



Australian Government  
Australian Fisheries Management Authority

# Residual Risk Assessment of the Level 2 Ecological Risk Assessment Species Results Report for the Small Pelagic Fishery – Midwater Trawl



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 Midwater Trawl 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 26 high risk species were assessed of which 8 remained high risk after applying the residual risk guidelines. These include 8 marine mammals. The primary reason for reducing the risk category for 18 species was due to high observer coverage with zero to low interaction rates recorded for the relevant species.



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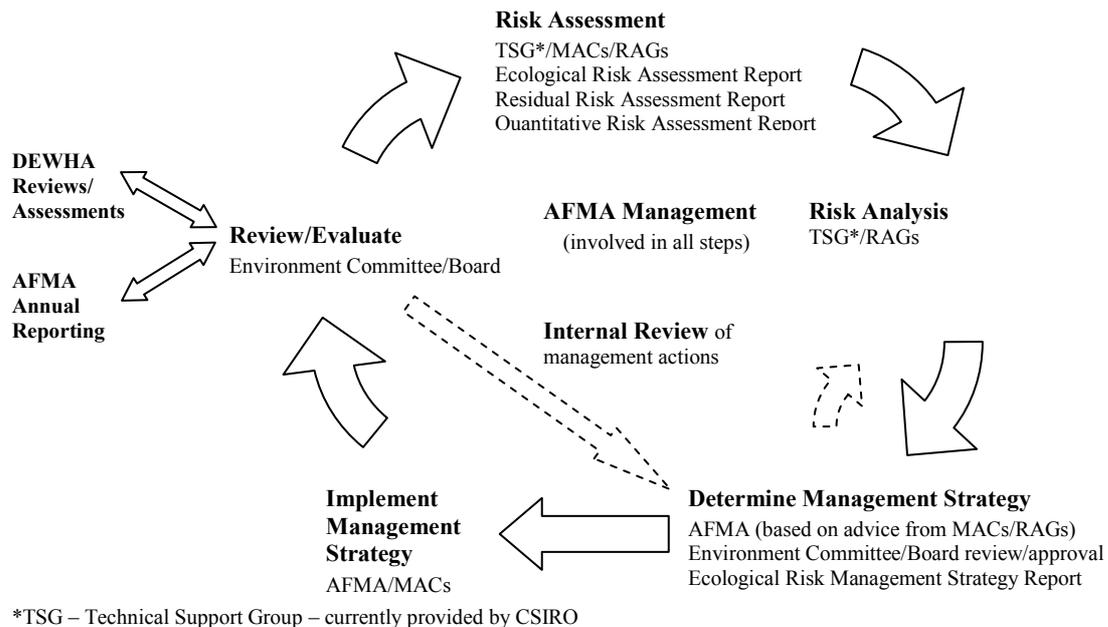
# 1. OVERVIEW

## 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

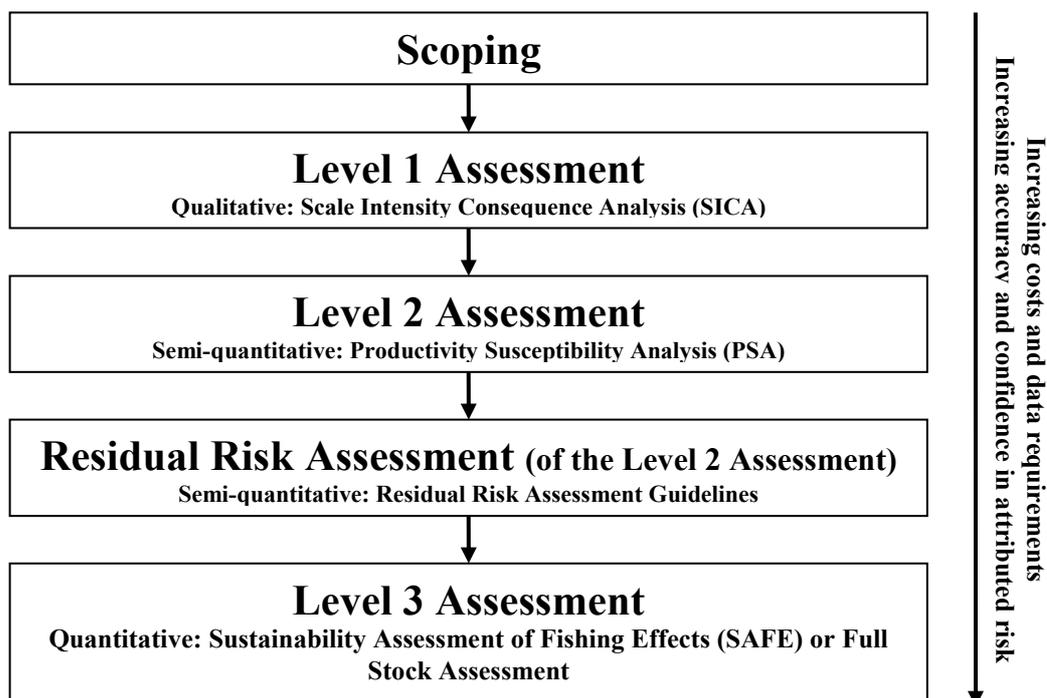


Figure 2 The different levels of risk assessment and the trend in confidence and cost



## **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.

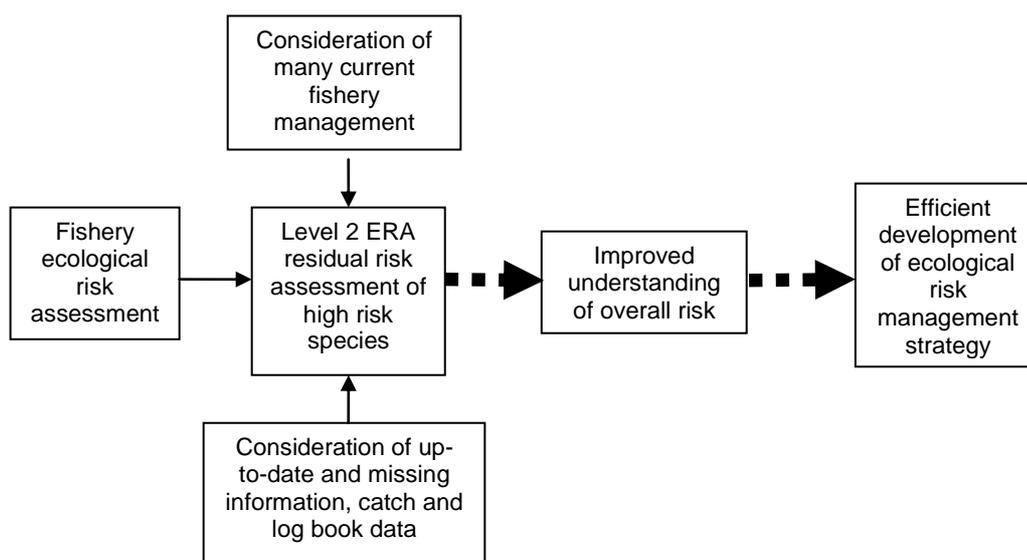
Although seasonal, spatial and depth closures have been considered in the initial ERA, more recent management measures have not been accounted for. The Level 2 PSA residual risk process will consider some of these arrangements and will bring the assessment up-to-date.



## 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\***

<b>Guideline Number</b>	<b>Summary</b>
<b>Guideline 1.</b> 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.
<b>Guideline 2.</b> 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.
<b>Guideline 3.</b> 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.
<b>Guideline 4.</b> At risk with spatial assumptions.	Uses additional information on spatial distribution of species populations to better represent the species distribution overlap with the fishery.
<b>Guideline 5.</b> 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.
<b>Guideline 6.</b> 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.
<b>Guideline 7.</b> 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.
<b>Guideline 8.</b> Limits on associated species through other management arrangements.	Considers the implications of management arrangements for a particular species on other associated species.
<b>Guideline 9.</b> 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](http://www.afma.gov.au/environment/eco_based/eras/reports.htm)

**Table 2 Stakeholder Engagement**

<b>Guideline stage</b>	<b>Stakeholder interaction</b>	<b>Date of interaction</b>	<b>Stakeholder group</b>	<b>Summary of outcome</b>
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:	Midwater otter trawl
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.
Depth range:	35 to ~ 357 m of bottom depth
Fleet size:	36 permits, only two active in 2009.
Effort:	Peak of 270 shots in 2005/06 down to 81 shots in 2008/09
Landings:	Peak of 11,165 tonnes in 2003/04 down to 1,754 tonnes in 2008/09
Discard rate:	Very low, bycatch less than 1%
Main target species:	Redbait ( <i>Emmelichthys nitidus</i> )
Management:	Transitional phase – <i>Small Pelagic Fishery Management Plan 2009</i> has been determined, currently limited entry permits but will move to quota statutory fishing rights once the grant is completed.
Observer program:	Consistent high coverage since 2003-04. Peak coverage in 2003/04 of 155 days (93% of days observed to days fished). Since then there has been a steady decline to 9 days (12% observer coverage) in 2008/09.

##### Ecological Units Assessed

Target species:	1
By-product and bycatch species:	16 and 2
TEP species:	218

##### Level 1 Results

There was at least one risk score of 3 – moderate – or above for four components. All but one hazard (fishing activities) was eliminated at Level 1 (risk scores 1 or 2). The remaining hazard was fishing.

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

Impacts from fishing on all species components were assessed in more detail at Level 2. Community impacts should also be examined in future iterations; time was insufficient to complete this analysis following development of the ERAEF Level 2 community analysis.



## Level 2 Results

Of the 237 species assessed at Level 2 using the PSA analysis, expert/observer overrides were used on 95 species. A total of 26 species were found to be at high risk. Of these, 1 species had more than 3 missing attributes.

The 26 species assessed to be at high risk are all TEP species. By taxa, the high risk species comprised 3 marine birds, and 23 marine mammals.

Of the 26 TEP species assessed to be at high risk, 2 of the bird species that are at high risk are common in the area fished and, although there are no records of mortalities in this fishery, there are records of warp strike mortality for these species in other domestic trawl and midwater trawl fisheries. The other bird species had missing life history information and is potentially a false positive result. The 23 marine mammals of high risk are most often found to be underwater and the way they interact with the gear fishing gear is difficult to document. Captures of at least two mammal species has resulted in mortality in this fishery (Browne et al, 2005, Observer Reports). These are seals and dolphins.

## Summary

Only one issue emerges from the ERAEF analysis of the SPF midwater trawl fishery. This is the direct impact of fishing on two groups of TEP species; birds and marine mammals. There have been recent observations of mortality of seals and dolphins in this sub-fishery, and mitigating this risk remains a challenge for the fishery. While the populations of these marine mammals may not be at risk from this mortality, under Australian legislation, these interactions require intervention and has in one case resulted in the temporary closure of the fishery.

### **3.2. Level 2 PSA Residual Risk Results**

The Level 2 PSA residual risk assessment summary for midwater trawl sub-fishery of the Small Pelagic Fishery in **Table 3**. Overall 237 species were assessed: 1 target, 2 bycatch (discard), 16 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**. Guideline 3 was used to reduce the risk level of 1 species. Overall there has been a change from 26 high risk species prior to the Level 2 PSA residual risk assessment to 8 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
Invertebrate	Nototodarus gouldi	Arrow Squid	BP	1.43	1.67	Low 2.20				Low 2.20
Teleost	Mola mola	ocean sunfish	BP	2.29	1.67	Med 2.83				Med 2.83
Teleost	Hyperoglyphe antarctica	Blue Eye Trevalla	BP	2.00	1.44	Low 2.47				Low 2.47
Teleost	Macruronus novaezelandiae	Blue Grenadier	BP	1.71	1.67	Low 2.39				Low 2.39
Teleost	Thyrsites atun	Barracouta	BP	1.57	1.67	Low 2.29				Low 2.29
Teleost	Centrolophus niger	Rudderfish	BP	1.57	1.67	Low 2.29				Low 2.29
Teleost	Centroberyx lineatus	swallowtail	BP	1.71	1.44	Low 2.24				Low 2.24
Teleost	Pseudocaranx dentex	Silver Trevally	BP	1.57	1.44	Low 2.13				Low 2.13
Teleost	Nelusetta ayraudi	Chinaman-Leatherjacket	BP	1.29	1.67	Low 2.10				Low 2.10
Teleost	Zenopsis nebulosus	Mirror Dory	BP	1.43	1.44	Low 2.03				Low 2.03
Teleost	Seriola punctata	Spotted Warehou	BP	1.43	1.44	Low 2.03				Low 2.03
Teleost	Cyttus australis	Silver dory	BP	1.29	1.44	Low 1.93				Low 1.93
Teleost	Trachurus declivis	Jack Mackerel	BP	1.29	1.44	Low 1.93				Low 1.93
Teleost	Scomber australasicus	Blue Mackerel	BP	1.29	1.44	Low 1.93				Low 1.93
Teleost	Seriola brama	Blue Warehou	BP	1.29	1.44	Low 1.93				Low 1.93
Teleost	Neoplatycephalus richardsoni	Flathead	BP	1.29	1.22	Low 1.77				Low 1.77
Teleost	Lepidotrigla vanessa	butterfly gurnard	DI			Low 1.77				Low 1.77
Teleost	Lepidopus caudatus	Southern Frostfish	DI	1.71	1.67	Low 2.39				Low 2.39

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	Emmelichthys nitidus	redbait	TA	1.57	1.67	Low 2.29				Low 2.29
Chondrichthyan	Carcharodon carcharias	white shark	TEP	2.86	1.22	Med 3.11				Med 3.11
Chondrichthyan	Rhincodon typus	whale shark	TEP	2.71	1.44	Med 3.07				Med 3.07
Chondrichthyan	Carcharias taurus	grey nurse shark	TEP	2.71	1.22	Med 2.98				Med 2.98
Marine Bird	Thalassarche cauta	Shy Albatross	TEP	2.43	2.33	High 3.37		Guideline 5	Zero interactions have been recorded in the fishery despite a very high level of observer coverage of MWT (54.5%) in the SPF over a 7 year period (2003-2009). According to Guideline 5, an overall low susceptibility score with low interaction/capture allows for the overall risk category to be reduced to medium.	Medium
Marine Bird	Thalassarche melanophrys	Black-browed Albatross	TEP	2.43	2.33	High 3.37		Guideline 5	Zero interactions have been recorded in the fishery despite a very high level of observer coverage of MWT (54.5%) in the SPF over a 7 year period (2003-2009). According to Guideline 5, an overall low susceptibility score with low interaction/capture allows for the overall risk category to be reduced to medium.	Medium
Marine Bird	Thalassarche eremita	Chatham albatross	TEP	2.86	1.44	High 3.20		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 2.95
Marine Bird	Thalassarche nov. sp.	Pacific Albatross	TEP	2.71	1.22	Med 2.98				Med 2.98
Marine Bird	Diomedea epomophora	Southern Royal Albatross	TEP	2.57	1.44	Med 2.95				Med 2.95
Marine Bird	Diomedea exulans	Wandering Albatross	TEP	2.57	1.44	Med 2.95				Med 2.95
Marine Bird	Diomedea gibsoni	Gibson's Albatross	TEP	2.57	1.44	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
						2.95				2.95
Marine Bird	Diomedea antipodensis	Antipodean Albatross	TEP	2.57	1.44	Med 2.95				Med 2.95
Marine Bird	Diomedea sanfordi	Northern Royal Albatross	TEP	2.57	1.44	Med 2.95				Med 2.95
Marine Bird	Thalassarche impavida	Campbell Albatross	TEP	2.57	1.44	Med 2.95				Med 2.95
Marine Bird	Thalassarche carteri	Indian Yellow-nosed Albatross	TEP	2.57	1.44	Med 2.95				Med 2.95
Marine Bird	Thalassarche salvini	Salvin's albatross	TEP	2.57	1.44	Med 2.95				Med 2.95
Marine Bird	Diomedea amsterdamensis	Amsterdam Albatross	TEP	2.57	1.44	Med 2.95				Med 2.95
Marine Bird	Diomedea dabbenena	Tristan Albatross	TEP	2.57	1.44	Med 2.95				Med 2.95
Marine Bird	Calonectris leucomelas	streaked shearwater	TEP	2.57	1.44	Med 2.95				Med 2.95
Marine Bird	Pachyptila turtur	Fairy Prion	TEP	2.43	1.67	Med 2.95				Med 2.95
Marine Bird	Puffinus tenuirostris	Short-tailed Shearwater	TEP	2.43	1.67	Med 2.95				Med 2.95
Marine Bird	Pterodroma cervicalis	White-necked Petrel	TEP	2.57	1.22	Med 2.85				Med 2.85
Marine Bird	Pterodroma solandri	Providence Petrel	TEP	2.57	1.22	Med 2.85				Med 2.85
Marine Bird	Puffinus bulleri	Buller's Shearwater	TEP	2.57	1.22	Med 2.85				Med 2.85
Marine Bird	Phalacrocorax fuscescens	Black faced cormorant	TEP	2.57	1.22	Med 2.85				Med 2.85
Marine Bird	Thalassarche steadi	White-capped Albatross	TEP	2.57	1.22	Med 2.85				Med 2.85
Marine Bird	Procellaria aequinoctialis	White-chinned Petrel	TEP	2.29	1.67	Med 2.83				Med 2.83
Marine Bird	Thalassarche bulleri	Buller's Albatross	TEP	2.43	1.44	Med 2.83				Med 2.83
Marine Bird	Thalassarche chrysostoma	Grey-headed Albatross	TEP	2.43	1.44	Med 2.83				Med 2.83
Marine Bird	Phoebastria palpebrata	Light-mantled Albatross	TEP	2.43	1.44	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
						2.83				2.83
Marine Bird	Fulmarus glacialisoides	Southern fulmar	TEP	2.43	1.44	Med 2.83				Med 2.83
Marine Bird	Halobaena caerulea	Blue Petrel	TEP	2.43	1.44	Med 2.83				Med 2.83
Marine Bird	Lugensa brevirostris	Kerguelen Petrel	TEP	2.43	1.44	Med 2.83				Med 2.83
Marine Bird	Procellaria parkinsoni	Black Petrel; Parkinsons Petrel	TEP	2.43	1.22	Med 2.72				Med 2.72
Marine Bird	Procellaria westlandica	Westland Petrel	TEP	2.43	1.22	Med 2.72				Med 2.72
Marine Bird	Pterodroma leucoptera	Gould's Petrel	TEP	2.43	1.22	Med 2.72				Med 2.72
Marine Bird	Pterodroma macroptera	Great-winged Petrel	TEP	2.43	1.22	Med 2.72				Med 2.72
Marine Bird	Pterodroma mollis	Soft-plumaged Petrel	TEP	2.43	1.22	Med 2.72				Med 2.72
Marine Bird	Pterodroma nigripennis	Black-winged Petrel	TEP	2.43	1.22	Med 2.72				Med 2.72
Marine Bird	Puffinus assimilis	Little Shearwater (Tasman Sea)	TEP	2.43	1.22	Med 2.72				Med 2.72
Marine Bird	Puffinus carneipes	Flesh-footed Shearwater	TEP	2.43	1.22	Med 2.72				Med 2.72
Marine Bird	Puffinus pacificus	Wedge-tailed Shearwater	TEP	2.43	1.22	Med 2.72				Med 2.72
Marine Bird	Fregetta grallaria	White-bellied Storm-Petrel (Tasman Sea),	TEP	2.43	1.22	Med 2.72				Med 2.72
Marine Bird	Fregetta tropica	Black-bellied Storm-Petrel	TEP	2.43	1.22	Med 2.72				Med 2.72
Marine Bird	Garrodia nereis	Grey-backed storm petrel	TEP	2.43	1.22	Med 2.72				Med 2.72
Marine Bird	Catharacta skua	Great Skua	TEP	2.43	1.22	Med 2.72				Med 2.72
Marine Bird	Thalassarche chlororhynchos	Yellow-nosed Albatross, Atlantic Yellow-	TEP	2.29	1.44	Med 2.70				Med 2.70
Marine Bird	Phoebetria fusca	Sooty Albatross	TEP	2.29	1.44	Med 2.70				Med 2.70
Marine Bird	Daption capense	Cape Petrel	TEP	2.29	1.44	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
						2.70				2.70
Marine Bird	Macronectes giganteus	Southern Giant-Petrel	TEP	2.29	1.22	Low 2.59				Low 2.59
Marine Bird	Macronectes halli	Northern Giant-Petrel	TEP	2.29	1.22	Low 2.59				Low 2.59
Marine Bird	Procellaria cinerea	Grey petrel	TEP	2.29	1.22	Low 2.59				Low 2.59
Marine Bird	Pseudobulweria rostrata	Tahiti Petrel	TEP	2.29	1.22	Low 2.59				Low 2.59
Marine Bird	Pterodroma lessoni	White-headed petrel	TEP	2.29	1.22	Low 2.59				Low 2.59
Marine Bird	Pterodroma neglecta	Kermadec Petrel (western)	TEP	2.29	1.22	Low 2.59				Low 2.59
Marine Bird	Puffinus griseus	Sooty Shearwater	TEP	2.29	1.22	Low 2.59				Low 2.59
Marine Bird	Phaethon rubricauda	Red-tailed Tropicbird	TEP	2.29	1.22	Low 2.59				Low 2.59
Marine Bird	Morus capensis	Cape gannet	TEP	2.29	1.22	Low 2.59				Low 2.59
Marine Bird	Morus serrator	Australasian Gannet	TEP	2.29	1.22	Low 2.59				Low 2.59
Marine Bird	Sula dactylatra	Masked Booby	TEP	2.29	1.22	Low 2.59				Low 2.59
Marine Bird	Anous stolidus	Common noddy	TEP	2.29	1.22	Low 2.59				Low 2.59
Marine Bird	Larus pacificus	Pacific Gull	TEP	2.29	1.22	Low 2.59				Low 2.59
Marine Bird	Sterna bergii	Crested Tern	TEP	2.29	1.22	Low 2.59				Low 2.59
Marine Bird	Sterna caspia	Caspian Tern	TEP	2.29	1.22	Low 2.59				Low 2.59
Marine Bird	Eudyptula minor	Little Penguin	TEP	2.14	1.22	Low 2.47				Low 2.47
Marine Bird	Puffinus gavia	Fluttering Shearwater	TEP	2.14	1.22	Low 2.47				Low 2.47
Marine Bird	Puffinus huttoni	Hutton's Shearwater	TEP	2.14	1.22	Low 2.47				Low 2.47
Marine Bird	Anous minutus	Black Noddy	TEP	2.14	1.22	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
						2.47				2.47
Marine Bird	Anous tenuirostris	Lesser noddy	TEP	2.14	1.22	Low 2.47				Low 2.47
Marine Bird	Larus dominicanus	Kelp Gull	TEP	2.14	1.22	Low 2.47				Low 2.47
Marine Bird	Larus novaehollandiae	Silver Gull	TEP	2.14	1.22	Low 2.47				Low 2.47
Marine Bird	Procelsterna cerulea	grey ternlet	TEP	2.14	1.22	Low 2.47				Low 2.47
Marine Bird	Sterna fuscata	Sooty tern	TEP	2.14	1.22	Low 2.47				Low 2.47
Marine Bird	Sterna hirundo	Common tern	TEP	2.14	1.22	Low 2.47				Low 2.47
Marine Bird	Sterna paradisaea	Arctic tern	TEP	2.14	1.22	Low 2.47				Low 2.47
Marine Bird	Sterna sumatrana	Black-naped tern	TEP	2.14	1.22	Low 2.47				Low 2.47
Marine Bird	Oceanites oceanicus	Wilson's storm petrel (subantarctic)	TEP	2.00	1.22	Low 2.34				Low 2.34
Marine Bird	Pelagodroma marina	White-faced Storm-Petrel	TEP	2.00	1.22	Low 2.34				Low 2.34
Marine Bird	Sterna albifrons	Little tern	TEP	2.00	1.22	Low 2.34				Low 2.34
Marine Bird	Sterna anaethetus	Bridled Tern	TEP	2.00	1.22	Low 2.34				Low 2.34
Marine Bird	Sterna striata	White-fronted Tern	TEP	2.00	1.22	Low 2.34				Low 2.34
Marine Bird	Pelecanoides urinatrix	Common Diving-Petrel	TEP	1.86	1.22	Low 2.22				Low 2.22
Marine Mammal	Arctocephalus pusillus doriferus	Australian Fur Seal	TEP	2.29	3.00	High 3.77	Underwater video surveys (Jan 06 – Feb 07) detected a higher number of mortalities of seals than was able to be observed from above the water line. Trials of top opening SEDs have to date been unsuccessful but a new project is likely to	None	Interactions with MWT have been recorded in the SPF. Populations of these species are in the proximity of the mid water trawl sub-fishery of the SPF and considering the susceptibility of seals to gear and the fact that it is a TEP species Residual Risk score remains High.	High 3.77

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
							start in July 2010.			
Marine Mammal	Feresa attenuata	Pygmy Killer Whale	TEP	2.86	1.67	High 3.31		Guideline 5	Zero interactions have been recorded in the fishery despite a very high level of observer coverage of MWT (54.5%) in the SPF over a 7 year period (2003-2009). According to Guideline 5, an overall low susceptibility score with low interaction/capture allows for the overall risk category to be reduced to medium.	Medium
Marine Mammal	Globicephala macrorhynchus	Short-finned Pilot Whale	TEP	2.86	1.67	High 3.31		Guideline 5	Zero interactions have been recorded in the fishery despite a very high level of observer coverage of MWT (54.5%) in the SPF over a 7 year period (2003-2009). According to Guideline 5, an overall low susceptibility score with low interaction/capture allows for the overall risk category to be reduced to medium.	Medium
Marine Mammal	Globicephala melas	Long-finned Pilot Whale	TEP	2.86	1.67	High 3.31		Guideline 5	Zero interactions have been recorded in the fishery despite a very high level of observer coverage of MWT (54.5%) in the SPF over a 7 year period (2003-2009). According to Guideline 5, an overall low susceptibility score with low interaction/capture allows for the overall risk category to be reduced to medium.	Medium
Marine Mammal	Grampus griseus	Risso's Dolphin	TEP	2.86	1.67	High 3.31	<p>Following dolphin interactions that were reported via logbooks, AFMA implemented 100% observer coverage. A pilot study using underwater video monitoring survey was conducted. No further dolphins were observed near trawl nets.</p> <p>A bottom opening SED has been used by the main trawler in the sector. Trials of top-opening SEDs have been unsuccessful to date but a new project is likely to</p>	None	Following this event there was a period of high observer coverage (peak of 93% of days fishing in 2003/04) which found that interactions with dolphins are a relatively rare event.	High 3.31

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 Mammal	Pseudorca crassidens	False Killer Whale	TEP	2.86	1.67	High 3.31		Guideline 5	Zero interactions have been recorded in the fishery despite a very high level of observer coverage of MWT (54.5%) in the SPF over a 7 year period (2003-2009). According to Guideline 5, an overall low susceptibility score with low interaction/capture allows for the overall risk category to be reduced to medium.	Medium
Marine Mammal	Tursiops truncatus	Bottlenose Dolphin	TEP	2.86	1.67	High 3.31	<p>Following dolphin interactions that were reported via logbooks, AFMA implemented 100% observer coverage. A pilot study using underwater video monitoring survey was conducted. No further dolphins were observed near trawl nets.</p> <p>A bottom opening SED has been used by the main trawler in the sector. Trials of top-opening SEDs have been unsuccessful to date but a new project is likely to start in July 2010.</p>	None	Following this event there was a period of high observer coverage (peak of 93% of days fishing in 2003/04) which found that interactions with dolphins are a relatively rare event.	High 3.31
Marine Mammal	Tursiops aduncus	Indian Ocean bottlenose dolphin	TEP	2.86	1.67	High 3.31	<p>Following dolphin interactions that were reported via logbooks, AFMA implemented 100% observer coverage. A pilot study using underwater video monitoring survey was conducted. No further dolphins were observed near trawl nets.</p> <p>A bottom opening SED has been used by the main</p>	None	Following this event there was a period of high observer coverage (peak of 93% of days fishing in 2003/04) which found that interactions with dolphins are a relatively rare event.	High 3.31

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
							trawler in the sector. Trials of top-opening SEDs have been unsuccessful to date but a new project is likely to start in July 2010.			
Marine Mammal	Mesoplodon bowdoini	Andrew's Beaked Whale	TEP	2.86	1.67	High 3.31		Guideline 5	Zero interactions have been recorded in the fishery despite a very high level of observer coverage of MWT (54.5%) in the SPF over a 7 year period (2003-2009). According to Guideline 5, an overall low susceptibility score with low interaction/capture allows for the overall risk category to be reduced to medium.	Medium
Marine Mammal	Mesoplodon densirostris	Blainville's Beaked Whale	TEP	2.86	1.67	High 3.31		Guideline 5	Zero interactions have been recorded in the fishery despite a very high level of observer coverage of MWT (54.5%) in the SPF over a 7 year period (2003-2009). According to Guideline 5, an overall low susceptibility score with low interaction/capture allows for the overall risk category to be reduced to medium.	Medium
Marine Mammal	Mesoplodon ginkgodens	Gingko Beaked Whale	TEP	2.86	1.67	High 3.31		Guideline 5	Zero interactions have been recorded in the fishery despite a very high level of observer coverage of MWT (54.5%) in the SPF over a 7 year period (2003-2009). According to Guideline 5, an overall low susceptibility score with low interaction/capture allows for the overall risk category to be reduced to medium.	Medium
Marine Mammal	Mesoplodon hectori	Hector's Beaked Whale	TEP	2.86	1.67	High 3.31		Guideline 5	Zero interactions have been recorded in the fishery despite a very high level of observer coverage of MWT (54.5%) in the SPF over a 7 year period (2003-2009). According to Guideline 5, an overall low susceptibility score with low interaction/capture allows for the overall risk category to be reduced to medium.	Medium
Marine Mammal	Mesoplodon mirus	True's Beaked Whale	TEP	2.86	1.67	High 3.31		Guideline 5	Zero interactions have been recorded in the fishery despite a very high level of observer coverage of MWT (54.5%) in the SPF over a 7 year period (2003-2009). According to Guideline 5, an overall low susceptibility score	Medium

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
									with low interaction/capture allows for the overall risk category to be reduced to medium.	
Marine Mammal	Hyperoodon planifrons	Southern Bottlenose Whale	TEP	2.86	1.44	High 3.20		Guideline 5	Zero interactions have been recorded in the fishery despite a very high level of observer coverage of MWT (54.5%) in the SPF over a 7 year period (2003-2009). According to Guideline 5, an overall low susceptibility score with low interaction/capture allows for the overall risk category to be reduced to medium.	Medium
Marine Mammal	Mesoplodon grayi	Gray's Beaked Whale	TEP	2.86	1.44	High 3.20		Guideline 5	Zero interactions have been recorded in the fishery despite a very high level of observer coverage of MWT (54.5%) in the SPF over a 7 year period (2003-2009). According to Guideline 5, an overall low susceptibility score with low interaction/capture allows for the overall risk category to be reduced to medium.	Medium
Marine Mammal	Mesoplodon layardii	Strap-toothed Beaked Whale	TEP	2.86	1.44	High 3.20		Guideline 5	Zero interactions have been recorded in the fishery despite a very high level of observer coverage of MWT (54.5%) in the SPF over a 7 year period (2003-2009). According to Guideline 5, an overall low susceptibility score with low interaction/capture allows for the overall risk category to be reduced to medium.	Medium
Marine Mammal	Ziphius cavirostris	Cuvier's Beaked Whale	TEP	2.86	1.44	High 3.20		Guideline 5	Zero interactions have been recorded in the fishery despite a very high level of observer coverage of MWT (54.5%) in the SPF over a 7 year period (2003-2009). According to Guideline 5, an overall low susceptibility score with low interaction/capture allows for the overall risk category to be reduced to medium.	Medium
Marine Mammal	Lagenodelphis hosei	Fraser's Dolphin	TEP	2.71	1.67	High 3.19	Following dolphin interactions that were reported via logbooks, AFMA implemented 100% observer coverage. A pilot study using underwater video monitoring survey was conducted. No further dolphins were observed	None	Following this event there was a period of high observer coverage (peak of 93% of days fishing in 2003/04) which found that interactions with dolphins are a relatively rare event.	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
							<p>near trawl nets.</p> <p>A bottom opening SED has been used by the main trawler in the sector. Trials of top-opening SEDs have been unsuccessful to date but a new project is likely to start in July 2010.</p>			
Marine Mammal	Lagenorhynchus cruciger	Hourglass dolphin	TEP	2.71	1.67	High 3.19	<p>Following dolphin interactions that were reported via logbooks, AFMA implemented 100% observer coverage. A pilot study using underwater video monitoring survey was conducted. No further dolphins were observed near trawl nets.</p> <p>A bottom opening SED has been used by the main trawler in the sector. Trials of top-opening SEDs have been unsuccessful to date but a new project is likely to start in July 2010.</p>	None	Following this event there was a period of high observer coverage (peak of 93% of days fishing in 2003/04) which found that interactions with dolphins are a relatively rare event.	High 3.19
Marine Mammal	Lissodelphis peronii	Southern Right Whale Dolphin	TEP	2.71	1.67	High 3.19	<p>Following dolphin interactions that were reported via logbooks, AFMA implemented 100% observer coverage. A pilot study using underwater video monitoring survey was conducted. No further dolphins were observed near trawl nets.</p> <p>A bottom opening SED has</p>	None	Following this event there was a period of high observer coverage (peak of 93% of days fishing in 2003/04) which found that interactions with dolphins are a relatively rare event.	High 3.19

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
							been used by the main trawler in the sector. Trials of top-opening SEDs have been unsuccessful to date but a new project is likely to start in July 2010.			
Marine Mammal	Stenella coeruleoalba	Striped Dolphin	TEP	2.71	1.67	High 3.19	<p>Following dolphin interactions that were reported via logbooks, AFMA implemented 100% observer coverage. A pilot study using underwater video monitoring survey was conducted. No further dolphins were observed near trawl nets.</p> <p>A bottom opening SED has been used by the main trawler in the sector. Trials of top-opening SEDs have been unsuccessful to date but a new project is likely to start in July 2010.</p>	None	Following this event there was a period of high observer coverage (peak of 93% of days fishing in 2003/04) which found that interactions with dolphins are a relatively rare event.	High 3.19
Marine Mammal	Hydrurga leptonyx	Leopard seal	TEP	2.71	1.67	High 3.19		Guideline 5	Zero interactions have been recorded in the fishery despite a very high level of observer coverage of MWT (54.5%) in the SPF over a 7 year period (2003-2009). According to Guideline 5, an overall low susceptibility score with low interaction/capture allows for the overall risk category to be reduced to medium.	Medium
Marine Mammal	Mirounga leonina	Elephant seal	TEP	2.71	1.67	High 3.19		Guideline 5	Zero interactions have been recorded in the fishery despite a very high level of observer coverage of MWT (54.5%) in the SPF over a 7 year period (2003-2009). According to Guideline 5, an overall low susceptibility score with low interaction/capture allows for the overall risk category to be reduced to medium.	Medium
Marine	Orcinus orca	Killer Whale	TEP	2.86	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
Mammal						3.11				3.11
Marine Mammal	<i>Berardius arnuxii</i>	Arnoux's Beaked Whale	TEP	2.86	1.22	Med 3.11				Med 3.11
Marine Mammal	<i>Tasmacetus shepherdi</i>	Tasman Beaked Whale	TEP	2.86	1.22	Med 3.11				Med 3.11
Marine Mammal	<i>Balaenoptera acutorostrata</i>	Minke Whale	TEP	2.86	1.15	Med 3.08				Med 3.08
Marine Mammal	<i>Peponocephala electra</i>	Melon-headed Whale	TEP	2.57	1.67	Med 3.06				Med 3.06
Marine Mammal	<i>Stenella attenuata</i>	Spotted Dolphin	TEP	2.57	1.67	Med 3.06				Med 3.06
Marine Mammal	<i>Balaenoptera borealis</i>	Sei Whale	TEP	2.86	1.07	Med 3.05				Med 3.05
Marine Mammal	<i>Balaenoptera edeni</i>	Bryde's Whale	TEP	2.86	1.07	Med 3.05				Med 3.05
Marine Mammal	<i>Balaenoptera physalus</i>	Fin Whale	TEP	2.86	1.07	Med 3.05				Med 3.05
Marine Mammal	<i>Balaenoptera bonaerensis</i>	Antarctic Minke Whale	TEP	2.86	1.07	Med 3.05				Med 3.05
Marine Mammal	<i>Kogia breviceps</i>	Pygmy Sperm Whale	TEP	2.86	1.07	Med 3.05				Med 3.05
Marine Mammal	<i>Physeter catodon</i>	Sperm Whale	TEP	2.86	1.07	Med 3.05				Med 3.05
Marine Mammal	<i>Megaptera novaeangliae</i>	Humpback Whale	TEP	2.71	1.22	Med 2.98				Med 2.98
Marine Mammal	<i>Sousa chinensis</i>	Indo-Pacific Humpback Dolphin	TEP	2.71	1.22	Med 2.98				Med 2.98
Marine Mammal	<i>Steno bredanensis</i>	Rough-toothed Dolphin	TEP	2.71	1.22	Med 2.98				Med 2.98
Marine Mammal	<i>Kogia simus</i>	Dwarf Sperm Whale	TEP	2.71	1.22	Med 2.98				Med 2.98
Marine Mammal	<i>Dugong dugon</i>	Dugong	TEP	2.71	1.22	Med 2.98				Med 2.98
Marine Mammal	<i>Caperea marginata</i>	Pygmy Right Whale	TEP	2.71	1.15	Med 2.95				Med 2.95
Marine Mammal	<i>Stenella longirostris</i>	Long-snouted Spinner Dolphin	TEP	2.43	1.67	Med 2.95				Med 2.95
Marine	<i>Arctocephalus forsteri</i>	New Zealand Fur-seal	TEP	2.43	1.67	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
Mammal						2.95				2.95
Marine Mammal	<i>Neophoca cinerea</i>	Australian Sea-lion	TEP	2.43	1.67	Med 2.95				Med 2.95
Marine Mammal	<i>Eubalaena australis</i>	Southern Right Whale	TEP	2.71	1.07	Med 2.92				Med 2.92
Marine Mammal	<i>Delphinus delphis</i>	Common Dolphin	TEP	2.29	1.67	Med 2.83				Med 2.83
Marine Mammal	<i>Arctocephalus tropicalis</i>	Subantarctic fur seal	TEP	2.29	1.67	Med 2.83				Med 2.83
Marine Mammal	<i>Balaenoptera musculus</i>	Blue Whale	TEP	2.57	1.07	Med 2.79				Med 2.79
Marine Mammal	<i>Lagenorhynchus obscurus</i>	Dusky Dolphin	TEP	2.29	1.22	Low 2.59				Low 2.59
Marine Reptile	<i>Disteira kingii</i>	spectacled seasnake	TEP	2.71	1.44	Med 3.07				Med 3.07
Marine Reptile	<i>Dermochelys coriacea</i>	Leathery turtle	TEP	2.57	1.67	Med 3.06				Med 3.06
Marine Reptile	<i>Acalyptophis peronii</i>	Horned Seasnake	TEP	2.71	1.22	Med 2.98				Med 2.98
Marine Reptile	<i>Astrotia stokesii</i>	Stokes' seasnake	TEP	2.71	1.22	Med 2.98				Med 2.98
Marine Reptile	<i>Hydrophis ornatus</i>	seasnake	TEP	2.71	1.22	Med 2.98				Med 2.98
Marine Reptile	<i>Pelamis platurus</i>	yellow-bellied seasnake	TEP	2.71	1.22	Med 2.98				Med 2.98
Marine Reptile	<i>Caretta caretta</i>	Loggerhead	TEP	2.43	1.67	Med 2.95				Med 2.95
Marine Reptile	<i>Chelonia mydas</i>	Green turtle	TEP	2.43	1.67	Med 2.95				Med 2.95
Marine Reptile	<i>Eretmochelys imbricata</i>	Hawksbill turtle	TEP	2.43	1.67	Med 2.95				Med 2.95
Marine Reptile	<i>Hydrophis elegans</i>	Elegant seasnake	TEP	2.14	1.22	Low 2.47				Low 2.47
Teleost	<i>Heteroclinus perspicillatus</i>	Common weedfish	TEP			2.29	1.22	Low 2.59		
Teleost	<i>Solenostomus cyanopterus</i>	Blue-finned Ghost Pipefish, Robust Ghost	TEP	2.14	1.22	Low 2.47				Low 2.47
Teleost	<i>Solenostomus paradoxus</i>	Harlequin Ghost Pipefish,	TEP	2.14	1.22	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
		Ornate Ghost Pipefish				2.47				2.47
Teleost	Hippocampus kuda	Spotted Seahorse, Yellow Seahorse	TEP	1.57	1.67	Low 2.29				Low 2.29
Teleost	Heraldia sp. 1 [in Kuitert, 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	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	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	Lissocampus runa	Javelin 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				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
						1.88				1.88
Teleost	<i>Leptoichthys fistularius</i>	Brushtail Pipefish	TEP	1.43	1.22	Low 1.88				Low 1.88
Teleost	<i>Kaupus costatus</i>	Deep-bodied Pipefish	TEP	1.43	1.22	Low 1.88				Low 1.88
Teleost	<i>Mitotichthys semistriatus</i>	Half-banded Pipefish	TEP	1.43	1.22	Low 1.88				Low 1.88
Teleost	<i>Lissocampus caudalis</i>	Australian Smooth Pipefish, Smooth Pipefish	TEP	1.43	1.22	Low 1.88				Low 1.88
Teleost	<i>Stigmatopora argus</i>	Spotted Pipefish	TEP	1.43	1.22	Low 1.88				Low 1.88
Teleost	<i>Stigmatopora nigra</i>	Wide-bodied Pipefish, Black Pipefish	TEP	1.43	1.22	Low 1.88				Low 1.88
Teleost	<i>Stipecampus cristatus</i>	Ring-backed Pipefish	TEP	1.43	1.22	Low 1.88				Low 1.88
Teleost	<i>Pugnaso curtirostris</i>	Pug-nosed Pipefish	TEP	1.43	1.22	Low 1.88				Low 1.88
Teleost	<i>Mitotichthys mollisoni</i>	Mollison's Pipefish	TEP	1.43	1.22	Low 1.88				Low 1.88
Teleost	<i>Vanacampus poecilolaemus</i>	Australian Long-snout Pipefish, Long-snouted Pipefish	TEP	1.43	1.22	Low 1.88				Low 1.88
Teleost	<i>Mitotichthys tuckeri</i>	Tucker's Pipefish	TEP	1.43	1.22	Low 1.88				Low 1.88
Teleost	<i>Hippocampus whitei</i>	white's seahorse	TEP	1.43	1.22	Low 1.88				Low 1.88
Teleost	<i>Solegnathus spinosissimus</i>	spiny pipehorse	TEP	1.43	1.22	Low 1.88				Low 1.88
Teleost	<i>Halicampus grayi</i>	Mud Pipefish, Gray's Pipefish	TEP	1.43	1.22	Low 1.88				Low 1.88
Teleost	<i>Acentronura breviperula</i>	Hairy Pygmy Pipehorse	TEP	1.43	1.22	Low 1.88				Low 1.88
Teleost	<i>Corythoichthys ocellatus</i>	Orange-spotted Pipefish, Ocellated Pipefish	TEP	1.43	1.22	Low 1.88				Low 1.88
Teleost	<i>Cosmocampus banneri</i>	Roughridge Pipefish	TEP	1.43	1.22	Low 1.88				Low 1.88
Teleost	<i>Cosmocampus howensis</i>	Lord Howe 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	<i>Festucalex cinctus</i>	Girdled Pipefish	TEP	1.43	1.22	Low 1.88				Low 1.88
Teleost	<i>Festucalex scalaris</i>	Ladder Pipefish	TEP	1.43	1.22	Low 1.88				Low 1.88
Teleost	<i>Filicampus tigris</i>	Tiger Pipefish	TEP	1.43	1.22	Low 1.88				Low 1.88
Teleost	<i>Halicampus brocki</i>	Brock's Pipefish	TEP	1.43	1.22	Low 1.88				Low 1.88
Teleost	<i>Halicampus macrorhynchus</i>	[a pipefish]	TEP	1.43	1.22	Low 1.88				Low 1.88
Teleost	<i>Heraldia nocturna</i>	Upside-down Pipefish	TEP	1.43	1.22	Low 1.88				Low 1.88
Teleost	<i>Hippichthys cyanospilos</i>	Blue-speckled Pipefish, Blue-spotted Pipefish	TEP	1.43	1.22	Low 1.88				Low 1.88
Teleost	<i>Hippichthys heptagonus</i>	Madura Pipefish	TEP	1.43	1.22	Low 1.88				Low 1.88
Teleost	<i>Hippichthys penicillus</i>	Beady Pipefish, Steep-nosed Pipefish	TEP	1.43	1.22	Low 1.88				Low 1.88
Teleost	<i>Hippocampus planifrons</i>	Flat-face Seahorse	TEP	1.43	1.22	Low 1.88				Low 1.88
Teleost	<i>Histiogamphelus cristatus</i>	Rhino Pipefish, Macleay's Crested Pipefish	TEP	1.43	1.22	Low 1.88				Low 1.88
Teleost	<i>Hypselognathus horridus</i>	Shaggy Pipefish, Prickly Pipefish	TEP	1.43	1.22	Low 1.88				Low 1.88
Teleost	<i>Kimblaesus bassensis</i>	Trawl Pipefish, Kimbla Pipefish	TEP	1.43	1.22	Low 1.88				Low 1.88
Teleost	<i>Lissocampus fatiloquus</i>	Prophet's Pipefish	TEP	1.43	1.22	Low 1.88				Low 1.88
Teleost	<i>Micrognathus andersonii</i>	Anderson's Pipefish, Shortnose Pipefish	TEP	1.43	1.22	Low 1.88				Low 1.88
Teleost	<i>Micrognathus pygmaeus</i>	[a pipefish]	TEP	1.43	1.22	Low 1.88				Low 1.88
Teleost	<i>Microphis manadensis</i>	Manado River Pipefish, Manado Pipefish	TEP	1.43	1.22	Low 1.88				Low 1.88
Teleost	<i>Mitotichthys meraculus</i>	Western Crested Pipefish	TEP	1.43	1.22	Low 1.88				Low 1.88
Teleost	<i>Nannocampus subosseus</i>	Bony-headed 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	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
Teleost	Solegnathus sp. 1 [in Kuiter, 2000]	Pipehorse	TEP	1.43	1.22	Low 1.88				Low 1.88
Teleost	Syngnathoides biaculeatus	Double-ended Pipehorse, Alligator Pipefish	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	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	Corythoichthys amplexus	Fijian Banded Pipefish, Brown-banded 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

\*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						1
Target Bait						
Bycatch (discard)						2
Byproduct					1	15
TEP	18			8	97	113
<b>Total</b>	18			8	98	131



## 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.

One risk level was reduced from a high to a medium category through the use of the Guideline 3 based on a new source of information for a missing attribute. Another 18 TEP species had their risk levels reduced from high to a medium category through the application of Guideline 5.

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	<p>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;</p> <p>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.</p>
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	<i>Environment Protection and Biodiversity Conservation Act (Cth) 1999</i>
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).



## REFERENCES

Daley, R., Dowdney, J., Bulman, C, Sporcic, M., Fuller, M., Ling, S. and Hobday, A (2007). Ecological Risk Assessment for the Effects of Fishing. Report for the midwater trawl sub-fishery of the Small Pelagic Fishery. Report for the Australian Fisheries Management Authority. Canberra, Australia.

Hobday, A.J., Smith, A, Webb, H., Daley, R., Wayte, S., Bulman, C., Dowdney, J., Williams, A., Sporcic, M., Dambacher, J., Fuller, M., Walker, T., 2007, Ecological Risk Assessment for Effects of Fishing: Methodology, Report Ro4/1072, Australian Fisheries Management Authority, Canberra.

Standards Australia, 2004, Australian/New Zealand Standard: Risk Management, Third Edition, Standards Australia International Ltd, Sydney, and Standards New Zealand, Wellington.

