine Bird	Diomedea antipodensis	Antipodean Albatross	TEP	2.57	3.00	High 3.95			AFMA has applied an expert override and reduced the selectivity score as purse seine gear is top opening allowing birds to escape.	Med
Marine Bird	Diomedea sanfordi	Northern Royal Albatross	TEP	2.57	3.00	High 3.95			AFMA has applied an expert override and reduced the selectivity score as purse seine gear is top opening allowing birds to escape.	Med
Marine Bird	Thalassarche impavida	Campbell Albatross	TEP	2.57	3.00	High 3.95			AFMA has applied an expert override and reduced the selectivity score as purse seine gear is top opening allowing birds to escape.	Med
Marine Bird	Thalassarche carteri	Indian Yellow-nosed Albatross	TEP	2.57	3.00	High 3.95			AFMA has applied an expert override and reduced the selectivity score as purse seine gear is top opening allowing birds to escape.	Med
Marine Bird	Thalassarche salvini	Salvin's Albatross	TEP	2.57	3.00	High 3.95			AFMA has applied an expert override and reduced the selectivity score as purse seine gear is top opening allowing birds to escape.	Med
Marine Bird	Diomedea amsterdamensis	Amsterdam Albatross	TEP	2.57	3.00	High 3.95			AFMA has applied an expert override and reduced the selectivity score as purse seine gear is top opening allowing birds to escape.	Med
Marine Bird	Diomedea dabbenena	Tristan Albatross	TEP	2.57	3.00	High 3.95			AFMA has applied an expert override and reduced the selectivity score as purse seine	Med

Taxonomic Group	Scientific Name	Common Name	Role in Fishery*	Productivity	Susceptibility	Level 2 ERA Risk Category Score	Current and Planned Management/ Assessment	Level 2 ERA Residual Risk Guideline(s) Applied	Justification	Level 2 ERA Residual Risk Score
									gear is top opening allowing birds to escape.	Med
Marine Bird	Calonectris leucomelas	Streaked Shearwater	TEP	2.57	3.00	High 3.95			AFMA has applied an expert override and reduced the selectivity score as purse seine gear is top opening allowing birds to escape.	Med
Marine Bird	Pterodroma cervicalis	White-necked Petrel	TEP	2.57	3.00	High 3.95			AFMA has applied an expert override and reduced the selectivity score as purse seine gear is top opening allowing birds to escape.	Med
Marine Bird	Pterodroma solandri	Providence Petrel	TEP	2.57	3.00	High 3.95			AFMA has applied an expert override and reduced the selectivity score as purse seine gear is top opening allowing birds to escape.	Med
Marine Bird	Puffinus bulleri	Buller's Shearwater	TEP	2.57	3.00	High 3.95			AFMA has applied an expert override and reduced the selectivity score as purse seine gear is top opening allowing birds to escape.	Med
Marine Bird	Phalacrocorax fuscescens	Black-faced cormorant	TEP	2.57	3.00	High 3.95			AFMA has applied an expert override and reduced the selectivity score as purse seine gear is top opening allowing birds to escape.	Med 3.06
Marine Bird	Thalassarche steadi	White-capped Albatross	TEP	2.57	3.00	High 3.95			AFMA has applied an expert override and reduced the selectivity score as purse seine gear is top opening allowing birds to escape.	Med 3.06
Marine Bird	Thalassarche bulleri	Buller's Albatross	TEP	2.43	3.00	High 3.86			AFMA has applied an expert override and reduced the selectivity score as purse seine gear is top opening allowing birds to escape.	Med 2.95
Marine Bird	Thalassarche cauta	Shy Albatross	TEP	2.43	3.00	High 3.86			AFMA has applied an expert override and reduced the selectivity score as purse seine gear is top opening allowing birds to escape.	Med 2.95
Marine Bird	Thalassarche chrysostoma	Grey-headed Albatross	TEP	2.43	3.00	High 3.86			AFMA has applied an expert override and reduced the selectivity score as purse seine gear is top opening allowing birds to escape.	Med 2.95
Marine Bird	Thalassarche melanophrys	Black-browed Albatross	TEP	2.43	3.00	High 3.86			AFMA has applied an expert override and reduced the selectivity score as purse seine gear is top opening allowing birds to escape.	Med 2.95
Marine Bird	Phoebetria palpebrata	Light-mantled Albatross	TEP	2.43	3.00	High 3.00			AFMA has applied an expert override and reduced the selectivity score as purse seine gear is top opening allowing birds to escape.	Med 2.95
Marine Bird	Fulmarus glacialoides	Southern Fulmar	TEP	2.43	3.00	High 3.86			AFMA has applied an expert override and reduced the selectivity score as purse seine gear is top opening allowing birds to escape.	Med 2.95
Marine Bird	Halobaena caerulea	Blue Petrel	TEP	2.43	3.00	High			AFMA has applied an expert override and	Med

Taxonomic Group	Scientific Name	Common Name	Role in Fishery*	Productivity	Susceptibility	Level 2 ERA Risk Category Score	Current and Planned Management/ Assessment	Level 2 ERA Residual Risk Guideline(s) Applied	Justification	Level 2 ERA Residual Risk Score
						3.86			reduced the selectivity score as purse seine gear is top opening allowing birds to escape.	2.95
Marine Bird	Lugensa brevirostris	Kerguelen Petrel	TEP	2.43	3.00	High 3.86			AFMA has applied an expert override and reduced the selectivity score as purse seine gear is top opening allowing birds to escape.	Med 2.95
Marine Bird	Pachyptila turtur	Fairy Prion	TEP	2.43	3.00	High 3.86			AFMA has applied an expert override and reduced the selectivity score as purse seine gear is top opening allowing birds to escape.	Med 2.95
Marine Bird	Procellaria parkinsoni	Black Petrel; Parkinsons Petrel	TEP	2.43	3.00	High 3.86			AFMA has applied an expert override and reduced the selectivity score as purse seine gear is top opening allowing birds to escape.	Med 2.95
Marine Bird	Procellaria westlandica	Westland Petrel	TEP	2.43	3.00	High 3.86			AFMA has applied an expert override and reduced the selectivity score as purse seine gear is top opening allowing birds to escape.	Med 2.95
Marine Bird	Pterodroma leucoptera	Gould's Petrel	TEP	2.43	3.00	High 3.86			AFMA has applied an expert override and reduced the selectivity score as purse seine gear is top opening allowing birds to escape.	Med 2.95
Marine Bird	Pterodroma macroptera	Great-winged Petrel	TEP	2.43	3.00	High 3.86			AFMA has applied an expert override and reduced the selectivity score as purse seine gear is top opening allowing birds to escape.	Med 2.95
Marine Bird	Pterodroma mollis	Soft-plumaged Petrel	TEP	2.43	3.00	High 3.86			AFMA has applied an expert override and reduced the selectivity score as purse seine gear is top opening allowing birds to escape.	Med 2.95
Marine Bird	Pterodroma nigripennis	Black-winged Petrel	TEP	2.43	3.00	High 3.86			AFMA has applied an expert override and reduced the selectivity score as purse seine gear is top opening allowing birds to escape.	Med 2.95
Marine Bird	Puffinus assimilis	Little Shearwater (Tasman Sea)	TEP	2.43	3.00	High 3.86			AFMA has applied an expert override and reduced the selectivity score as purse seine gear is top opening allowing birds to escape.	Med 2.95
Marine Bird	Puffinus carneipes	Flesh-footed Shearwater	TEP	2.43	3.00	High 3.86			AFMA has applied an expert override and reduced the selectivity score as purse seine gear is top opening allowing birds to escape.	Med 2.95
Marine Bird	Puffinus pacificus	Wedge-tailed Shearwater	TEP	2.43	3.00	High 3.86			AFMA has applied an expert override and reduced the selectivity score as purse seine gear is top opening allowing birds to escape.	Med 2.95
Marine Bird	Puffinus tenuirostris	Short-tailed Shearwater	TEP	2.43	3.00	High 3.86			AFMA has applied an expert override and reduced the selectivity score as purse seine gear is top opening allowing birds to escape.	Med 2.95

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Marine Bird	Fregetta grallaria	White-bellied Storm-Petrel (Tasman Sea),	TEP	2.43	3.00	High 3.86			AFMA has applied an expert override and reduced the selectivity score as purse seine gear is top opening allowing birds to escape.	Med 2.95
Marine Bird	Fregetta tropica	Black-bellied Storm-Petrel	TEP	2.43	3.00	High 3.86			AFMA has applied an expert override and reduced the selectivity score as purse seine gear is top opening allowing birds to escape.	Med 2.95
Marine Bird	Garrodia nereis	Grey-backed storm petrel	TEP	2.43	3.00	High 3.86			AFMA has applied an expert override and reduced the selectivity score as purse seine gear is top opening allowing birds to escape.	Med 2.95
Marine Bird	Catharacta skua	Great Skua	TEP	2.43	3.00	High 3.86			AFMA has applied an expert override and reduced the selectivity score as purse seine gear is top opening allowing birds to escape.	Med 2.95
Marine Bird	Thalassarche eremita	Chatham Albatross	TEP	2.86	3.00	High 4.14		Guideline 3	This species has 3 missing productivity attributes (Average Max Age, Average Age at Maturity and Trophic Level). There are closely related species from the genus Thalassarche including Shy Albatross, Whitecapped Albatross and Campbell Albatross. The attribute risk scores from these three species were the same for the missing productivity attributes and were therefore borrowed for this species	Med 2.43
Marine Bird	Thalassarche chlororhynchos	Yellow-nosed Albatross, Atlantic Yellow-	TEP	2.29	3.00	High 3.77			AFMA has applied an expert override and reduced the selectivity score as purse seine gear is top opening allowing birds to escape.	Med 2.83
Marine Bird	Phoebetria fusca	Sooty Albatross	TEP	2.29	3.00	High 3.77			AFMA has applied an expert override and reduced the selectivity score as purse seine gear is top opening allowing birds to escape.	Med 2.83
Marine Bird	Daption capense	Cape Petrel	TEP	2.29	3.00	High 3.77			AFMA has applied an expert override and reduced the selectivity score as purse seine gear is top opening allowing birds to escape.	Med 2.83
Marine Bird	Macronectes giganteus	Southern Giant-Petrel	TEP	2.29	3.00	High 3.77			AFMA has applied an expert override and reduced the selectivity score as purse seine gear is top opening allowing birds to escape.	Med 2.83
Marine Bird	Macronectes halli	Northern Giant-Petrel	TEP	2.29	3.00	High 3.77			AFMA has applied an expert override and reduced the selectivity score as purse seine gear is top opening allowing birds to escape.	Med 2.83
Marine Bird	Procellaria aequinoctialis	White-chinned Petrel	TEP	2.29	3.00	High 3.77			AFMA has applied an expert override and reduced the selectivity score as purse seine gear is top opening allowing birds to escape.	Med 2.83

Taxonomic Group	Scientific Name	Common Name	Role in Fishery*	Productivity	Susceptibility	Level 2 ERA Risk Category Score	Current and Planned Management/ Assessment	Level 2 ERA Residual Risk Guideline(s) Applied	Justification	Level 2 ERA Residual Risk Score
Marine Bird	Procellaria cinerea	Grey petrel	TEP	2.29	3.00	High 3.77			AFMA has applied an expert override and reduced the selectivity score as purse seine gear is top opening allowing birds to escape.	Med 2.83
Marine Bird	Pseudobulweria rostrata	Tahiti Petrel	TEP	2.29	3.00	High 3.77			AFMA has applied an expert override and reduced the selectivity score as purse seine gear is top opening allowing birds to escape.	Med 2.83
Marine Bird	Pterodroma lessoni	White-headed Petrel	TEP	2.29	3.00	High 3.77			AFMA has applied an expert override and reduced the selectivity score as purse seine gear is top opening allowing birds to escape.	Med 2.83
Marine Bird	Pterodroma neglecta	Kermadec Petrel (western)	TEP	2.29	3.00	High 3.77			AFMA has applied an expert override and reduced the selectivity score as purse seine gear is top opening allowing birds to escape.	Med 2.83
Marine Bird	Puffinus griseus	Sooty Shearwater	TEP	2.29	3.00	High 3.77			AFMA has applied an expert override and reduced the selectivity score as purse seine gear is top opening allowing birds to escape.	Med 2.83
Marine Bird	Phaethon rubricauda	Red-tailed Tropicbird	TEP	2.29	3.00	High 3.77			AFMA has applied an expert override and reduced the selectivity score as purse seine gear is top opening allowing birds to escape.	Med 2.83
Marine Bird	Morus capensis	Cape Gannet	TEP	2.29	3.00	High 3.77			AFMA has applied an expert override and reduced the selectivity score as purse seine gear is top opening allowing birds to escape.	Med 2.83
Marine Bird	Morus serrator	Australasian Gannet	TEP	2.29	3.00	High 3.77			AFMA has applied an expert override and reduced the selectivity score as purse seine gear is top opening allowing birds to escape.	Med 2.83
Marine Bird	Sula dactylatra	Masked Booby	TEP	2.29	3.00	High 3.77			AFMA has applied an expert override and reduced the selectivity score as purse seine gear is top opening allowing birds to escape.	Med 2.83
Marine Bird	Anous stolidus	Common Noddy	TEP	2.29	3.00	High 3.77			AFMA has applied an expert override and reduced the selectivity score as purse seine gear is top opening allowing birds to escape.	Med 2.83
Marine Bird	Larus pacificus	Pacific Gull	TEP	2.29	3.00	High 3.77			AFMA has applied an expert override and reduced the selectivity score as purse seine gear is top opening allowing birds to escape.	Med 2.83
Marine Bird	Sterna bergii	Crested Tern	TEP	2.29	3.00	High 3.77			AFMA has applied an expert override and reduced the selectivity score as purse seine gear is top opening allowing birds to escape.	Med 2.83
Marine Bird	Sterna caspia	Caspian Tern	TEP	2.29	3.00	High 3.77			AFMA has applied an expert override and reduced the selectivity score as purse seine gear is top opening allowing birds to escape.	Med 2.83

Taxonomic Group	Scientific Name	Common Name	Role in Fishery*	Productivity	Susceptibility	Level 2 ERA Risk Category Score	Current and Planned Management/ Assessment	Level 2 ERA Residual Risk Guideline(s) Applied	Justification	Level 2 ERA Residual Risk Score
Marine Bird	Thalassarche nov. sp.	Pacific Albatross	TEP	2.29	3.00	High 3.77			AFMA has applied an expert override and reduced the selectivity score as purse seine gear is top opening allowing birds to escape.	Med 2.83
Marine Bird	Eudyptula minor	Little Penguin	TEP	2.14	3.00	High 3.69			AFMA has applied an expert override and reduced the selectivity score as purse seine gear is top opening allowing birds to escape.	Med 2.71
Marine Bird	Puffinus gavia	Fluttering Shearwater	TEP	2.14	3.00	High 3.69			AFMA has applied an expert override and reduced the selectivity score as purse seine gear is top opening allowing birds to escape.	Med 2.71
Marine Bird	Puffinus huttoni	Hutton's Shearwater	TEP	2.14	3.00	High 3.69			AFMA has applied an expert override and reduced the selectivity score as purse seine gear is top opening allowing birds to escape.	Med 2.71
Marine Bird	Anous minutus	Black Noddy	TEP	2.14	3.00	High 3.69			AFMA has applied an expert override and reduced the selectivity score as purse seine gear is top opening allowing birds to escape.	Med 2.71
Marine Bird	Anous tenuirostris	Lesser Noddy	TEP	2.14	3.00	High 3.69			AFMA has applied an expert override and reduced the selectivity score as purse seine gear is top opening allowing birds to escape.	Med 2.71
Marine Bird	Larus dominicanus	Kelp Gull	TEP	2.14	3.00	High 3.69			AFMA has applied an expert override and reduced the selectivity score as purse seine gear is top opening allowing birds to escape.	Med 2.71
Marine Bird	Larus novaehollandiae	Silver Gull	TEP	2.14	3.00	High 3.69			AFMA has applied an expert override and reduced the selectivity score as purse seine gear is top opening allowing birds to escape.	Med 2.71
Marine Bird	Procelsterna cerulea	Grey Ternlet	TEP	2.14	3.00	High 3.69			AFMA has applied an expert override and reduced the selectivity score as purse seine gear is top opening allowing birds to escape.	Med 2.71
Marine Bird	Sterna fuscata	Sooty Tern	TEP	2.14	3.00	High 3.69			AFMA has applied an expert override and reduced the selectivity score as purse seine gear is top opening allowing birds to escape.	Med 2.71
Marine Bird	Sterna hirundo	Common Tern	TEP	2.14	3.00	High 3.69			AFMA has applied an expert override and reduced the selectivity score as purse seine gear is top opening allowing birds to escape.	Med 2.71
Marine Bird	Sterna paradisaea	Arctic Tern	TEP	2.14	3.00	High 3.69			AFMA has applied an expert override and reduced the selectivity score as purse seine gear is top opening allowing birds to escape.	Med 2.71
Marine Bird	Sterna sumatrana	Black-naped Tern	TEP	2.14	3.00	High 3.69			AFMA has applied an expert override and reduced the selectivity score as purse seine gear is top opening allowing birds to escape.	Med 2.71

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Marine Bird	Oceanites oceanicus	Wilson's Storm Petrel (subantarctic)	TEP	2.00	3.00	High 3.61			AFMA has applied an expert override and reduced the selectivity score as purse seine gear is top opening allowing birds to escape.	Low 2.60
Marine Bird	Pelagodroma marina	White-faced Storm-Petrel	TEP	2.00	3.00	High 3.61			AFMA has applied an expert override and reduced the selectivity score as purse seine gear is top opening allowing birds to escape.	Low 2.60
Marine Bird	Sterna albifrons	Little Tern	TEP	2.00	3.00	High 3.61			AFMA has applied an expert override and reduced the selectivity score as purse seine gear is top opening allowing birds to escape.	Low 2.60
Marine Bird	Sterna anaethetus	Bridled Tern	TEP	2.00	3.00	High 3.61			AFMA has applied an expert override and reduced the selectivity score as purse seine gear is top opening allowing birds to escape.	Low 2.60
Marine Bird	Sterna striata	White-fronted Tern	TEP	2.00	3.00	High 3.61			AFMA has applied an expert override and reduced the selectivity score as purse seine gear is top opening allowing birds to escape.	Low 2.60
Marine Bird	Pelecanoides urinatrix	Common Diving-Petrel	TEP	1.86	3.00	High 3.53			AFMA has applied an expert override and reduced the selectivity score as purse seine gear is top opening allowing birds to escape.	Low 2.49
Marine Mammal	Hydrurga leptonyx	Leopard Seal	TEP	2.71	3.00	High 4.05			No record of interactions with purse seine gear however due to low observer coverage in the sector it is not possible to reduce the risk through the application of guideline 3.	High 4.05
Marine Mammal	Arctocephalus pusillus doriferus	Australian Fur Seal	TEP	2.29	3.00	High 3.77			No record of interactions with purse seine gear however due to low observer coverage in the sector it is not possible to reduce the risk through the application of guideline 3.	High 3.77
Marine Mammal	Feresa attenuata	Pygmy Killer Whale	TEP	2.86	1.67	High 3.31			No record of interactions with purse seine gear however due to low observer coverage in the sector it is not possible to reduce the risk through the application of guideline 3.	High 3.31
Marine Mammal	Globicephala macrorhynchus	Short-finned Pilot Whale	TEP	2.86	1.67	High 3.31			No record of interactions with purse seine gear however due to low observer coverage in the sector it is not possible to reduce the risk through the application of guideline 3.	High 3.31
Marine Mammal	Globicephala melas	Long-finned Pilot Whale	TEP	2.86	1.67	High 3.31			No record of interactions with purse seine gear however due to low observer coverage in the sector it is not possible to reduce the risk through the application of guideline 3.	High 3.31
Marine Mammal	Grampus griseus	Risso's Dolphin	TEP	2.86	1.67	High			No record of interactions with purse seine gear	High

Taxonomic Group	Scientific Name	Common Name	Role in Fishery*	Productivity	Susceptibility	Level 2 ERA Risk Category Score	Current and Planned Management/ Assessment	Level 2 ERA Residual Risk Guideline(s) Applied	Justification	Level 2 ERA Residual Risk Score
						3.31			however due to low observer coverage in the sector it is not possible to reduce the risk through the application of guideline 3.	3.31
Marine Mammal	Orcinus orca	Killer Whale	TEP	2.86	1.67	High 3.31			No record of interactions with purse seine gear however due to low observer coverage in the sector it is not possible to reduce the risk through the application of guideline 3.	High 3.31
Marine Mammal	Pseudorca crassidens	False Killer Whale	TEP	2.86	1.67	High 3.31			No record of interactions with purse seine gear however due to low observer coverage in the sector it is not possible to reduce the risk through the application of guideline 3.	High 3.31
Marine Mammal	Tursiops truncatus	Bottlenose Dolphin	TEP	2.86	1.67	High 3.31			No record of interactions with purse seine gear however due to low observer coverage in the sector it is not possible to reduce the risk through the application of guideline 3.	High 3.31
Marine Mammal	Tursiops aduncus	Indian Ocean bottlenose dolphin	TEP	2.86	1.67	High 3.31			No record of interactions with purse seine gear however due to low observer coverage in the sector it is not possible to reduce the risk through the application of guideline 3.	High 3.31
Marine Mammal	Mesoplodon bowdoini	Andrew's Beaked Whale	TEP	2.86	1.67	High 3.31			No record of interactions with purse seine gear however due to low observer coverage in the sector it is not possible to reduce the risk through the application of guideline 3.	High 3.31
Marine Mammal	Mesoplodon densirostris	Blainville's Beaked Whale	TEP	2.86	1.67	High 3.31			No record of interactions with purse seine gear however due to low observer coverage in the sector it is not possible to reduce the risk through the application of guideline 3.	High 3.31
Marine Mammal	Mesoplodon gingkodens	Gingko Beaked Whale	TEP	2.86	1.67	High 3.31			No record of interactions with purse seine gear however due to low observer coverage in the sector it is not possible to reduce the risk through the application of guideline 3.	High 3.31
Marine Mammal	Mesoplodon hectori	Hector's Beaked Whale	TEP	2.86	1.67	High 3.31			No record of interactions with purse seine gear however due to low observer coverage in the sector it is not possible to reduce the risk through the application of guideline 3.	High 3.31
Marine Mammal	Mesoplodon mirus	True's Beaked Whale	TEP	2.86	1.67	High 3.31			No record of interactions with purse seine gear however due to low observer coverage in the sector it is not possible to reduce the risk through the application of guideline 3.	High 3.31

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Marine Mammal	Balaenoptera acutorostrata	Minke Whale	TEP	2.86	1.44	High 3.20			No record of interactions with purse seine gear however due to low observer coverage in the sector it is not possible to reduce the risk through the application of guideline 3.	High 3.20
Marine Mammal	Hyperoodon planifrons	Southern Bottlenose Whale	TEP	2.86	1.44	High 3.20			No record of interactions with purse seine gear however due to low observer coverage in the sector it is not possible to reduce the risk through the application of guideline 3.	High 3.20
Marine Mammal	Mesoplodon grayi	Gray's Beaked Whale	TEP	2.86	1.44	High 3.20			No record of interactions with purse seine gear however due to low observer coverage in the sector it is not possible to reduce the risk through the application of guideline 3.	High 3.20
Marine Mammal	Mesoplodon layardii	Strap-toothed Beaked Whale	TEP	2.86	1.44	High 3.20			No record of interactions with purse seine gear however due to low observer coverage in the sector it is not possible to reduce the risk through the application of guideline 3.	High 3.20
Marine Mammal	Ziphius cavirostris	Cuvier's Beaked Whale	TEP	2.86	1.44	High 3.20			No record of interactions with purse seine gear however due to low observer coverage in the sector it is not possible to reduce the risk through the application of guideline 3.	High 3.20
Marine Mammal	Megaptera novaeangliae	Humpback Whale	TEP	2.71	1.67	High 3.19			No record of interactions with purse seine gear however due to low observer coverage in the sector it is not possible to reduce the risk through the application of guideline 3.	High 3.19
Marine Mammal	Lagenodelphis hosei	Fraser's Dolphin	TEP	2.71	1.67	High 3.19			No record of interactions with purse seine gear however due to low observer coverage in the sector it is not possible to reduce the risk through the application of guideline 3.	High 3.19
Marine Mammal	Lagenorhynchus cruciger	Hourglass dolphin	TEP	2.71	1.67	High 3.19			No record of interactions with purse seine gear however due to low observer coverage in the sector it is not possible to reduce the risk through the application of guideline 3.	High 3.19
Marine Mammal	Lissodelphis peronii	Southern Right Whale Dolphin	TEP	2.71	1.67	High 3.19			No record of interactions with purse seine gear however due to low observer coverage in the sector it is not possible to reduce the risk through the application of guideline 3.	High 3.19
Marine Mammal	Sousa chinensis	Indo-Pacific Humpback Dolphin	TEP	2.71	1.67	High 3.19			No record of interactions with purse seine gear however due to low observer coverage in the sector it is not possible to reduce the risk	High 3.19

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									through the application of guideline 3.	High 3.19
Marine Mammal	Stenella coeruleoalba	Striped Dolphin	TEP	2.71	1.67	High 3.19			No record of interactions with purse seine gear however due to low observer coverage in the sector it is not possible to reduce the risk through the application of guideline 3.	High 3.19
Marine Mammal	Steno bredanensis	Rough-toothed Dolphin	TEP	2.71	1.67	High 3.19			No record of interactions with purse seine gear however due to low observer coverage in the sector it is not possible to reduce the risk through the application of guideline 3.	High 3.19
Marine Mammal	Kogia simus	Dwarf Sperm Whale	TEP	2.71	1.67	High 3.19			No record of interactions with purse seine gear however due to low observer coverage in the sector it is not possible to reduce the risk through the application of guideline 3.	High 3.19
Marine Mammal	Mirounga leonina	Elephant Seal	TEP	2.71	1.67	High 3.19			No record of interactions with purse seine gear however due to low observer coverage in the sector it is not possible to reduce the risk through the application of guideline 3.	High 3.19
Marine Mammal	Balaenoptera borealis	Sei Whale	TEP	2.86	1.22	Med 3.11				Med 3.11
Marine Mammal	Balaenoptera edeni	Bryde's Whale	TEP	2.86	1.22	Med 3.11				Med 3.11
Marine Mammal	Balaenoptera physalus	Fin Whale	TEP	2.86	1.22	Med 3.11				Med 3.11
Marine Mammal	Balaenoptera bonaerensis	Antarctic Minke Whale	TEP	2.86	1.22	Med 3.11				Med 3.11
Marine Mammal	Kogia breviceps	Pygmy Sperm Whale	TEP	2.86	1.22	Med 3.11				Med 3.11
Marine Mammal	Physeter catodon	Sperm Whale	TEP	2.86	1.22	Med 3.11				Med 3.11
Marine Mammal	Berardius arnuxii	Arnoux's Beaked Whale	TEP	2.86	1.22	Med 3.11				Med 3.11
Marine Mammal	Tasmacetus shepherdi	Tasman Beaked Whale	TEP	2.86	1.22	Med 3.11				Med 3.11
Marine Mammal	Caperea marginata	Pygmy Right Whale	TEP	2.71	1.44	Med 3.07				Med 3.07
Marine Mammal	Peponocephala electra	Melon-headed Whale	TEP	2.57	1.67	Med 3.06				Med 3.06
Marine Mammal	Stenella attenuata	Spotted Dolphin	TEP	2.57	1.67	Med				Med

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						3.06				3.06
Marine Mammal	Eubalaena australis	Southern Right Whale	TEP	2.71	1.22	Med 2.98				Med 2.98
Marine Mammal	Dugong dugon	Dugong	TEP	2.71	1.22	Med 2.98				Med 2.98
Marine Mammal	Stenella longirostris	Long-snouted Spinner Dolphin	TEP	2.43	1.67	Med 2.95				Med 2.95
Marine Mammal	Arctocephalus forsteri	New Zealand Fur-seal	TEP	2.43	1.67	Med 2.95				Med 2.95
Marine Mammal	Neophoca cinerea	Australian Sea-lion	TEP	2.43	1.67	Med 2.95				Med 2.95
Marine Mammal	Balaenoptera musculus	Blue Whale	TEP	2.57	1.22	Med 2.85				Med 2.85
Marine Mammal	Delphinus delphis	Common Dolphin	TEP	2.29	1.67	Med 2.83				Med 2.83
Marine Mammal	Lagenorhynchus obscurus	Dusky Dolphin	TEP	2.29	1.67	Med 2.83				Med 2.83
Marine Mammal	Arctocephalus tropicalis	Subantarctic Fur Seal	TEP	2.29	1.67	Med 2.83				Med 2.83
Marine Reptile	Hydrophis elegans	Elegant Seasnake	TEP	2.14	1.22	Low 2.47				Low 2.47
Marine Reptile	Acalyptophis peronii	Horned Seasnake	TEP	2.71	1.22	Med 2.98				Med 2.98
Marine Reptile	Astrotia stokesii	Stokes' Seasnake	TEP	2.71	1.22	Med 2.98				Med 2.98
Marine Reptile	Disteira kingii	Spectacled Seasnake	TEP	2.71	1.22	Med 2.98				Med 2.98
Marine Reptile	Hydrophis ornatus	Seasnake	TEP	2.71	1.22	Med 2.98				Med 2.98
Marine Reptile	Pelamis platurus	Yellow-bellied Seasnake	TEP	2.71	1.22	Med 2.98				Med 2.98
Marine Reptile	Dermochelys coriacea	Leathery Turtle	TEP	2.57	1.22	Med 2.85				Med 2.85
Marine Reptile	Caretta caretta	Loggerhead	TEP	2.43	1.22	Med 2.72				Med 2.72
Marine Reptile	Chelonia mydas	Green Turtle	TEP	2.43	1.22	Med 2.72				Med 2.72
Marine Reptile	Eretmochelys imbricata	Hawksbill Turtle	TEP	2.43	1.22	Med				Med

Taxonomic Group	Scientific Name	Common Name	Role in Fishery*	Productivity	Susceptibility	Level 2 ERA Risk Category Score	Current and Planned Management/ Assessment	Level 2 ERA Residual Risk Guideline(s) Applied	Justification	Level 2 ERA Residual Risk Score
						2.72				2.72
Teleost	Heteroclinus perspicillatus	Common Weedfish	TEP	2.29	1.22	Low 2.59				Low 2.59
Teleost	Solenostomus paradoxus	Harlequin Ghost Pipefish, Ornate Ghost Pipefish	TEP	2.14	1.22	Low 2.47				Low 2.47
Teleost	Stigmatopora argus	Spotted Pipefish	TEP	1.43	1.67	Low 2.20				Low 2.20
Teleost	Lissocampus fatiloquus	Prophet's Pipefish	TEP	1.43	1.67	Low 2.20				Low 2.20
Teleost	Heraldia sp. 1 [in Kuiter, 2000]	Western upsidedown pipefish	TEP	1.43	1.67	Low 2.20				Low 2.20
Teleost	Hippocampus kelloggi	Kellogg's Seahorse	TEP	1.43	1.67	Low 2.20				Low 2.20
Teleost	Hippocampus subelongatus	West Australian Seahorse	TEP	1.43	1.67	Low 2.20				Low 2.20
Teleost	Idiotropiscis australe	Southern Pygmy Pipehorse	TEP	1.43	1.67	Low 2.20				Low 2.20
Teleost	Hippocampus kuda	Spotted Seahorse, Yellow Seahorse	TEP	1.57	1.44	Low 2.13				Low 2.13
Teleost	Lissocampus runa	Javelin Pipefish	TEP	1.43	1.44	Low 2.03				Low 2.03
Teleost	Lissocampus caudalis	Australian Smooth Pipefish, Smooth Pipefish	TEP	1.43	1.44	Low 2.03				Low 2.03
Teleost	Stigmatopora nigra	Wide-bodied Pipefish, Black Pipefish	TEP	1.43	1.44	Low 2.03				Low 2.03
Teleost	Microphis manadensis	Manado River Pipefish, Manado Pipefish	TEP	1.43	1.44	Low 2.03				Low 2.03
Teleost	Phycodurus eques	Leafy Seadragon	TEP	1.57	1.22	Low 1.99				Low 1.99
Teleost	Phyllopteryx taeniolatus	Weedy Seadragon, Common Seadragon	TEP	1.57	1.22	Low 1.99				Low 1.99
Teleost	Hippocampus taeniopterus	Spotted Seahorse, Yellow Seahorse	TEP	1.57	1.22	Low 1.99				Low 1.99
Teleost	Doryrhamphus melanopleura	Bluestripe Pipefish	TEP	1.57	1.22	Low 1.99				Low 1.99
Teleost	Maroubra perserrata	Sawtooth Pipefish	TEP	1.57	1.15	Low 1.95				Low 1.95
Teleost	Corythoichthys amplexus	Fijian Banded Pipefish,	TEP	1.43	1.30	Low				Low

Taxonomic Group	Scientific Name	Common Name	Role in Fishery*	Productivity	Susceptibility	Level 2 ERA Risk Category Score	Current and Planned Management/ Assessment	Level 2 ERA Residual Risk Guideline(s) Applied	Justification	Level 2 ERA Residual Risk Score
		Brown-banded Pipefish				1.93				1.93
Teleost	Solegnathus guentheri	Indonesian Pipefish, Gunther's Pipehorse	TEP	1.43	1.22	Low 1.88				Low 1.88
Teleost	Solegnathus robustus	Robust Spiny Pipehorse, Robust Pipehorse	TEP	1.43	1.22	Low 1.88				Low 1.88
Teleost	Hippocampus angustus	Western Spiny Seahorse	TEP	1.43	1.22	Low 1.88				Low 1.88
Teleost	Trachyrhamphus bicoarctatus	Bend Stick Pipefish, Short-tailed Pipefish	TEP	1.43	1.22	Low 1.88				Low 1.88
Teleost	Urocampus carinirostris	Hairy Pipefish	TEP	1.43	1.22	Low 1.88				Low 1.88
Teleost	Hippocampus bleekeri	Pot-bellied Seahorse	TEP	1.43	1.22	Low 1.88				Low 1.88
Teleost	Histiogamphelus briggsii	Briggs' Crested Pipefish, Briggs' Pipefish	TEP	1.43	1.22	Low 1.88				Low 1.88
Teleost	Hypselognathus rostratus	Knife-snouted Pipefish	TEP	1.43	1.22	Low 1.88				Low 1.88
Teleost	Leptoichthys fistularius	Brushtail Pipefish	TEP	1.43	1.22	Low 1.88				Low 1.88
Teleost	Kaupus costatus	Deep-bodied Pipefish	TEP	1.43	1.22	Low 1.88				Low 1.88
Teleost	Mitotichthys semistriatus	Half-banded Pipefish	TEP	1.43	1.22	Low 1.88				Low 1.88
Teleost	Stipecampus cristatus	Ring-backed Pipefish	TEP	1.43	1.22	Low 1.88				Low 1.88
Teleost	Pugnaso curtirostris	Pug-nosed Pipefish	TEP	1.43	1.22	Low 1.88				Low 1.88
Teleost	Mitotichthys mollisoni	Mollison's Pipefish	TEP	1.43	1.22	Low 1.88				Low 1.88
Teleost	Vanacampus poecilolaemus	Australian Long-snout Pipefish, Long-snouted Pipefish	TEP	1.43	1.22	Low 1.88				Low 1.88
Teleost	Mitotichthys tuckeri	Tucker's Pipefish	TEP	1.43	1.22	Low 1.88				Low 1.88
Teleost	Solegnathus spinosissimus	Spiny Pipehorse	TEP	1.43	1.22	Low 1.88				Low 1.88
Teleost	Halicampus grayi	Mud Pipefish, Gray's Pipefish	TEP	1.43	1.22	Low 1.88				Low 1.88

Taxonomic Group	Scientific Name	Common Name	Role in Fishery*	Productivity	Susceptibility	Level 2 ERA Risk Category Score	Current and Planned Management/ Assessment	Level 2 ERA Residual Risk Guideline(s) Applied	Justification	Level 2 ERA Residual Risk Score
Teleost	Acentronura breviperula	Hairy Pygmy Pipehorse	TEP	1.43	1.22	Low 1.88				Low 1.88
Teleost	Corythoichthys ocellatus	Orange-spotted Pipefish, Ocellated Pipefish	TEP	1.43	1.22	Low 1.88				Low 1.88
Teleost	Cosmocampus banneri	Roughridge Pipefish	TEP	1.43	1.22	Low 1.88				Low 1.88
Teleost	Cosmocampus howensis	Lord Howe Pipefish	TEP	1.43	1.22	Low 1.88				Low 1.88
Teleost	Festucalex cinctus	Girdled Pipefish	TEP	1.43	1.22	Low 1.88				Low 1.88
Teleost	Festucalex scalaris	Ladder Pipefish	TEP	1.43	1.22	Low 1.88				Low 1.88
Teleost	Filicampus tigris	Tiger Pipefish	TEP	1.43	1.22	Low 1.88				Low 1.88
Teleost	Halicampus brocki	Brock's Pipefish	TEP	1.43	1.22	Low 1.88				Low 1.88
Teleost	Hippichthys penicillus	Beady Pipefish, Steep-nosed Pipefish	TEP	1.43	1.22	Low 1.88				Low 1.88
Teleost	Hippocampus planifrons	Flat-face Seahorse	TEP	1.43	1.22	Low 1.88				Low 1.88
Teleost	Histiogamphelus cristatus	Rhino Pipefish, Macleay's Crested Pipefish	TEP	1.43	1.22	Low 1.88				Low 1.88
Teleost	Hypselognathus horridus	Shaggy Pipefish, Prickly Pipefish	TEP	1.43	1.22	Low 1.88				Low 1.88
Teleost	Kimblaeus bassensis	Trawl Pipefish, Kimbla Pipefish	TEP	1.43	1.22	Low 1.88				Low 1.88
Teleost	Micrognathus andersonii	Anderson's Pipefish, Shortnose Pipefish	TEP	1.43	1.22	Low 1.88				Low 1.88
Teleost	Micrognathus pygmaeus	[a pipefish]	TEP	1.43	1.22	Low 1.88				Low 1.88
Teleost	Mitotichthys meraculus	Western Crested Pipefish	TEP	1.43	1.22	Low 1.88				Low 1.88
Teleost	Nannocampus subosseus	Bony-headed Pipefish	TEP	1.43	1.22	Low 1.88				Low 1.88
Teleost	Notiocampus ruber	Red Pipefish	TEP	1.43	1.22	Low 1.88				Low 1.88
Teleost	Solegnathus dunckeri	Duncker's Pipehorse	TEP	1.43	1.22	Low 1.88				Low 1.88

Taxonomic Group	Scientific Name	Common Name	Role in Fishery*	Productivity	Susceptibility	Level 2 ERA Risk Category Score	Current and Planned Management/ Assessment	Level 2 ERA Residual Risk Guideline(s) Applied	Justification	Level 2 ERA Residual Risk Score
Teleost	Solegnathus sp. 1 [in Kuiter, 2000]	Pipehorse	TEP	1.43	1.22	Low 1.88				Low 1.88
Teleost	Vanacampus margaritifer	Mother-of-pearl Pipefish	TEP	1.43	1.22	Low 1.88				Low 1.88
Teleost	Vanacampus vercoi	Verco's Pipefish	TEP	1.43	1.22	Low 1.88				Low 1.88
Teleost	Hippocampus minotaur	Bullneck Seahorse	TEP	1.43	1.22	Low 1.88				Low 1.88
Teleost	Halicampus boothae	[a pipefish]	TEP	1.43	1.22	Low 1.88				Low 1.88
Teleost	Hippocampus queenslandicus	Kellogg's Seahorse	TEP	1.43	1.22	Low 1.88				Low 1.88
Teleost	Hippocampus tristis	[a pipefish]	TEP	1.43	1.22	Low 1.88				Low 1.88
Teleost	Hippocampus abdominalis	Big-bellied / southern potbellied seahorse	TEP	1.43	1.22	Low 1.88				Low 1.88
Teleost	Hippocampus subelongatus	West Australian Seahorse	TEP	1.43	1.22	Low 1.88				Low 1.88
Teleost	Hippocampus breviceps	Short-head Seahorse, Short-snouted Seaho	TEP	1.43	1.15	Low 1.83				Low 1.83
Teleost	Hippocampus whitei	White's Seahorse	TEP	1.43	1.15	Low 1.83				Low 1.83
Teleost	Acentronura australe	Southern Pygmy Pipehorse	TEP	1.43	1.15	Low 1.83				Low 1.83
Teleost	Campichthys galei	Gale's Pipefish	TEP	1.43	1.15	Low 1.83				Low 1.83
Teleost	Campichthys tryoni	Tryon's Pipefish	TEP	1.43	1.15	Low 1.83				Low 1.83
Teleost	Choeroichthys suillus	Pig-snouted Pipefish	TEP	1.43	1.15	Low 1.83				Low 1.83
Teleost	Heraldia nocturna	Upside-down Pipefish	TEP	1.43	1.15	Low 1.83				Low 1.83
Teleost	Hippichthys cyanospilos	Blue-speckled Pipefish, Blue-spotted Pipefish	TEP	1.43	1.15	Low 1.83				Low 1.83
Teleost	Hippichthys heptagonus	Madura Pipefish	TEP	1.43	1.15	Low 1.83				Low 1.83
Teleost	Vanacampus phillipi	Port Phillip Pipefish	TEP	1.29	1.22	Low 1.77				Low 1.77

Taxonomic Group	Scientific Name	Common Name	Role in Fishery*	Productivity	Susceptibility	Level 2 ERA Risk Category Score	Current and Planned Management/ Assessment	Level 2 ERA Residual Risk Guideline(s) Applied	Justification	Level 2 ERA Residual Risk Score
Teleost	Halicampus macrorhynchus	[a pipefish]	TEP	1.43	1.00	Low 1.74				Low 1.74
Teleost	Syngnathoides biaculeatus	Double-ended Pipehorse, Alligator Pipefish	TEP	1.43	2.33	Med 2.74				Med 2.74
Teleost	Solenostomus cyanopterus	Blue-finned Ghost Pipefish, Robust Ghost	TEP	2.14	1.67	Med 2.71				Med 2.71

*Role in Fishery – TA (target), TB (target bait), BP (byproduct), DI (discard/bycatch), TEP (threatened, endangered or protected).

Table 4 Summary of Level 2 PSA Residual Risk Results

Component	Changed from high to medium	Changed from high to low	Changed from medium to low	High Residual Risk	Medium Residual Risk	Low Residual Risk
Target	-	-	-	-	-	5
Target Bait	-	-	-	-	-	-
Bycatch (discard)	-	-	-	-	-	3
Byproduct	-	-	-	-	-	9
TEP	72	7	-	29	105	84
Total	**72**	**7**	**-**	**29**	**105**	**101**

4. CONCLUSION

The purpose in applying the Level 2 PSA residual risk guidelines was to take into account additional information and to ensure that the assessment was refined appropriately. Refinements were considered in either increasing or reducing the risk as appropriate.

Overall the main reason for reducing the number of species from the high risk category is that 78 species were sea birds and AFMA expert advice is that sea birds are readily able to escape from the purse seine nets which are top opening. No TEP species interactions are recorded in the TEP species interaction data for purse seine fishing in the SPF. This data covers the period 2004 to 2009.

The residual risk process brings the ERA assessment up-to-date with most of the current management initiatives within the fishery. Using the results presented here, an appropriate management strategy will be developed to address the high priority species as part of the ERM framework.

GLOSSARY

Activity	Refers to any fishing activity.
Actual risk	The real risk posed for a species from fishing activities.
Attribute	A general term for a set of properties relating to the productivity or susceptibility of a particular unit of analysis.
Availability	Used in Level 2 PSA assessment to calculate the impact on an ecological component due to a fishing activity. Considers overlap of fishing effort with a species distribution.
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 be retained for sale.
Catch limit	The vessel catch limit is a limit on the quantity each individual vessel can land per trip or short period of time.
Component	The marine ecosystem is broken down into five components for the risk assessment: target species (TA); byproduct (BI) and bycatch species (DI); threatened, endangered and protected species (TEP); habitats; and ecological communities.
Effort	The total fishing gear in use for a specified period of time.
Encounterability	Used in Level 2 PSA assessment to calculate the impact on an ecological component due to a fishing activity. Considers the likelihood that a species will encounter fishing gear that is deployed within the geographic range of that species (based on two attributes: adult habitat and bathymetry).
EPBC Act	*Environment Protection and Biodiversity Conservation Act (Cth) 1999*
ERA	Ecological risk assessment for the effects of fishing as developed by AFMA and CSIRO.
ERM Framework	Ecological risk management process outlined by AFMA.
False negative	Species assessed to be low risk when they are actually high risk.
False positive	Species assessed to have a high risk when they are actually low risk
Fishery	A related set of fish harvesting activities regulated by an authority (e.g. South-East Trawl Fishery).

Gear	The equipment used for fishing, e.g. gillnet, Danish seine, pelagic longline, midwater trawl, purse seine, trap etc.
Level 1	The level of the ERA assessment which includes a qualitative assessment of scale, intensity, consequence analysis (SICA).
Potential risk	Possible risk as a result of fishing activities
Post Capture Mortality	Used in Level 2 PSA assessment to calculate the impact on an ecological component due to a fishing activity. Considers the condition and subsequent survival of a species that is captured and released (or discarded).
Precautionary	The approach whereby, if there is uncertainty about the risk, risk is assumed to be high, unless there is advice to the contrary.
PSA	Productivity susceptibility analysis for Level 2 assessment of the ecological assessment.
Productivity	This determines the rate at which the unit can recover after potential depletion or damage by the fishing.
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.
Selectivity	Used in Level 2 PSA assessment to calculate the impact on an ecological component due to a fishing activity. Considers the potential of the gear to capture or retain species.
SICA	Scale, intensity, consequence analysis for the Level 1 assessment.
Spatial management	Fisheries management that encompasses spatial arrangements such as depth closures or area closures.
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.
Unit	The entities for which attributes are scored in the Level 2 analysis. For example, the units of analysis for the Target Species component are individual "species".

APPENDIX A - SUMMARY OF PRODUCTIVITY AND SUSCEPTIBILITY SCORING

Productivity

The productivity of a unit determines the rate at which the unit can recover after potential depletion or damage by fishing. The productivity score is the average of the following attributes:

1. Average age of species at maturity;

2. Average size of species at maturity;

3. Average maximum age of species;

4. Average maximum size of species;

5. Fecundity of species;

6. Reproductive strategy of species; and

7. Trophic level: organisms position in the food chain.

Susceptibility

Susceptibility is the extent of the impact on an ecological component due to a fishing activity. The susceptibility score is the product of the following attributes:

1. **Availability**: considers overlap of fishing effort with a species distribution;

2. **Encounterability**: considers the likelihood that a species will encounter fishing gear that is deployed within the geographic range of that species (based on two attributes: adult habitat and bathymetry);

3. **Selectivity**: considers the potential of the gear to capture or retain species; and

4. **Post Capture Mortality**: considers the condition and subsequent survival of a species that is captured and released (or discarded).

Based on the Level 2 results, if a unit is assessed at low risk from fishing, the rationale is documented and it is not assessed at a higher level. For units assessed at medium or high risk, management arrangements to mitigate the risks are to be further investigated and implemented. If there are no planned or agreed management arrangements, the assessment moves to Level 3 (for more detail, refer to Hobday *et al.*, 2007).

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