Australian Government

Australian Fisheries Management Authority

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

Report for the Bass Strait Central Zone Scallop Fishery

November 2009

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 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.

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 Bass Strait Central Zone Scallop Fishery (BSCZSF), the results from the Level 2 PSA table are used here to determine the residual risk at this level of assessment. Overall 25 high risk species were assessed of which four remained high risk after applying the residual risk guidelines. The primary reasons why 21 species were reduced from high risk after applying the guidelines was due to additional information being provided in a report from the Tasmanian Aquaculture and Fisheries Institute (TAFI) (Abrantes and Semmens, 2008).

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1. OVERVIEW

1.1. Ecological Risk Management Process

A key component in the Australian Fisheries Management Authority's (AFMA's) move towards ecosystem based fisheries management (EBFM) 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 EBFM 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 EBFM. 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.
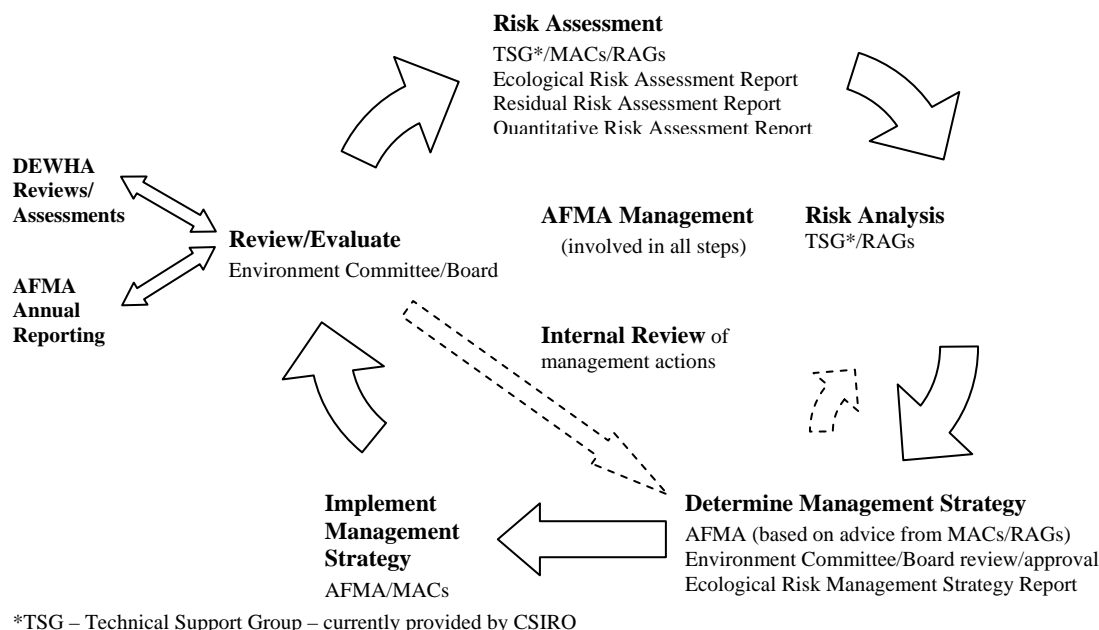

Figure 1 Ecological Risk Management framework

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

Scoping

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Level 1 Assessment Qualitative: Scale Intensity Consequence Analysis (SICA)

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Level 2 Assessment Semi-quantitative: Productivity Susceptibility Analysis (PSA)

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Residual Risk Assessment (of the Level 2 Assessment) Semi-quantitative: Residual Risk Assessment Guidelines

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Level 3 Assessment Quantitative: Sustainability Assessment of Fishing Effects (SAFE) or Full Stock Assessment

Increasing costs and data requirements
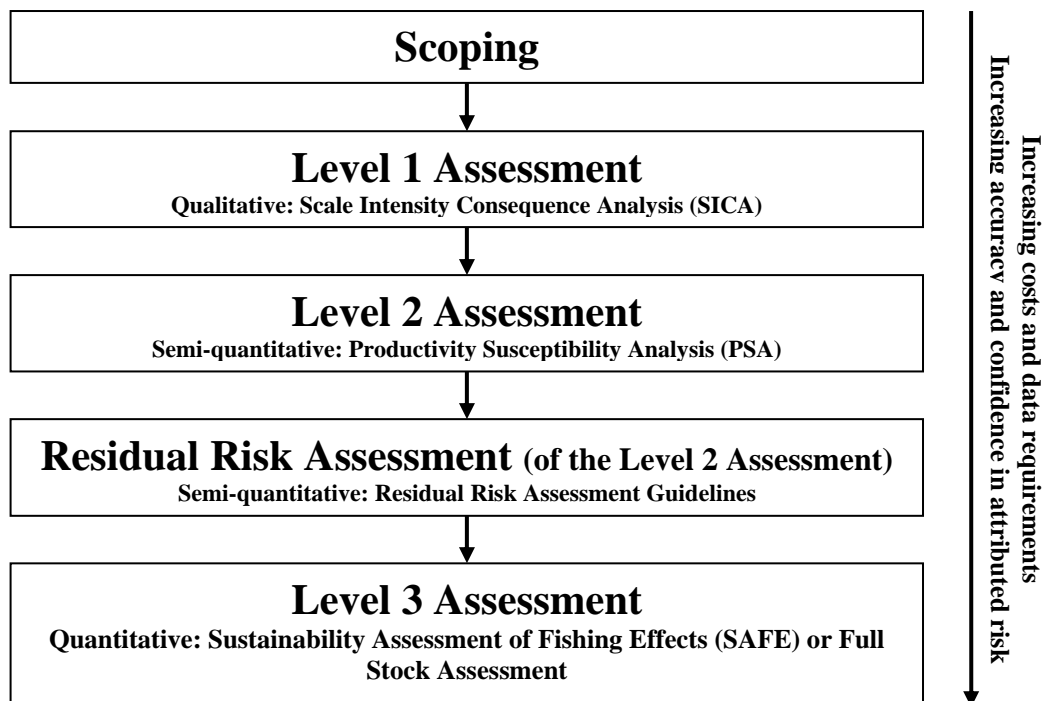Increasing accuracy and confidence in attributed risk

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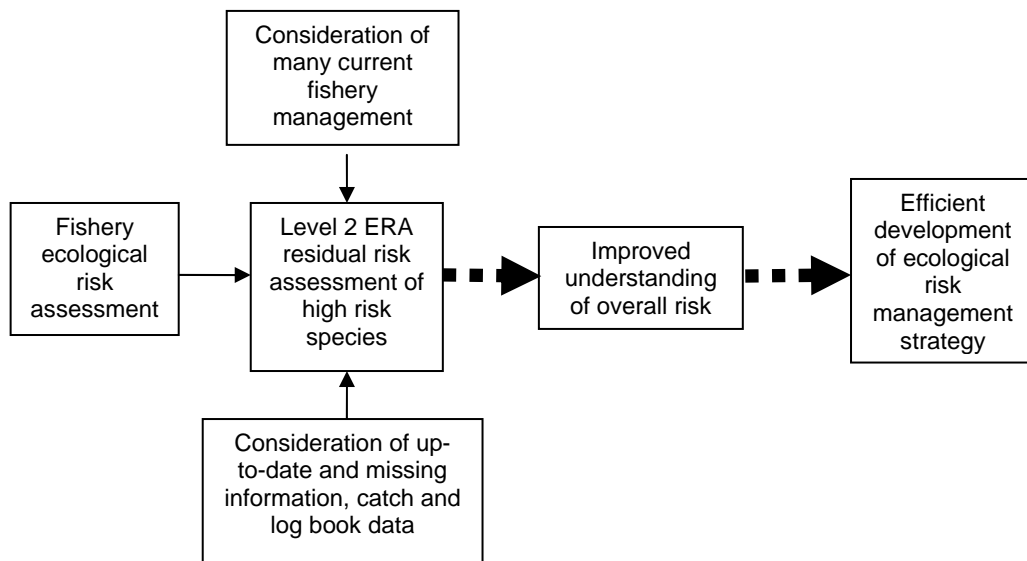
Figure 3 Flow diagram of the Level 2 ERA residual risk process

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 ERA for the BSCZSF	ScallopMAC	August 2006	Fisheries manager, environment staff from AFMA, industry, conservation member, state member	The Level 1 and draft Level 2 ERA results were presented and discussed
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
Final ERA for the BSCZSF	ScallopMAC	27 March 2007	Fisheries manager, industry members, scientific member, conservation member, state government representatives	The final Level 2 ERA was presented and the final high risk species were discussed

Draft Level 2 residual risk assessment for the BSCZSF	ScallopMAC	18 March 2008	Fisheries manager, industry members, scientific member, conservation member, state government representatives	The draft Level 2 residual risk assessment for the BSCZSF was presented and the results were discussed. Additional information to be sought
Additional information for the draft Level 2 ERA residual risk assessment for the BSCZSF	TAFI	June – July 2008	Fisheries manager, senior management officer, TAFI	A report was submitted to AFMA from TAFI (Abrantes and Semmens, 2008). Information contained in this report used to complete the Level 2 ERA residual risk assessment
Final Level 2 residual risk assessment for the BSCZSF	ScallopRAG	27 February and 17 December 2009	Fisheries manager, industry members, scientific members, state government representatives	Report submitted for endorsement. Request for sourcing of additional information. Report subsequently endorsed.
Final Level 2 residual risk assessment for the BSCZSF	ScallopMAC	12-13 January 2010	Fisheries manager, industry members, scientific member, conservation member, state government representatives	Report endorsed.

3. RESULTS

3.1. ERA Results

Fishery Description

Gear:	Dredge
Area:	Central Bass Strait
Depth range:	20-100 m
Fleet size:	103 Statutory Fishing Rights
Effort:	hours or shots unknown (fishery closed at time of assessment)
Landings:	1419 t in 2004
Discard rate:	Low when scallops fished at high density
Main target species:	Commercial scallop *(Pecten fumatus)*
Management:	Quota system
Observer program:	No direct program

Species Assessed

Target species:	1
Byproduct species:	1
Bycatch (discard) species	140
TEP species:	137

Level 1 Results

One ecological component was eliminated at Level 1 (TEP species). There was at least one risk score of 3 – moderate – or above for the remaining components; target, bycatch and byproduct species.

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

- Fishing (direct and indirect impacts on the identified ecological components)

Significant external hazards included: other fisheries in the region, coastal development, and other extractive activities. Risks rated as major or above (risk scores 4 or 5) were all related to direct or indirect impacts from primary fishing operations. Impacts from fishing on target, bycatch and byproduct species components were assessed in more detail at Level 2.

Level 2 Results

A total of 142 species were assessed at Level 2 using the PSA analysis. Of these, 26 were assessed to be at high risk, including the single target species and 25 bycatch species. Of the 142 species assessed, expert over rides were used on 85 species. Of the 26 species assessed to be at high risk, 24 species had more than 3 missing attributes. Most of these high risk species were invertebrates lacking attribute data, meaning they are potential false positives. Effort to gather data for these species is suggested.

Summary

The assessment showed that the ecological impacts of the BSCZSF were confined to the target species. The TEP component was eliminated at Level 1, while the byproduct and bycatch components were eliminated at Level 2.

3.2. Level 2 PSA Residual Risk Results

The Level 2 ERA residual risk assessment summary for BSCZSF is given in **Table 3**. Overall 25 species were assessed: 1 target and 24 bycatch (discard) species. One species, *Bollonaster pectinatus*, was identified as having a synonymous scientific name, *Astropecten pectinatus* (same species, different scientific name). As a general rule of scientific nomenclature the earliest applicable name (i.e. first name to be published) has priority. *B pectinatus* is the accepted species name and as such the treatment of *A. pectinatus* as a separate species has been discontinued.

A summary of the number of species in each category of risk and the guidelines used for each component are given in **Table 4**. The most common guideline used was Guideline 1 which reduced risk based on the sourcing of additional productivity information by TAFI (Abrantes and Semmens, 2008). Overall there has been a change from 25 high risk species prior to the Level 2 ERA residual risk assessment to 4 high residual risk species.

Table 3 Level 2 PSA Residual Risk Results

Taxonomic Group	Common Name	Scientific Name	Role in Fishery	Productivity	Susceptibility	Level 2 ERA Risk Category Score	Current and Planned Management/Assessment for the BSCZSF	Level 2 ERA Residual Risk Guideline(s) Applied	Justification	Level 2 ERA Residual Risk Score
Invertebrate	Commercial scallop	*Pecten fumatus*	TA	1.14	3.00	High	The BSCZSF has implemented a harvest strategy which provides a framework for the sustainable management of the fishery. Scientific surveys conducted annually will inform management decisions in line with this harvest strategy.	6 and 9	Guideline 6: Annual TAC applies to this species determined through the application of the harvest strategy decision rules to survey results. AFMA has confidence that there is a high level of compliance with the catch limit. Overall risk category reduced to medium. Guideline 9: Seasonal closure provides protection during period of highest vulnerability for recruitment. Extensive spatial closures encompass a viable breeding population. These closures substantially restrict the catch of this species. However as the decrease in the proportion of catch can not be quantified in the terms this guideline requires, this guideline has not been applied. Overall risk category reduced to medium.	Medium
Invertebrate	Crassatella	*Eucrassatella kingicola*	DI	2.71	3.00	High	BSCZSF harvest strategy and annual scientific surveys.	1	Guideline 1: Literature review undertaken of missing productive information. Data was identified for 2 attributes - maximum size: 0.8 cm (shell length), trophic level: 2. Productivity risk score reduced to 1.86. Overall risk category remains high.	High
Invertebrate	Southern blue ringed octopus	*Hapalochlaena maculosa*	DI	1.71	3.00	High	BSCZSF harvest strategy and annual scientific surveys.	1	Guideline 1: Literature review undertaken of missing productive information. Data was identified for 7 attributes - average age at maturity: 4 months, maximum age male: 5 months, maximum	High

Taxonomic Group	Common Name	Scientific Name	Role in Fishery	Productivity	Susceptibility	Level 2 ERA Risk Category Score	Current and Planned Management/Assessment for the BSCZSF	Level 2 ERA Residual Risk Guideline(s) Applied	Justification	Level 2 ERA Residual Risk Score
									age female: 1 year, maximum size: 5 cm (mantle length), maximum size at maturity: 4 cm (mantle length), reproductive strategy: brooder, trophic level: 3.5. Productivity and susceptibility risk scores remain unchanged and overall risk category remains high.	
Invertebrate	Snapping shrimp	*Alpheus spp.*	DI	3.00	1.67	High	BSCZSF harvest strategy and annual scientific surveys.	1	Guideline 1: Literature review undertaken of missing productive information. Data was identified for 4 attributes - maximum size: 7 cm (total length), fecundity: 200 eggs/event, reproductive strategy: brooder, trophic level: 2.5. Productivity risk score reduced to 1.86. Overall risk category reduced to low.	Low
Invertebrate	Pebble crab	*Bellidilia undecimspinosa*	DI	2.29	2.33	High	BSCZSF harvest strategy and annual scientific surveys.	1	Guideline 1: Literature review undertaken of missing productive information. Data was identified for 2 attributes - maximum size: 3.8 cm (carapace width), trophic level: 2.5. Productivity risk score reduced to 2.00 and susceptibility risk score increased to 3.00. Overall risk category remains high.	High
Invertebrate	Black and white seastar	*Luidia australiae*	DI	2.43	3.00	High	BSCZSF harvest strategy and annual scientific surveys.	1 and 3	Guideline 1: Literature review undertaken of missing productive information. Data was identified for 3 attributes - maximum size: 20 cm (arm radius), reproductive strategy: broadcast spawner, trophic level: 3. Productivity risk score reduced to 2.00. Guideline 3: This species also has missing information for	High

Taxonomic Group	Common Name	*Scientific Name*	Role in Fishery	Productivity	Susceptibility	Level 2 ERA Risk Category Score	Current and Planned Management/Assessment for the BSCZSF	Level 2 ERA Residual Risk Guideline(s) Applied	Justification	Level 2 ERA Residual Risk Score
									fecundity. There are closely related species from the genus *Luidia* including *L. sarsi* and *L. ciliaris*. The fecundity of these two species (2-200x10^6 eggs/event) is similar (would be scored the same) and therefore the fecundity attribute risk score is borrowed for this species. Productivity risk score reduced to 1.71. Overall risk category remains high.	
Invertebrate	Sea whip	*Primnoella australasiae*	DI	3.00	1.67	High	BSCZSF harvest strategy and annual scientific surveys.	1	Guideline 1: Literature review undertaken of missing productive information. Data was identified for 2 attributes – maximum size: 70 cm (colony height), trophic level: 2. Productivity risk score reduced to 2.29. Overall risk category reduced to medium.	Medium
Invertebrate	Bryozoan	*Membranipora perfragilis*	DI	3.00	1.67	High	BSCZSF harvest strategy and annual scientific surveys.	1	Guideline 1: Literature review undertaken of missing productive information. Data was identified for 2 attributes – maximum size: 15 cm (colony diameter), trophic level: 2. Productivity risk score reduced to 2.14. Overall risk category reduced to medium.	Medium
Invertebrate	New Holland spindle shell	*Fusinus (Fusinus) novaehollandiae*	DI	2.86	1.67	High	BSCZSF harvest strategy and annual scientific surveys.	1	Guideline 1: Literature review undertaken of missing productive information. Data was identified for 2 attributes – maximum size: 30 cm (shell length), trophic level: 3. Productivity risk score reduced to 2.14. Overall risk category reduced to medium.	Medium
Invertebrate	Sea hare	*Aplysiidae*	DI	3.00	1.22	High	BSCZSF harvest strategy	1	Guideline 1: Literature review	Low

Taxonomic Group	Common Name	Scientific Name	Role in Fishery	Productivity	Susceptibility	Level 2 ERA Risk Category Score	Current and Planned Management/Assessment for the BSCZSF	Level 2 ERA Residual Risk Guideline(s) Applied	Justification	Level 2 ERA Residual Risk Score
		(undifferentiated)				High	and annual scientific surveys.		undertaken of missing productive information. Data was identified for 4 attributes – maximum age: 1 year, reproductive strategy: egg layer, fecundity: 10^5 eggs/event, trophic level: 2. Productivity risk score reduced to 1.71. Overall risk category reduced to low.	Low
Invertebrate	Dog cockle	*Glycymeris (Veletuceta) grayana*	DI	2.71	1.67	High	BSCZSF harvest strategy and annual scientific surveys.	1	Guideline 1: Literature review undertaken of missing productive information. Data was identified for 2 attributes – maximum size: 5 cm (shell length), trophic level: 2. Productivity risk score reduced to 1.86. Overall risk category reduced to low.	Low
Invertebrate	Mud oyster	*Ostrea (Eostrea) angasi*	DI	3.00	1.67	High	BSCZSF harvest strategy and annual scientific surveys.	1	Guideline 1: Literature review undertaken of missing productive information. Data was identified for 5 attributes – maximum size: 18 cm (shell length), size at maturity: 6.8 cm, reproductive strategy: brooder, fecundity: 3×10^5 eggs/event, trophic level: 2. Productivity risk score reduced to 1.71. Overall risk category reduced to low.	Low
Invertebrate	Sand octopus	*Octopus berrima*	DI	2.86	1.67	High	BSCZSF harvest strategy and annual scientific surveys.	1	Guideline 1: Literature review undertaken of missing productive information. Data was identified for 7 attributes – maximum size: 10.6 cm (mantle length), size at maturity male: 2.5 cm (mantle length), size at maturity female: 4 cm (mantle length), maximum age: 2 years, reproductive strategy: brooder, fecundity: 50 eggs/event, trophic level: 3.5. Productivity risk score reduced to	Low

Taxonomic Group	Common Name	Scientific Name	Role in Fishery	Productivity	Susceptibility	Level 2 ERA Risk Category Score	Current and Planned Management/Assessment for the BSCZSF	Level 2 ERA Residual Risk Guideline(s) Applied	Justification	Level 2 ERA Residual Risk Score
						High			1.71. Overall risk category reduced to low.	Low
Invertebrate	Sponge crab	*Lamarckdromia globosa*	DI	2.86	1.67	High	BSCZSF harvest strategy and annual scientific surveys.	1	Guideline 1: Literature review undertaken of missing productive information. Data was identified for 2 attributes – maximum size: 4 cm (carapace width), trophic level: 3. Productivity risk score reduced to 2.14. Overall risk category reduced to medium.	Medium
Invertebrate	Sponge crab	*Dromia wilsoni*	DI	2.86	1.67	High	BSCZSF harvest strategy and annual scientific surveys.	1	Guideline 1: Literature review undertaken of missing productive information. Data was identified for 2 attributes – maximum size: 7 cm (carapace width), trophic level: 3. Productivity risk score reduced to 2.14. Overall risk category reduced to medium.	Medium
Invertebrate	Hairy shore crab	*Pilumnus etherridgei*	DI	2.86	1.67	High	BSCZSF harvest strategy and annual scientific surveys.	1	Guideline 1: Literature review undertaken of missing productive information. Data was identified for 2 attributes – maximum size: 1.7 cm (carapace width), trophic level: 2.25. Productivity risk score reduced to 2.00 and susceptibility risk score reduced to 1.44. Overall risk category reduced to low.	Low
Invertebrate	Great spider crab	*Leptomithrax gaimardii*	DI	2.86	1.67	High	BSCZSF harvest strategy and annual scientific surveys.	1	Guideline 1: Literature review undertaken of missing productive information. Data was identified for 2 attributes – maximum size: 16.5 cm (carapace length), trophic level: 2.5. Productivity risk score reduced to 2.00. Overall risk category reduced to low.	Low
Invertebrate	Swimming	*Liocarcinus*	DI	2.86	1.67	High	BSCZSF harvest strategy	1	Guideline 1: Literature review	Medium

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	crab	*corrugatus*				High	and annual scientific surveys.		undertaken of missing productive information. Data was identified for 2 attributes – maximum size: 4 cm (carapace width), trophic level: 3. Productivity risk score reduced to 2.14. Overall risk category reduced to medium.	Medium
Invertebrate	Red swimmer crab	*Nectocarcinus tuberculosus*	DI	2.86	1.67	High	BSCZSF harvest strategy and annual scientific surveys.	1	Guideline 1: Literature review undertaken of missing productive information. Data was identified for 3 attributes – maximum size: 9 cm (carapace width), size at maturity: 2.5 cm (carapace width), trophic level: 2.5. Productivity risk score reduced to 2.00. Overall risk category reduced to low.	Low
Invertebrate	Seastar	*Bollonaster pectinatus*	DI	2.71	1.67	High	BSCZSF harvest strategy and annual scientific surveys.	1	Guideline 1: Literature review undertaken of missing productive information. Data was identified for 2 attributes – maximum size: 5 cm (arm radius), trophic level: 3. Productivity risk score reduced to 2.00. Overall risk category reduced to low.	Low
Invertebrate	Ocellate seastar	*Nectria ocellata*	DI	3.00	1.67	High	BSCZSF harvest strategy and annual scientific surveys.	1	Guideline 1: Literature review undertaken of missing productive information. Data was identified for 3 attributes – maximum size: 13 cm (arm radius), reproductive strategy: broadcast spawner, trophic level: 3. Productivity risk score reduced to 2.00. Overall risk category reduced to low.	Low
Invertebrate	Common urchin	*Heliocidaris erythrogramma*	DI	3.00	1.67	High	BSCZSF harvest strategy and annual scientific surveys.	1	Guideline 1: Literature review undertaken of missing productive information. Data was identified for 8 attributes – maximum size:	Low

Taxonomic Group	Common Name	Scientific Name	Role in Fishery	Productivity	Susceptibility	Level 2 ERA Risk Category Score	Current and Planned Management/Assessment for the BSCZSF	Level 2 ERA Residual Risk Guideline(s) Applied	Justification	Level 2 ERA Residual Risk Score
						High			10.6 cm (test diameter), size at maturity male: 2.7 cm (test diameter), size at maturity female: 3.2 cm (test diameter), maximum age: 37 years, age at maturity: 4 years, fecundity: 2,000 eggs/event, reproductive strategy: broadcast spawner, trophic level: 2. Productivity risk score reduced to 1.43. Overall risk category reduced to low.	Low
Invertebrate	Sea urchin	*Holopneustes inflatus*	DI	3.00	1.67	High	BSCZSF harvest strategy and annual scientific surveys.	1	Guideline 1: Literature review undertaken of missing productive information. Data was identified for 3 attributes – maximum size: 7 cm (test diameter), reproductive strategy: broadcast spawner, trophic level: 2. Productivity risk score reduced to 1.86. Overall risk category reduced to low.	Low
Invertebrate	Sea squirt	*Herdmania momus*	DI	3.00	1.67	High	BSCZSF harvest strategy and annual scientific surveys.	1	Guideline 1: Literature review undertaken of missing productive information. Data was identified for 5 attributes – maximum size: 20 cm (height), size at maturity: 5 cm (height), fecundity: 10,000 eggs/event, reproductive strategy: brooder, trophic level: 2. Productivity risk score reduced to 1.86. Overall risk category reduced to low.	Low
Invertebrate	Colonial ascidian	*Polycitor giganteus*	DI	2.71	1.67	High	BSCZSF harvest strategy and annual scientific surveys.	1	Guideline 1: Literature review undertaken of missing productive information. Data was identified for 3 attributes – maximum size: 30 cm (colony height), reproductive strategy: brooder, trophic level: 2. Productivity risk score reduced to 2.00. Overall	Low

Taxonomic Group	Common Name	Scientific Name	Role in Fishery	Productivity	Susceptibility	Level 2 ERA Risk Category Score	Current and Planned Management/Assessment for the BSCZSF	Level 2 ERA Residual Risk Guideline(s) Applied	Justification	Level 2 ERA Residual Risk Score
						Red			risk category reduced to low.	Green
Chondrichthyan	Draughtboard Shark	*Cephaloscyllium laticeps*	DI	2.57	1.67	Medium	BSCZSF harvest strategy and annual scientific surveys.	N/A	N/A	Medium
Chondrichthyan	Smooth stingray	*Dasyatis brevicaudata*	DI	2.29	1.67	Medium	BSCZSF harvest strategy and annual scientific surveys.	N/A	N/A	Medium
Chondrichthyan	Thornback skate	*Dipturus lemprieri*	DI	1.86	2.33	Medium	BSCZSF harvest strategy and annual scientific surveys.	N/A	N/A	Medium
Chondrichthyan	Whitley's (melbourne) skate	*Dipturus whitleyi*	DI	2.43	1.44	Medium	BSCZSF harvest strategy and annual scientific surveys.	N/A	N/A	Medium
Chondrichthyan	Port Jackson shark	*Heterodontus portusjacksoni*	DI	2.29	1.67	Medium	BSCZSF harvest strategy and annual scientific surveys.	N/A	N/A	Medium
Chondrichthyan	Common stingaree	*Trygonoptera testacea*	DI	2.29	1.67	Medium	BSCZSF harvest strategy and annual scientific surveys.	N/A	N/A	Medium
Chondrichthyan	Fiddler ray	*Trygonorrhina fasciata*	DI	2.29	1.67	Medium	BSCZSF harvest strategy and annual scientific surveys.	N/A	N/A	Medium
Invertebrate	Doughboy scallop	*Mimachlamys asperrima*	BP	1.57	2.33	Medium	BSCZSF harvest strategy and annual scientific surveys.	N/A	N/A	Medium
Invertebrate	Stone crab	*Actaea peronii peronii*	DI	2.29	1.67	Medium	BSCZSF harvest strategy and annual scientific surveys.	N/A	N/A	Medium
Invertebrate	Brazier's auger	*Acuminia brazieri*	DI	2.29	1.67	Medium	BSCZSF harvest strategy and annual scientific surveys.	N/A	N/A	Medium
Invertebrate	Lace coral : bryozoan	*Adeana cellulosa*	DI	2.71	1.22	Medium	BSCZSF harvest strategy and annual scientific	N/A	N/A	Medium

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						Medium	surveys.			Medium
Invertebrate	Temnopleurid urchin	*Amblypneustes ovum*	DI	2.14	1.67	Medium	BSCZSF harvest strategy and annual scientific surveys.	N/A	N/A	Medium
Invertebrate	Bass triton	*Argobuccinum bassi*	DI	2.29	1.67	Medium	BSCZSF harvest strategy and annual scientific surveys.	N/A	N/A	Medium
Invertebrate	Umbilicated top shell	*Astele (Astele) subcarinatum*	DI	2.29	1.67	Medium	BSCZSF harvest strategy and annual scientific surveys.	N/A	N/A	Medium
Invertebrate	Razor clam	*Atrina (Atrina) tasmanica*	DI	2.14	1.67	Medium	BSCZSF harvest strategy and annual scientific surveys.	N/A	N/A	Medium
Invertebrate	Nudibranch	*Ceratosoma brevicaudatum*	DI	2.29	1.67	Medium	BSCZSF harvest strategy and annual scientific surveys.	N/A	N/A	Medium
Invertebrate	Cone shell	*Conus anemone*	DI	2.86	1.22	Medium	BSCZSF harvest strategy and annual scientific surveys.	N/A	N/A	Medium
Invertebrate	Little basket shell (a cockle)	*Corbula stolata*	DI	2.14	1.67	Medium	BSCZSF harvest strategy and annual scientific surveys.	N/A	N/A	Medium
Invertebrate	11 armed starfish	*Coscinasterias muricata*	DI	2.29	1.67	Medium	BSCZSF harvest strategy and annual scientific surveys.	N/A	N/A	Medium
Invertebrate	Triton	*Cymatium (Monoplex) parthenopeum*	DI	2.86	1.22	Medium	BSCZSF harvest strategy and annual scientific surveys.	N/A	N/A	Medium
Invertebrate	Cowrie	*Cypraea (Notocypraea) comptoni*	DI	2.86	1.22	Medium	BSCZSF harvest strategy and annual scientific surveys.	N/A	N/A	Medium
Invertebrate	Venus shell	*Dosinia caerulea*	DI	2.86	1.22	Medium	BSCZSF harvest strategy and annual scientific	N/A	N/A	Medium

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						Medium	surveys.			Medium
Invertebrate	Gunn's screw shell	*Gazameda gunni*	DI	2.29	1.67	Medium	BSCZSF harvest strategy and annual scientific surveys.	N/A	N/A	Medium
Invertebrate	Dog cockle	*Glycymeris (Glycymeris) striatularis*	DI	2.14	1.67	Medium	BSCZSF harvest strategy and annual scientific surveys.	N/A	N/A	Medium
Invertebrate	Deepwater bug; Wollongong bug	*Ibacus alticrenatus*	DI	2.29	1.67	Medium	BSCZSF harvest strategy and annual scientific surveys.	N/A	N/A	Medium
Invertebrate	Balmain bug	*Ibacus peronii*	DI	2.29	1.67	Medium	BSCZSF harvest strategy and annual scientific surveys.	N/A	N/A	Medium
Invertebrate	Screw shell	*Maoricolpus roseus*	DI	2.86	1.22	Medium	BSCZSF harvest strategy and annual scientific surveys.	N/A	N/A	Medium
Invertebrate	False jingle shell	*Myochama anomoides*	DI	2.29	1.67	Medium	BSCZSF harvest strategy and annual scientific surveys.	N/A	N/A	Medium
Invertebrate	Fan worm	*Myxicola infundibulum*	DI	2.43	1.67	Medium	BSCZSF harvest strategy and annual scientific surveys.	N/A	N/A	Medium
Invertebrate	Brooch shell	*Neotrigonia margaritacea*	DI	2.29	1.67	Medium	BSCZSF harvest strategy and annual scientific surveys.	N/A	N/A	Medium
Invertebrate	Decorator crab	*Notomithrax ursus*	DI	2.29	1.67	Medium	BSCZSF harvest strategy and annual scientific surveys.	N/A	N/A	Medium
Invertebrate	Pale octopus	*Octopus pallidus*	DI	2.29	1.67	Medium	BSCZSF harvest strategy and annual scientific surveys.	N/A	N/A	Medium
Invertebrate	Ophiodermatid	*Ophiarachnella*	DI	2.29	1.67	Medium	BSCZSF harvest strategy	N/A	N/A	Medium

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		ramsayi				Medium	and annual scientific surveys.			Medium
Invertebrate	Brittle star	*Ophiocrossota multispina*	DI	2.43	1.67	Medium	BSCZSF harvest strategy and annual scientific surveys.	N/A	N/A	Medium
Invertebrate	Ophiomyxid	*Ophiomyxa australis*	DI	2.43	1.67	Medium	BSCZSF harvest strategy and annual scientific surveys.	N/A	N/A	Medium
Invertebrate	Ophionereid	*Ophionereis schayeri*	DI	2.14	1.67	Medium	BSCZSF harvest strategy and annual scientific surveys.	N/A	N/A	Medium
Invertebrate	Brittlestar	*Ophioplocus bispinosus*	DI	2.43	1.67	Medium	BSCZSF harvest strategy and annual scientific surveys.	N/A	N/A	Medium
Invertebrate	Ophiotrichid	*Ophiothrix (Ophiothrix) caespitosa*	DI	2.43	1.67	Medium	BSCZSF harvest strategy and annual scientific surveys.	N/A	N/A	Medium
Invertebrate	Sand crab	*Ovalipes australiensis*	DI	2.29	1.67	Medium	BSCZSF harvest strategy and annual scientific surveys.	N/A	N/A	Medium
Invertebrate	Hat urchin	*Peronella peronii*	DI	2.43	1.67	Medium	BSCZSF harvest strategy and annual scientific surveys.	N/A	N/A	Medium
Invertebrate	Echinasterid	*Plectaster decanus*	DI	2.43	1.67	Medium	BSCZSF harvest strategy and annual scientific surveys.	N/A	N/A	Medium
Invertebrate	Cunjevoi	*Pyura stolonifera*	DI	2.14	1.67	Medium	BSCZSF harvest strategy and annual scientific surveys.	N/A	N/A	Medium
Invertebrate	Sea pen	*Sarcoptilus grandis*	DI	2.43	1.67	Medium	BSCZSF harvest strategy and annual scientific surveys.	N/A	N/A	Medium
Invertebrate	Stichopodid	*Stichopus mollis*	DI	2.14	1.67	Medium	BSCZSF harvest strategy	N/A	N/A	Medium

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						Medium	and annual scientific surveys.			Medium
Invertebrate	Ridged sponge crab	*Stimdromia lateralis*	DI	2.29	1.67	Medium	BSCZSF harvest strategy and annual scientific surveys.	N/A	N/A	Medium
Invertebrate	Hermit crab	*Strigopagurus strigimanus*	DI	2.29	1.67	Medium	BSCZSF harvest strategy and annual scientific surveys.	N/A	N/A	Medium
Invertebrate	False cockle	*Venericardia amabilis*	DI	2.71	1.22	Medium	BSCZSF harvest strategy and annual scientific surveys.	N/A	N/A	Medium
Invertebrate	Friendly hermit crab	*Paguristes tuberculatus*	DI	2.29	1.67	Medium	BSCZSF harvest strategy and annual scientific surveys.	N/A	N/A	Medium
Invertebrate	Whelk	*Penion maximus*	DI	2.29	1.67	Medium	BSCZSF harvest strategy and annual scientific surveys.	N/A	N/A	Medium
Invertebrate	Maori octopus	*Pinnoctopus cordiformis (syn Octopus maorum)*	DI	2.29	1.67	Medium	BSCZSF harvest strategy and annual scientific surveys.	N/A	N/A	Medium
Teleost	Painted stinkfish	*Eocallionymus papilio*	DI	1.43	2.33	Medium	BSCZSF harvest strategy and annual scientific surveys.	N/A	N/A	Medium
Teleost	Sandfish	*Gonorynchus greyi*	DI	2.14	1.67	Medium	BSCZSF harvest strategy and annual scientific surveys.	N/A	N/A	Medium
Teleost	Cobbler	*Gymnapistes marmoratus*	DI	1.71	2.33	Medium	BSCZSF harvest strategy and annual scientific surveys.	N/A	N/A	Medium
Teleost	Brown-striped leatherjacket	*Meuschenia australis*	DI	1.29	2.33	Medium	BSCZSF harvest strategy and annual scientific surveys.	N/A	N/A	Medium

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Teleost	Ruddy gurnard perch	*Neosebastes scorpaenoides*	DI	2.14	1.67	Medium	BSCZSF harvest strategy and annual scientific surveys.	N/A	N/A	Medium
Teleost	Serpent eel	*Ophisurus serpens*	DI	2.57	1.22	Medium	BSCZSF harvest strategy and annual scientific surveys.	N/A	N/A	Medium
Teleost	Silverbelly	*Parequula melbournensis*	DI	1.43	2.33	Medium	BSCZSF harvest strategy and annual scientific surveys.	N/A	N/A	Medium
Teleost	Short-finned worm eel	*Scolecenchelys australis*	DI	2.14	1.67	Medium	BSCZSF harvest strategy and annual scientific surveys.	N/A	N/A	Medium
Chondrichthyan	Little numbfish	*Narcine tasmaniensis*	DI	2.00	1.67	Low	BSCZSF harvest strategy and annual scientific surveys.	N/A	N/A	Low
Chondrichthyan	Banded stingaree	*Urolophus cruciatus*	DI	1.86	1.67	Low	BSCZSF harvest strategy and annual scientific surveys.	N/A	N/A	Low
Chondrichthyan	Sparsely-spotted stingaree	*Urolophus paucimaculatus*	DI	1.71	1.67	Low	BSCZSF harvest strategy and annual scientific surveys.	N/A	N/A	Low
Invertebrate	Wavy volute	*Amoria undulata*	DI	2.29	1.22	Low	BSCZSF harvest strategy and annual scientific surveys.	N/A	N/A	Low
Invertebrate	Large whelk	*Austrosipho maxima*	DI	2.29	1.22	Low	BSCZSF harvest strategy and annual scientific surveys.	N/A	N/A	Low
Invertebrate	Barnacle	*Balanus trigonus*	DI	2.00	1.02	Low	BSCZSF harvest strategy and annual scientific surveys.	N/A	N/A	Low
Invertebrate	Wedding-cake cockle	*Bassina (Callanaitis) disjecta*	DI	2.14	1.22	Low	BSCZSF harvest strategy and annual scientific surveys.	N/A	N/A	Low

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Invertebrate	Triton	*Cabestana spengleri*	DI	2.29	1.22	Low	BSCZSF harvest strategy and annual scientific surveys.	N/A	N/A	Low
Invertebrate	Triton	*Charonia lampas rubicunda*	DI	2.29	1.22	Low	BSCZSF harvest strategy and annual scientific surveys.	N/A	N/A	Low
Invertebrate	Top shell	*Clanculus undatus*	DI	2.29	1.22	Low	BSCZSF harvest strategy and annual scientific surveys.	N/A	N/A	Low
Invertebrate	Umbilicated cowry	*Cypraea (Umbilia) hesitata*	DI	2.29	1.22	Low	BSCZSF harvest strategy and annual scientific surveys.	N/A	N/A	Low
Invertebrate	Volute	*Ericusa sowerbyi*	DI	2.29	1.22	Low	BSCZSF harvest strategy and annual scientific surveys.	N/A	N/A	Low
Invertebrate	Lamp shell	*Magellania flavacens*	DI	2.29	1.22	Low	BSCZSF harvest strategy and annual scientific surveys.	N/A	N/A	Low
Invertebrate	Eastern king prawn	*Melicertus plebejus*	DI	1.14	1.67	Low	BSCZSF harvest strategy and annual scientific surveys.	N/A	N/A	Low
Invertebrate	Arrow squid	*Nototodarus gouldi*	DI	1.43	1.44	Low	BSCZSF harvest strategy and annual scientific surveys.	N/A	N/A	Low
Invertebrate	Venus shell	*Placamen placidum*	DI	2.29	1.22	Low	BSCZSF harvest strategy and annual scientific surveys.	N/A	N/A	Low
Invertebrate	Tulip shell	*Pleuroploca australasia*	DI	2.29	1.22	Low	BSCZSF harvest strategy and annual scientific surveys.	N/A	N/A	Low
Invertebrate	Pear helmet	*Semicassis pyrum*	DI	2.29	1.22	Low	BSCZSF harvest strategy and annual scientific surveys.	N/A	N/A	Low

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Invertebrate	Half-grained helmet	*Semicassis (Antephalium) semigranosum*	DI	2.29	1.22	Low	BSCZSF harvest strategy and annual scientific surveys.	N/A	N/A	Low
Invertebrate	Helmut shell	*Semicassis (Semicassis) pyrum*	DI	2.29	1.22	Low	BSCZSF harvest strategy and annual scientific surveys.	N/A	N/A	Low
Invertebrate	Southern calamari	*Sepioteuthis australis*	DI	1.43	1.67	Low	BSCZSF harvest strategy and annual scientific surveys.	N/A	N/A	Low
Invertebrate	Venus shell	*Tawera gallinula*	DI	2.29	1.22	Low	BSCZSF harvest strategy and annual scientific surveys.	N/A	N/A	Low
Invertebrate	Venus shell	*Tawera lagopus*	DI	2.29	1.22	Low	BSCZSF harvest strategy and annual scientific surveys.	N/A	N/A	Low
Invertebrate	Fan-like dog cockle	*Tucetona flabellata*	DI	2.14	1.22	small	BSCZSF harvest strategy and annual scientific surveys.	N/A	N/A	Low
Teleost	Bridled leatherjacket	*Acanthaluteres spilomelanurus*	DI	1.00	1.67	Low	BSCZSF harvest strategy and annual scientific surveys.	N/A	N/A	Low
Teleost	Toothbrush leatherjacket	*Acanthaluteres vittiger*	DI	1.00	2.33	Low	BSCZSF harvest strategy and annual scientific surveys.	N/A	N/A	Low
Teleost	Sea moth	*Acanthopegasus lancifer/Pegasus lancifer*	DI	2.00	1.67	Low	BSCZSF harvest strategy and annual scientific surveys.	N/A	N/A	Low
Teleost	Spotted flounder	*Ammotretis lituratus*	DI	1.29	1.67	Low	BSCZSF harvest strategy and annual scientific surveys.	N/A	N/A	Low
Teleost	Shaw's cowfish	*Aracana aurita*	DI	2.00	1.67	Low	BSCZSF harvest strategy and annual scientific surveys.	N/A	N/A	Low

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Teleost	Ornate cowfish	*Aracana ornata*	DI	2.00	1.67	Low	BSCZSF harvest strategy and annual scientific surveys.	N/A	N/A	Low
Teleost	Mueller's flounder	*Arnoglossus muelleri*	DI	1.43	1.67	Low	BSCZSF harvest strategy and annual scientific surveys.	N/A	N/A	Low
Teleost	Butterfly perch	*Caesioperca lepidoptera*	DI	1.29	1.67	Low	BSCZSF harvest strategy and annual scientific surveys.	N/A	N/A	Low
Teleost	Barber perch	*Caesioperca rasor*	DI	1.29	1.67	Low	BSCZSF harvest strategy and annual scientific surveys.	N/A	N/A	Low
Teleost	Silver dory	*Cyttus australis*	DI	1.29	1.67	Low	BSCZSF harvest strategy and annual scientific surveys.	N/A	N/A	Low
Teleost	Globe fish	*Diodon nicthemerus*	DI	1.57	1.67	Low	BSCZSF harvest strategy and annual scientific surveys.	N/A	N/A	Low
Teleost	Castlenau's wrasse	*Dotalabrus aurantiacus*	DI	1.29	1.44	Low	BSCZSF harvest strategy and annual scientific surveys.	N/A	N/A	Low
Teleost	Broad sandfish	*Enigmapercis reducta*	DI	1.43	1.67	Low	BSCZSF harvest strategy and annual scientific surveys.	N/A	N/A	Low
Teleost	Velvet leatherjacket	*Eubalichthys gunnii*	DI	1.00	1.67	Low	BSCZSF harvest strategy and annual scientific surveys.	N/A	N/A	Low
Teleost	Mosaic leatherjacket	*Eubalichthys mosaicus*	DI	1.14	1.67	Low	BSCZSF harvest strategy and annual scientific surveys.	N/A	N/A	Low
Teleost	Common stinkfish	*Foetorepus calauropomus*	DI	1.43	1.67	Low	BSCZSF harvest strategy and annual scientific surveys.	N/A	N/A	Low

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Teleost	Ocean perch - inshore	*Helicolenus percoides*	DI	1.86	1.67	Low	BSCZSF harvest strategy and annual scientific surveys.	N/A	N/A	Low
Teleost	Half-banded sea perch	*Hypoplectrodes maccullochi*	DI	1.29	1.44	Low	BSCZSF harvest strategy and annual scientific surveys.	N/A	N/A	Low
Teleost	Common stargazer	*Kathetostoma laeve*	DI	2.00	1.67	Low	BSCZSF harvest strategy and annual scientific surveys.	N/A	N/A	Low
Teleost	Grooved gurnard	*Lepidotrigla modesta*	DI	1.29	1.67	Low	BSCZSF harvest strategy and annual scientific surveys.	N/A	N/A	Low
Teleost	Spiny gurnard	*Lepidotrigla papilio*	DI	1.29	1.67	Low	BSCZSF harvest strategy and annual scientific surveys.	N/A	N/A	Low
Teleost	Butterfly gurnard	*Lepidotrigla vanessa*	DI	1.29	1.67	Low	BSCZSF harvest strategy and annual scientific surveys.	N/A	N/A	Low
Teleost	Crested flounder	*Lophonectes gallus*	DI	1.29	1.67	Low	BSCZSF harvest strategy and annual scientific surveys.	N/A	N/A	Low
Teleost	Velvet leatherjacket	*Meuschenia scaber*	DI	1.29	1.67	Low	BSCZSF harvest strategy and annual scientific surveys.	N/A	N/A	Low
Teleost	Jackass Morwong	*Nemadactylus macropterus*	DI	1.43	1.67	Low	BSCZSF harvest strategy and annual scientific surveys.	N/A	N/A	Low
Teleost	Flathead	*Neoplatycephalus richardsoni*	DI	1.29	1.67	Low	BSCZSF harvest strategy and annual scientific surveys.	N/A	N/A	Low
Teleost	Rosy wrasse	*Pseudolabrus mortonii*	DI	1.29	1.22	Low	BSCZSF harvest strategy and annual scientific surveys.	N/A	N/A	Low

Taxonomic Group	Common Name	Scientific Name	Role in Fishery	Productivity	Susceptibility	Level 2 ERA Risk Category Score	Current and Planned Management/Assessment for the BSCZSF	Level 2 ERA Residual Risk Guideline(s) Applied	Justification	Level 2 ERA Residual Risk Score
Teleost	Bearded rock cod	*Pseudophycis barbata*	DI	1.86	1.22	Low	BSCZSF harvest strategy and annual scientific surveys.	N/A	N/A	Low
Teleost	Latchet	*Pterygotrigla polyommata*	DI	1.29	1.67	Low	BSCZSF harvest strategy and annual scientific surveys.	N/A	N/A	Low
Teleost	Greenback flounder	*Rhombosolea tapirina*	DI	1.29	1.67	Low	BSCZSF harvest strategy and annual scientific surveys.	N/A	N/A	Low
Teleost	Red Rock Cod	*Scorpaena papillosa*	DI	1.43	1.22	Low	BSCZSF harvest strategy and annual scientific surveys.	N/A	N/A	Low
Teleost	School whiting	*Sillago bassensis*	DI	1.14	1.67	Low	BSCZSF harvest strategy and annual scientific surveys.	N/A	N/A	Low
Teleost	Degen's leatherjacket	*Thamnaconus degeni*	DI	1.29	1.67	Low	BSCZSF harvest strategy and annual scientific surveys.	N/A	N/A	Low
Teleost	Many-banded sole	*Zebrias fasciatus*	DI	1.57	1.67	Low	BSCZSF harvest strategy and annual scientific surveys.	N/A	N/A	Low

*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	High Residual Risk	Medium Residual Risk	Low Residual Risk
Target	1	0	0	1	0
Bycatch (discard)	6	14	4	6	14
Total	7	14	4	7	14

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 guideline used to assess residual risk was Guideline 1 as many of the species assessed as high risk were missing productivity information. A study undertaken by TAFI was able to identify much of the missing information through an extensive literature review (Abrantes and Semmens, 2008). Guideline 3 was also applied where closely related species information was borrowed. Guideline 6 was applied in the case of the target species, *Pecten fumatus*, as this species is subject to an annual TAC. This catch limit is determined through the application of comprehensive harvest strategy decision rules to the results of fishery surveys. AFMA has confidence that there is a high level of compliance with the catch limit and as such the overall risk category was reduced to medium. Overall the risk profiles for 21 species were reduced through this process with four remaining as high risk.

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

GLOSSARY

Activity	Refers to any fishing activity.
Actual risk	The real risk posed for a species from fishing activities.
Attribute	A general term for a set of properties relating to the productivity or susceptibility of a particular unit of analysis.
Availability	Used in Level 2 PSA assessment to calculate the impact on an ecological component due to a fishing activity. Considers overlap of fishing effort with a species distribution.
Bycatch	That part of fisher's catch which is returned to the sea either because it has no commercial value or regulations preclude it from being retained and;
	that part of the catch that does not reach the deck of the fishing vessel but is affected by the interaction with the fishing gear.
Byproduct	A non-target species captured in a fishery, that has value to the fisher and be retained for sale.
Catch limit	The vessel catch limit is a limit on the quantity each individual vessel can land per trip or short period of time.
Component	The marine ecosystem is broken down into five components for the risk assessment: target species (TA); byproduct (BI) and bycatch species (DI); threatened, endangered and protected species (TEP); habitats; and ecological communities.
EBFM	Ecosystem-based fisheries management considers the impact that fishing has on all of the aspects of the broader marine ecosystem, not just the target species.
Effort	The total fishing gear in use for a specified period of time.
Encounterability	Used in Level 2 PSA assessment to calculate the impact on an ecological component due to a fishing activity. Considers the likelihood that a species will encounter fishing gear that is deployed within the geographic range of that species (based on two attributes: adult habitat and bathymetry).
EPBC Act	*Environment Protection and Biodiversity Conservation Act (Cth) 1999*
ERA	Ecological risk assessment for the effects of fishing as developed by AFMA and CSIRO.
ERM Framework	Ecological risk management process outlined by AFMA.
False negative	Species assessed to be low risk when they are actually high risk.
False positive	Species assessed to have a high risk when they are actually low risk

Fishery	A related set of fish harvesting activities regulated by an authority (e.g. South-East Trawl Fishery).
Gear	The equipment used for fishing, e.g. gillnet, Danish seine, pelagic longline, midwater trawl, purse seine, trap etc.
Level 1	The level of the ERA assessment which includes a qualitative assessment of scale, intensity, consequence analysis (SICA).
Potential risk	Possible risk as a result of fishing activities
Post Capture Mortality	Used in Level 2 PSA assessment to calculate the impact on an ecological component due to a fishing activity. Considers the condition and subsequent survival of a species that is captured and released (or discarded).
Precautionary	The approach whereby, if there is uncertainty about the risk, risk is assumed to be high, unless there is advice to the contrary.
PSA	Productivity susceptibility analysis for Level 2 assessment of the ecological assessment.
Productivity	This determines the rate at which the unit can recover after potential depletion or damage by the fishing.
Level 2 PSA Residual Risk	In the context of this document residual risk means the residual risk after the Level 2 PSA assessment.
Scoping	A general step in an ERA or the first step in the ERAEF involving the identification of the fishery history, management, methods, scope and activities.
Selectivity	Used in Level 2 PSA assessment to calculate the impact on an ecological component due to a fishing activity. Considers the potential of the gear to capture or retain species.
SICA	Scale, intensity, consequence analysis for the Level 1 assessment.
Spatial management	Fisheries management that encompasses spatial arrangements such as depth closures or area closures.
Susceptibility	Used in Level 2 PSA assessment to calculate the impact on an ecological component due to a fishing activity. The extent of the impact due to the fishing activity, determined by the affect of the fishing activities on the unit.
Unit	The entities for which attributes are scored in the Level 2 analysis. For example, the units of analysis for the Target Species component are individual "species".

APPENDIX A - SUMMARY OF PRODUCTIVITY AND SUSCEPTIBILITY SCORING

Productivity

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

1. Average age of species at maturity;
2. Average size of species at maturity;
3. Average maximum age of species;
4. Average maximum size of species;
5. Fecundity of species;
6. Reproductive strategy of species; and
7. Trophic level: organisms position in the food chain.

Susceptibility

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

1. **Availability**: considers overlap of fishing effort with a species distribution;
2. **Encounterability**: considers the likelihood that a species will encounter fishing gear that is deployed within the geographic range of that species (based on two attributes: adult habitat and bathymetry);
3. **Selectivity**: considers the potential of the gear to capture or retain species; and
4. **Post Capture Mortality**: considers the condition and subsequent survival of a species that is captured and released (or discarded).

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

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