



Australian Government

Australian Fisheries Management Authority

 Residual Risk Assessment of the
Level 2 Ecological Risk Assessment
Species Results
Report for the Western Tuna and Billfish Fishery



November 2009

EXECUTIVE SUMMARY

Since 2001, AFMA has undertaken a detailed ecological risk assessment (ERA) for all major AFMA-managed fisheries as a key part of the move towards ecosystem-based fisheries management. 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.

An 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 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 responses for each fishery. This will ensure transparency in the response process and allow for easier co-ordination within and between fisheries. Using the results presented here, an appropriate management response 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 results do not directly account for all management measures, resulting in an over-estimation of the actual risk for some species. To account for this and to bring the results of the ERA up-to-date, the Level 2 analysis has undergone further assessment for residual risk. Residual risk is what remains after consideration is given to mitigation measures that may modify risk.

In early 2007, a set of residual risk guidelines were developed in consultation with CSIRO and stakeholders to assist AFMA managers in calculating residual risk. 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 current management arrangements. To assist managers, a clear set of decision rules are outlined that are to be applied to individual species.

For the Western Tuna and Billfish fishery, the results from the Level 2 PSA table are used here to determine the residual risk for the fishery. Overall 32 species from a total of 348 assessed were deemed to be high risk. There has been a change from 32 high risk species prior to the residual risk assessment to zero high residual risk species. The primary reason behind changes in risk scores were due to compliance with the statutory Threat Abatement Plan (TAP) for the incidental catch of seabirds.



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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.

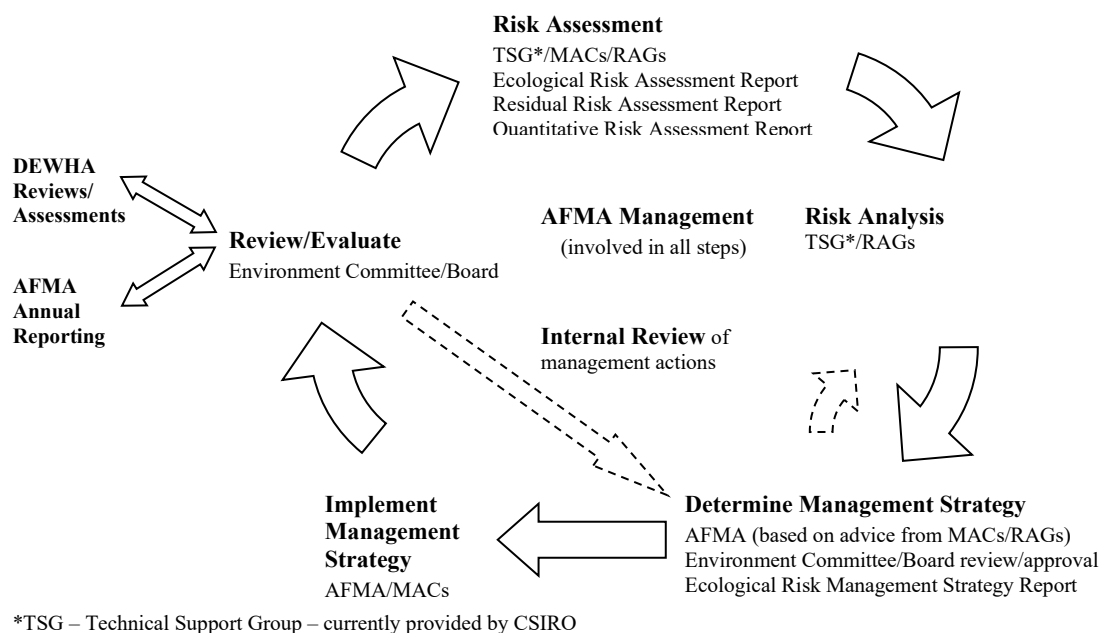


Figure 1 Ecological Risk Management framework



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

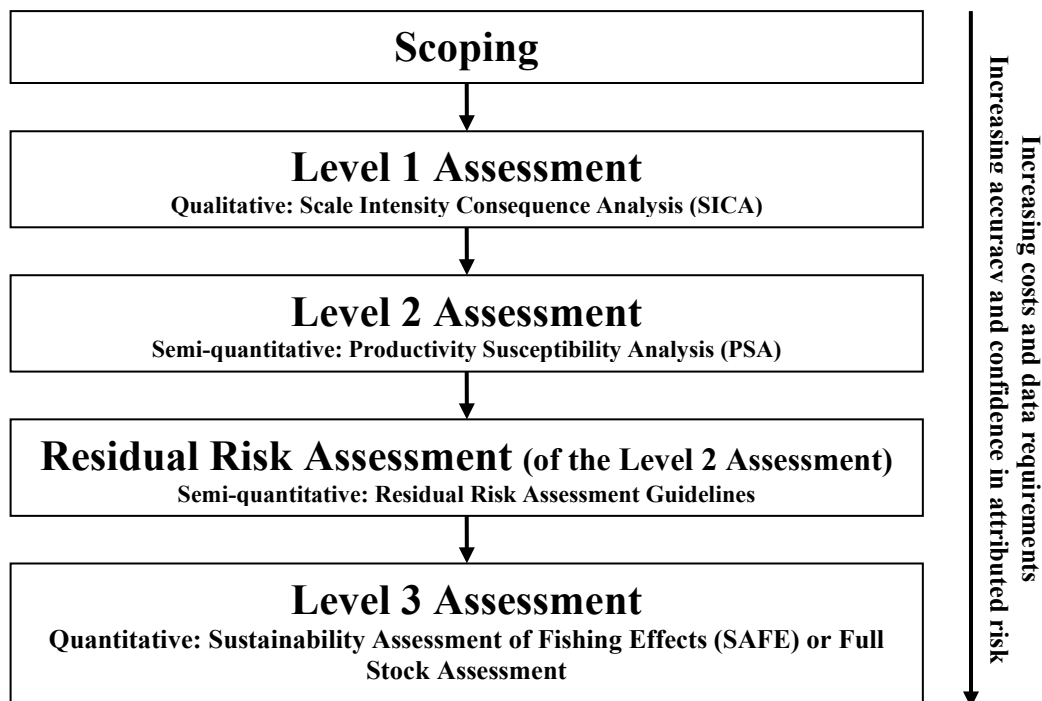


Figure 2 The different levels of risk assessment and the trend in confidence and cost



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.

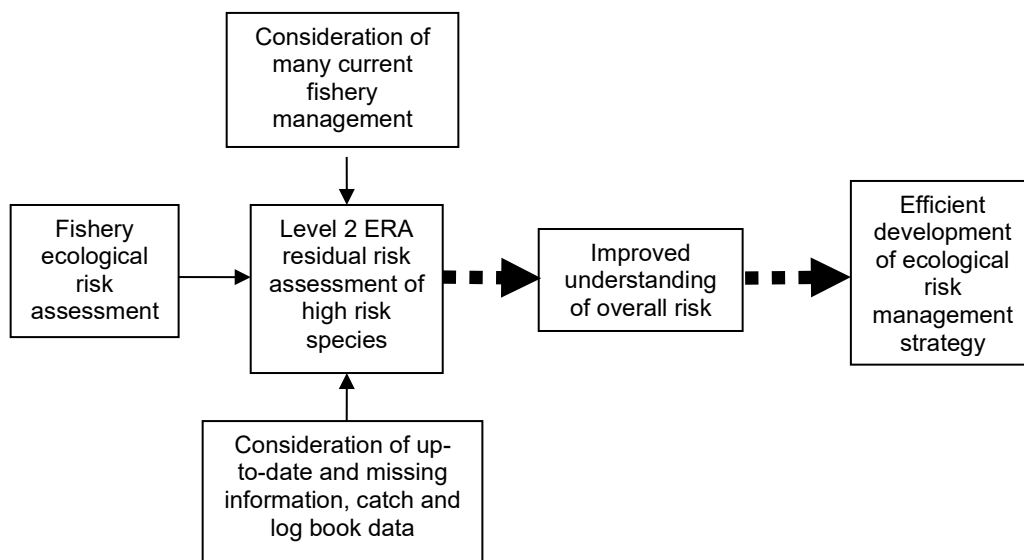


Figure 3 Flow diagram of the Level 2 ERA residual risk process

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
Draft Level 2 ERA residual risk assessment trial in SESSF	AFMA workshop	December 12 th , 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	May 21 st , 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	March 13 th , 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.



Draft Level 2 residual risk assessment for Western Tuna and Billfish Fishery using final ERA results / Draft ERM for the Western Tuna and Billfish Fishery	Review of draft Residual Risk report / ERM	May 2009	Tropical Tuna MAC (TTMAC) 2	TTMAC endorsed the ERM Report and Residual Risk Results to be published on the AFMA website.
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3. RESULTS

3.1. ERA Results

3.1.1 ERA Results

Overall 32 species from a total of 348 assessed were deemed to be high risk in the WTBF. These included two byproduct species, three bycatch species, and 27 TEP species. There has been a change from 32 high risk species prior to the residual risk assessment to zero high residual risk species. The primary reason behind changes in risk was because of the fishery meeting targets set under the statutory Threat Abatement Plan (TAP) for the incidental catch of seabirds.

Fishery Description

Gear:	Pelagic longline, minor line (handline, troll, rod and reel)
Area:	The WTBF extends westward from Cape York Peninsula (142°30'E) off Queensland to 34°S off the west coast of Western Australia. It also extends eastwards from 34°S off the west coast of WA, across the Great Australian Bight to 141°E at the South Australian/Victorian border. The WTBF also includes Australian waters outside of 12 nm off Christmas Island and Cocos Keeling Islands
Depth range:	30-200m
Fleet size:	110 permits, but fewer boats (5-10 in 2005)
Effort:	Average (1986-2003), 3,989 sets and 4,355,385 hooks
Landings:	Retained catch (in tonnes) for 2005/06 was 926 tonnes (including 446 tonnes of Skipjack) worth \$3.2 million.
Discard rate:	Not known
Main target species:	Yellowfin Tuna (<i>Thunnus albacares</i>), Bigeye Tuna (<i>T. obesus</i>), Albacore Tuna (<i>T. alalunga</i>) and Broadbill Swordfish (<i>Xiphias gladius</i>)

Management: AFMA manages the commercial sector through a system of input and output controls, including limited entry, zoning, spatial closures, bycatch provisions, gear restrictions and total allowable catch arrangements. SFRs are being implemented, which will be based on a system of individual tradeable effort units (hooks)

Ecological Units Assessed

Target species:	6
Target species/Bait:	7
By-product/bycatch species:	23 and 48 respectively
TEP species:	264

Level 1 Results

The habitat component was eliminated at Level 1. For all other components, there was at least one risk score of 3 – moderate – or above.

A number of hazards (fishing activities) were eliminated at Level 1 (risk scores 1 or 2). Those remaining included:



- Fishing (direct impact on 4 ecological components)
- Translocation of species (impact on communities)

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

Risks rated as major (risk score 4) for the WTBF were related to direct impacts from primary fishing operations on target and byproduct/bycatch species. No severe impacts (risk score 5) were recorded. Impacts from fishing on all species components were assessed in more detail at Level 2.

Level 2 Results

Species

A total of 348 species were assessed at Level 2 using the PSA analysis. Of these, 32 were assessed to be at high risk, 2 byproduct species, 3 bycatch species, and 27 TEP species. By taxa, the high risk species comprised 6 chondrichthyans (sharks and rays), 21 marine birds, and 5 marine mammals.

The uncertainty is due lack of biological data for some of the birds and sea snakes, to the poor observer coverage on the fishery so far, and the lack of detailed taxonomic resolution in the observer reports. A number of shark and ray species, and several groups of marine birds are most likely to be at high risk from this fishery.

Summary

There remains considerable uncertainty about many high risk species for this fishery. Those that should be the focus of initial management response include several chondrichthyan species (including byproduct, bycatch and TEP), and several groups of marine birds (including albatross, petrels and shearwaters).

3.2. Level 2 PSA Residual Risk Results

The Level 2 PSA residual risk assessment summary for the Western Tuna and Billfish Fishery is given in **Table 4**. Overall 32 species from a total of 348 assessed were deemed to be high risk. There has been a change from 32 high risk species prior to the residual risk assessment to zero high residual risk species. The primary reason behind changes in risk scores were due to compliance with the statutory Threat Abatement Plan (TAP) for the incidental catch of seabirds.



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
Chondrichthyan	Carcharhinus obscurus	Dusky Shark	BP	3.00	1.67	High	- Ban of wire traces - A 20 shark trip limit in AFZ and 100 sharks on high seas - Ban on shark finning	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 the Skipjack purse seine fishery.	Low
Chondrichthyan	Lamna nasus	Porbeagle shark	BP	2.71	1.67	High	- Ban of wire traces - A 20 shark trip limit in AFZ and 100 sharks on high seas - Ban on shark finning	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 the Skipjack purse seine fishery.	Low
Chondrichthyan	Alopias vulpinus	Thintail Thresher Shark	DI	2.57	2.33	High	- Ban of wire traces - A 20 shark trip limit in AFZ and 100 sharks on high seas - Ban on shark finning	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 the Skipjack purse seine fishery.	Low
Chondrichthyan	Scymnodalatis albicauda	Sherwoods dogfish	DI	2.86	1.44	High	- Ban of wire traces - A 20 shark trip limit in AFZ and 100 sharks on high seas - Ban on shark finning	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 the Skipjack purse seine fishery.	Low
Chondrichthyan	Sphyrna zygaena	Smooth hammerhead	DI	2.71	1.67	High	- Ban of wire traces - A 20 shark trip limit in AFZ and 100 sharks on high seas - Ban on shark finning	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 the Skipjack purse seine fishery.	Low
Chondrichthyan	Carcharodon carcharias	White shark	TEP	2.86	1.89	High	Ban of wire traces	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 the Skipjack purse seine fishery.	Low
Marine Bird	Thalassarche eremita	Chatham albatross	TEP	2.86	3.00	High	None	Guideline 3	This species has 3 missing productivity attributes (Average Max Size, Average Size at Maturity and Trophic Level). There are closely related species from the genus Thalassarche including Shy Albatross, White-capped Albatross and Campbell Albatross. Decided to borrow attributes from Shy Albatross because it was the most closely related species.	Med
							None	Guideline 5	There has been an adequate level of observer coverage in the fishery. Due to low fishing effort over recent years the observer coverage has been variable ranging from 2 to 16%, however averaging 6.8% over the past 5 years. Total observer interaction data for this species was zero with a negligible level of cryptic mortality. Species has a high susceptibility of 3 so reduce susceptibility from 3-1.	

							Species is subject to a TAP	Guideline 7	Species has a TAP in place with a high degree of confidence in the effectiveness of the mitigation measures. The fishery is compliant with the TAP in not exceeding catch rates of 0.05 birds per 1000 hooks. Effort (no. of hooks) is low in the WTBF (for the 2006/07 season [1st July 2006 - present] a total of 388,539 hooks were set in the WTBF). Mitigation measures such as tori line use, night setting and using thawed bait have reduced seabird catch. These reduce the encounterability of seabirds to hooks.	
Marine Bird	Thalassarche salvini	Salvin's albatross	TEP	2.57	2.33	High	None	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, White-capped Albatross and Campbell Albatross. Decided to borrow attributes from Shy Albatross because it was the most closely related species.	Med
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Marine Bird	Thalassarche platei	Pacific albatross	TEP	2.71	3.00	High	None	Guideline 5	There has been an adequate level of observer coverage in the fishery. Due to low fishing effort over recent years the observer coverage has been variable ranging from 2 to 16%, however averaging 6.8% over the past 5 years. Total observer interaction data for this species was zero with a negligible level of cryptic mortality. Species has a high susceptibility of 3 so reduce susceptibility from 3-1.	Med
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Marine Bird	Diomedea exulans	Wandering Albatross	TEP	2.57	3.00	High	Species is subject to a TAP	Guideline 7	Species has a TAP in place with a high degree of confidence in the effectiveness of the mitigation measures. The fishery is compliant with the TAP in not exceeding catch rates of 0.05 birds per 1000 hooks. Effort (no. of hooks) is low in the WTBF (for the 2006/07 season [1st July 2006 - present] a total of 388,539 hooks were set in the WTBF). Mitigation measures such as tori line use, night setting and using thawed bait have reduced seabird catch. These reduce the encounterability of seabirds to hooks.	Med

							None	Guideline 5	There has been an adequate level of observer coverage in the fishery. Due to low fishing effort over recent years the observer coverage has been variable ranging from 2 to 16%, however averaging 6.8% over the past 5 years. Total observer interaction data for this species was zero with a negligible level of cryptic mortality. Species has a high susceptibility of 3 so reduce susceptibility from 3-1.	
Marine Bird	Diomedea antipodensis	Antipodean Albatross	TEP	2.57	3.00	High	Species is subject to a TAP	Guideline 7	Species has a TAP in place with a high degree of confidence in the effectiveness of the mitigation measures. The fishery is compliant with the TAP in not exceeding catch rates of 0.05 birds per 1000 hooks. Effort (no. of hooks) is low in the WTBF (for the 2006/07 season [1st July 2006 - present] a total of 388,539 hooks were set in the WTBF). Mitigation measures such as tori line use, night setting and using thawed bait have reduced seabird catch. These reduce the encounterability of seabirds to hooks.	Med
							None	Guideline 5	There has been an adequate level of observer coverage in the fishery. Due to low fishing effort over recent years the observer coverage has been variable ranging from 2 to 16%, however averaging 6.8% over the past 5 years.. Total observer interaction data for this species was zero with a negligible level of cryptic mortality. Species has a high susceptibility of 3 so reduce susceptibility from 3-1.	
Marine Bird	Diomedea epomophora	Southern Royal Albatross	TEP	2.57	3.00	High	Species is subject to a TAP	Guideline 7	Species has a TAP in place with a high degree of confidence in the effectiveness of the mitigation measures. The fishery is compliant with the TAP in not exceeding catch rates of 0.05 birds per 1000 hooks. Effort (no. of hooks) is low in the WTBF (for the 2006/07 season [1st July 2006 - present] a total of 388,539 hooks were set in the WTBF). Mitigation measures such as tori line use, night setting and using thawed bait have reduced seabird catch. These reduce the encounterability of seabirds to hooks.	Med
							None	Guideline 5	There has been an adequate level of observer coverage in the fishery. Due to low fishing effort over recent years the observer coverage has been variable ranging from 2 to 16%, however averaging 6.8% over the past 5 years. Total observer interaction data for this species was zero with a negligible level of cryptic mortality. Species has a high susceptibility of 3 so reduce susceptibility from 3-1.	
Marine Bird	Diomedea gibsoni	Gibson's Albatross	TEP	2.57	3.00	High	Species is subject to a TAP	Guideline 7	Species has a TAP in place with a high degree of confidence in the effectiveness of the mitigation measures. The fishery is compliant with the TAP in not exceeding catch rates of 0.05 birds per 1000 hooks. Effort (no. of hooks) is low in the WTBF (for the 2006/07 season [1st July 2006 - present] a total of 388,539 hooks were set in the WTBF). Mitigation measures such as tori line use, night setting and using thawed bait have reduced seabird catch. These reduce the encounterability of seabirds to hooks.	Med
							None	Guideline 5	There has been an adequate level of observer coverage in the fishery. Due to low fishing effort over recent years the observer coverage has been variable ranging from 2 to 16%, however averaging 6.8% over the past 5 years. Total observer interaction data for this species was zero with a negligible level of cryptic mortality. Species has a high susceptibility of 3 so reduce susceptibility from 3-1.	
Marine Bird	Diomedea sanfordi	Northern Royal Albatross	TEP	2.57	3.00	High	None	Guideline 5	There has been an adequate level of observer coverage in the fishery. Due to low fishing effort over recent years the observer coverage has been variable ranging from 2 to 16%, however averaging 6.8% over the past 5 years. Total observer interaction data for this species was zero with a negligible level of cryptic mortality. Species has a high susceptibility of 3 so reduce susceptibility from 3-1.	Med

							Species is subject to a TAP	Guideline 7	Species has a TAP in place with a high degree of confidence in the effectiveness of the mitigation measures. The fishery is compliant with the TAP in not exceeding catch rates of 0.05 birds per 1000 hooks. Effort (no. of hooks) is low in the WTBF (for the 2006/07 season [1st July 2006 - present] a total of 388,539 hooks were set in the WTBF). Mitigation measures such as tori line use, night setting and using thawed bait have reduced seabird catch. These reduce the encounterability of seabirds to hooks.	
							None	Guideline 5	There has been an adequate level of observer coverage in the fishery. Due to low fishing effort over recent years the observer coverage has been variable ranging from 2 to 16%, however averaging 6.8% over the past 5 years. Total observer interaction data for this species was zero with a negligible level of cryptic mortality. Species has a high susceptibility of 3 so reduce susceptibility from 3-1.	
Marine Bird	Thalassarche impavida	Campbell Albatross	TEP	2.57	3.00	High	Species is subject to a TAP	Guideline 7	Species has a TAP in place with a high degree of confidence in the effectiveness of the mitigation measures. The fishery is compliant with the TAP in not exceeding catch rates of 0.05 birds per 1000 hooks. Effort (no. of hooks) is low in the WTBF (for the 2006/07 season [1st July 2006 - present] a total of 388,539 hooks were set in the WTBF). Mitigation measures such as tori line use, night setting and using thawed bait have reduced seabird catch. These reduce the encounterability of seabirds to hooks.	Med
							None	Guideline 5	There has been an adequate level of observer coverage in the fishery. Due to low fishing effort over recent years the observer coverage has been variable ranging from 2 to 16%, however averaging 6.8% over the past 5 years. Total observer interaction data for this species was zero with a negligible level of cryptic mortality. Species has a high susceptibility of 3 so reduce susceptibility from 3-1.	
Marine Bird	Diomedea amsterdamensis	Amsterdam Albatross	TEP	2.57	3.00	High	Species is subject to a TAP	Guideline 7	Species has a TAP in place with a high degree of confidence in the effectiveness of the mitigation measures. The fishery is compliant with the TAP in not exceeding catch rates of 0.05 birds per 1000 hooks. Effort (no. of hooks) is low in the WTBF (for the 2006/07 season [1st July 2006 - present] a total of 388,539 hooks were set in the WTBF). Mitigation measures such as tori line use, night setting and using thawed bait have reduced seabird catch. These reduce the encounterability of seabirds to hooks.	Med
							None	Guideline 5	There has been an adequate level of observer coverage in the fishery. Due to low fishing effort over recent years the observer coverage has been variable ranging from 2 to 16%, however averaging 6.8% over the past 5 years. Total observer interaction data for this species was zero with a negligible level of cryptic mortality. Species has a high susceptibility of 3 so reduce susceptibility from 3-1.	
Marine Bird	Diomedea dabbenena	Tristan Albatross	TEP	2.57	3.00	High	Species is subject to a TAP	Guideline 7	Species has a TAP in place with a high degree of confidence in the effectiveness of the mitigation measures. The fishery is compliant with the TAP in not exceeding catch rates of 0.05 birds per 1000 hooks. Effort (no. of hooks) is low in the WTBF (for the 2006/07 season [1st July 2006 - present] a total of 388,539 hooks were set in the WTBF). Mitigation measures such as tori line use, night setting and using thawed bait have reduced seabird catch. These reduce the encounterability of seabirds to hooks.	Med

Marine Bird	Puffinus carneipes	Flesh-footed Shearwater	TEP	2.43	3.00	High	Species is subject to a TAP	Guideline 7	Species has a TAP in place with a high degree of confidence in the effectiveness of the mitigation measures. The fishery is compliant with the TAP in not exceeding catch rates of 0.05 birds per 1000 hooks. Effort (no. of hooks) is low in the WTBF (for the 2006/07 season [1 st July 2006 – present] a total of 388,539 hooks were set in the WTBF). Mitigation measures such as tori line use, night setting and using thawed bait have reduced seabird catch. These reduce the encounterability of seabirds to hooks.	Med
							None	Guideline 5	There has been an adequate level of observer coverage in the fishery. Due to low fishing effort over recent years the observer coverage has been variable ranging from 2 to 16%, however averaging 6.8% over the past 5 years. Total observer interaction data for this species was zero with a negligible level of cryptic mortality. Species has a high susceptibility of 3 so reduce susceptibility from 3-1.	
Marine Bird	Puffinus pacificus	Wedge-tailed Shearwater	TEP	2.43	3.00	High	Species is subject to a TAP	Guideline 7	Species has a TAP in place with a high degree of confidence in the effectiveness of the mitigation measures. The fishery is compliant with the TAP in not exceeding catch rates of 0.05 birds per 1000 hooks. Effort (no. of hooks) is low in the WTBF (for the 2006/07 season [1 st July 2006 – present] a total of 388,539 hooks were set in the WTBF). Mitigation measures such as tori line use, night setting and using thawed bait have reduced seabird catch. These reduce the encounterability of seabirds to hooks.	Low
Marine Bird	Thalassarche carteri	Indian Yellow-nosed Albatross	TEP	2.57	2.33	High	Species is subject to a TAP	Guideline 7	Species has a TAP in place with a high degree of confidence in the effectiveness of the mitigation measures. The fishery is compliant with the TAP in not exceeding catch rates of 0.05 birds per 1000 hooks. Effort (no. of hooks) is low in the WTBF (for the 2006/07 season [1 st July 2006 – present] a total of 388,539 hooks were set in the WTBF). Mitigation measures such as tori line use, night setting and using thawed bait have reduced seabird catch. These reduce the encounterability of seabirds to hooks.	Med
							None	Guideline 5	There has been an adequate level of observer coverage in the fishery. Due to low fishing effort over recent years the observer coverage has been variable ranging from 2 to 16%, however averaging 6.8% over the past 5 years. Total observer interaction data for this species was 1 with a negligible level of cryptic mortality. Species has a high susceptibility of 2.33 so reduce susceptibility from 3-2.	
Marine Bird	Phoebastria palpebrata	Light-mantled Albatross	TEP	2.43	2.33	High	Species is subject to a TAP	Guideline 7	Species has a TAP in place with a high degree of confidence in the effectiveness of the mitigation measures. The fishery is compliant with the TAP in not exceeding catch rates of 0.05 birds per 1000 hooks. Effort (no. of hooks) is low in the WTBF (for the 2006/07 season [1 st July 2006 – present] a total of 388,539 hooks were set in the WTBF). Mitigation measures such as tori line use, night setting and using thawed bait have reduced seabird catch. These reduce the encounterability of seabirds to hooks.	Med
Marine Bird	Thalassarche bulleri	Buller's Albatross	TEP	2.43	2.33	High	None	Guideline 5	There has been an adequate level of observer coverage in the fishery. Due to low fishing effort over recent years the observer coverage has been variable ranging from 2 to 16%, however averaging 6.8% over the past 5 years. Total observer interaction data for this species was zero with a negligible level of cryptic mortality. Species has a high susceptibility of 2.33 so reduce susceptibility from 3-1.	Low

							Species is subject to a TAP	Guideline 7	Species has a TAP in place with a high degree of confidence in the effectiveness of the mitigation measures. The fishery is compliant with the TAP in not exceeding catch rates of 0.05 birds per 1000 hooks. Effort (no. of hooks) is low in the WTBF (for the 2006/07 season [1st July 2006 - present] a total of 388,539 hooks were set in the WTBF). Mitigation measures such as tori line use, night setting and using thawed bait have reduced seabird catch. These reduce the encounterability of seabirds to hooks.	
							None	Guideline 5	There has been an adequate level of observer coverage in the fishery. Due to low fishing effort over recent years the observer coverage has been variable ranging from 2 to 16%, however averaging 6.8% over the past 5 years. Total observer interaction data for this species was zero with a negligible level of cryptic mortality. Species has a high susceptibility of 2.33 so reduce susceptibility from 3-1.	
Marine Bird	Thalassarche cauta	Shy Albatross	TEP	2.43	2.33	High	Species is subject to a TAP	Guideline 7	Species has a TAP in place with a high degree of confidence in the effectiveness of the mitigation measures. The fishery is compliant with the TAP in not exceeding catch rates of 0.05 birds per 1000 hooks. Effort (no. of hooks) is low in the WTBF (for the 2006/07 season [1st July 2006 - present] a total of 388,539 hooks were set in the WTBF). Mitigation measures such as tori line use, night setting and using thawed bait have reduced seabird catch. These reduce the encounterability of seabirds to hooks.	Low
							None	Guideline 5	There has been an adequate level of observer coverage in the fishery. Due to low fishing effort over recent years the observer coverage has been variable ranging from 2 to 16%, however averaging 6.8% over the past 5 years. Total observer interaction data for this species was 8 with a negligible level of cryptic mortality. Species has a high susceptibility of 2.33 so reduce susceptibility from 3-2.	
Marine Bird	Thalassarche chrysostoma	Grey-headed Albatross	TEP	2.43	2.33	High	Species is subject to a TAP	Guideline 7	Species has a TAP in place with a high degree of confidence in the effectiveness of the mitigation measures. The fishery is compliant with the TAP in not exceeding catch rates of 0.05 birds per 1000 hooks. Effort (no. of hooks) is low in the WTBF (for the 2006/07 season [1st July 2006 - present] a total of 388,539 hooks were set in the WTBF). Mitigation measures such as tori line use, night setting and using thawed bait have reduced seabird catch. These reduce the encounterability of seabirds to hooks.	Med
							None	Guideline 5	There has been an adequate level of observer coverage in the fishery. Due to low fishing effort over recent years the observer coverage has been variable ranging from 2 to 16%, however averaging 6.8% over the past 5 years. Total observer interaction data for this species was 0 with a negligible level of cryptic mortality. Species has a high susceptibility of 2.33 so reduce susceptibility from 3-1.	
Marine Bird	Thalassarche melanophrys	Black-browed Albatross	TEP	2.43	2.33	High	Species is subject to a TAP	Guideline 7	Species has a TAP in place with a high degree of confidence in the effectiveness of the mitigation measures. The fishery is compliant with the TAP in not exceeding catch rates of 0.05 birds per 1000 hooks. Effort (no. of hooks) is low in the WTBF (for the 2006/07 season [1st July 2006 - present] a total of 388,539 hooks were set in the WTBF). Mitigation measures such as tori line use, night setting and using thawed bait have reduced seabird catch. These reduce the encounterability of seabirds to hooks.	Low

										There has been an adequate level of observer coverage in the fishery. Due to low fishing effort over recent years the observer coverage has been variable ranging from 2 to 16%, however averaging 6.8% over the past 5 years. Total observer interaction data for this species was zero with a negligible level of cryptic mortality. Species has a high susceptibility of 2.33 so reduce susceptibility from 3-1.			
Marine Bird	Phoebetria fusca	Sooty Albatross	TEP	2.29	2.33	High	None	Guideline 5		Species is subject to a TAP	Guideline 7	Species has a TAP in place with a high degree of confidence in the effectiveness of the mitigation measures. The fishery is compliant with the TAP in not exceeding catch rates of 0.05 birds per 1000 hooks. Effort (no. of hooks) is low in the WTBF (for the 2006/07 season [1st July 2006 - present] a total of 388,539 hooks were set in the WTBF). Mitigation measures such as tori line use, night setting and using thawed bait have reduced seabird catch. These reduce the encounterability of seabirds to hooks.	Low
Marine Bird	Thalassarche chlororhynchos	Atlantic Yellow-nosed Albatross	TEP	2.29	2.33	High	Species is subject to a TAP	Guideline 7		Species has a TAP in place with a high degree of confidence in the effectiveness of the mitigation measures. The fishery is compliant with the TAP in not exceeding catch rates of 0.05 birds per 1000 hooks. Effort (no. of hooks) is low in the WTBF (for the 2006/07 season [1st July 2006 - present] a total of 388,539 hooks were set in the WTBF). Mitigation measures such as tori line use, night setting and using thawed bait have reduced seabird catch. These reduce the encounterability of seabirds to hooks.		Med	
Marine Mammal	Globicephala melas	Long-finned Pilot Whale	TEP	2.86	1.44	High	None	Guideline 5		There has been an adequate level of observer coverage in the fishery. Due to low fishing effort over recent years the observer coverage has been variable ranging from 2 to 16%, however averaging 6.8% over the past 5 years. Total observer interaction data for this species was zero with a negligible level of cryptic mortality. Species has a low susceptibility of 1.44 so reduce risk score from High to Low.		Low	
Marine Mammal	Mesoplodon bowdoini	Andrew's Beaked Whale	TEP	2.86	1.44	High	None	Guideline 5		There has been an adequate level of observer coverage in the fishery. Due to low fishing effort over recent years the observer coverage has been variable ranging from 2 to 16%, however averaging 6.8% over the past 5 years. Total observer interaction data for this species was zero with a negligible level of cryptic mortality. Species has a low susceptibility of 1.44 so reduce risk score from High to Low.		Low	
Marine Mammal	Mesoplodon ginkodens	Ginkgo Beaked Whale	TEP	2.86	1.44	High	None	Guideline 5		There has been an adequate level of observer coverage in the fishery. Due to low fishing effort over recent years the observer coverage has been variable ranging from 2 to 16%, however averaging 6.8% over the past 5 years. Total observer interaction data for this species was zero with a negligible level of cryptic mortality. Species has a low susceptibility of 1.44 so reduce risk score from High to Low.		Low	
Marine Mammal	Mesoplodon mirus	True's Beaked Whale	TEP	2.86	1.44	High	None	Guideline 5		There has been an adequate level of observer coverage in the fishery. Due to low fishing effort over recent years the observer coverage has been variable ranging from 2 to 16%, however averaging 6.8% over the past 5 years. Total observer interaction data for this species was zero with a negligible level of cryptic mortality. Species has a low susceptibility of 1.44 so reduce risk score from High to Low.		Low	
Marine Mammal	Indopacetus pacificus	Longman's Beaked Whale	TEP	3.00	1.07	High	None	Guideline 5		There has been an adequate level of observer coverage in the fishery. Due to low fishing effort over recent years the observer coverage has been variable ranging from 2 to 16%, however averaging 6.8% over the past 5 years. Total observer interaction data for this species was zero with a negligible level of cryptic mortality. Species has a low susceptibility of 1.44 so reduce risk score from High to Low.		Low	

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
TA	0	0	0	0	1	5
TB	0	0	0	0	0	7
DI	0	3	0	0	26	22
BP	0	2	0	0	7	16
TEP	16	11	0	0	130	134
Total	16	16	0	0	164	184



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 most common guidelines used to assess residual risk were Guideline 7 and Guideline 2. Risk scores were reduced under Guideline 7 because the fishery is compliant with the statutory Threat Abatement Plan (TAP) which reduces the encounterability of birds to hooks through line weighting, tori lines, use of thawed bait and prohibition on offal discharge for all vessels. Guideline 2 reduced the risk of shark species because a Level 3 assessment had been completed for those species and found them to be at low risk. Guideline 5 was used to reduce risk of species due to zero observed catch in the past five years. Guideline 3 was used twice to complete productivity attributes for species that were missing values. In total the guidelines were employed 51 times across 32 species.

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).



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