Australian Government
Australian Fisheries Management Authority

Residual Risk Assessment

Teleost and Chondrichthyan Species

Report for the Scalefish Automatic Longline Method of the Gillnet Hook and Trap Sector

2014

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Executive Summary

The Australian Fisheries Management Authority (AFMA) has undertaken detailed ecological risk assessments (ERAs) for all major and minor 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 in fisheries. To support implementation of the ERM framework, AFMA will fully document the risk management strategies 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 risk species as part of the ERM framework.

In early 2007, the residual risk guidelines were developed in consultation with the Commonwealth Scientific and Industrial Research Organisation (CSIRO) and stakeholders to assist AFMA managers in refining the Level 2 Productivity Susceptibility Analysis (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 most current management arrangements. To assist managers, a clear set of decision rules are outlined that are to be applied to individual species.

In 2012, a quantitative Sustainability Assessment for Fishing Effects (SAFE) was completed for all teleost and chondrichthyan species for each major fishing method in the Southern and Eastern Scalefish and Shark Fishery (SESSF). The scalefish automatic longline method used in the gillnet, hook and trap sector (GHAT) was one of the methods assessed. While SAFE analysis is the most quantitative method for assessing potential risk posed to a species by fishing activity, the results do not directly account for all management measures, sometime resulting in an over-estimation of the actual risk, or false-positives, for some species. AFMA has consulted with CSIRO and agreed that it would be appropriate to apply residual risk guidelines and expert overrides to some of those risk scores. This allows management measures, additional research and interaction levels to be taken into account to determine the risk level.

For the scalefish automatic longline sector of the GHAT, SAFE resulted in fifteen species (12 chondrichthyan, 3 teleost) being classified as at risk from the impacts of fishing. In order to apply residual risk guidelines, the productivity and susceptibility scores from the level 2 PSA are used to determine the residual risk at this level of assessment. After application of the residual risk guidelines, seven of the species identified as high risk using

the SAFE analysis remain high. Using these results, an appropriate management strategy will be developed to address the high risk species as a part of AFMA's ERM framework.

1. Overview

1.1 Ecological Risk Management Framework

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 components of the marine environment, the ERAs encompass an ecosystem-based assessment approach. The ERAs 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.

The ERA process is hierarchical, and currently includes three levels of assessment. The first is a Level 1 Scale Intensity Consequence Analysis (SICA), which is a qualitative assessment that broadly looks at which hazards (activities) could lead to a significant impact on species, habitats or communities. The next is a Level 2 Productivity Susceptibility Analysis (PSA) which is a semi-quantitative analysis. Under PSA, risk to a species, habitat or community is based on its susceptibility to fishing, and productivity, or the rate at which the unit can recover after an impact. Level 2 PSA has been completed for all major Commonwealth fisheries. The final Level 3 is quantitative in nature, and can include assessments such as the CSIRO's sustainability assessment for fishing effects (SAFE), or stock assessments for commercially fished species.

Due to the semi-quantitative nature of the Level 2 ERAs, not all risk scores are an accurate representation of actual risk. To account for this and to ensure management effort is not unnecessarily expended on 'false positives', an additional step called a residual risk assessment is included in the ERA process. The residual risk assessment is used to account for current management measures which reduce the level of risk posed by a fishery to species, and adjust risk scores where appropriate. During a detailed review of the ERA methodology, AFMA found that some ERAs did not include all existing management arrangements at the time of assessment. Furthermore, since the initial ERAs were completed in 2007, the management of some fisheries has changed and additional data and information may have become available to provide further detail on the actual level of risk of fishing on a species, habitat or community.

To assist with the implementation of EBFM across all fisheries AFMA has established a process for implementing ecological risk management (ERM) (see Figure 1). This process ensures that a consistent process is followed across fisheries when responding to the ERA outcomes. While this 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 fisheries' responses to the results of ERAs and incorporate other initiatives such as bycatch and discard programs and species-specific management arrangements.

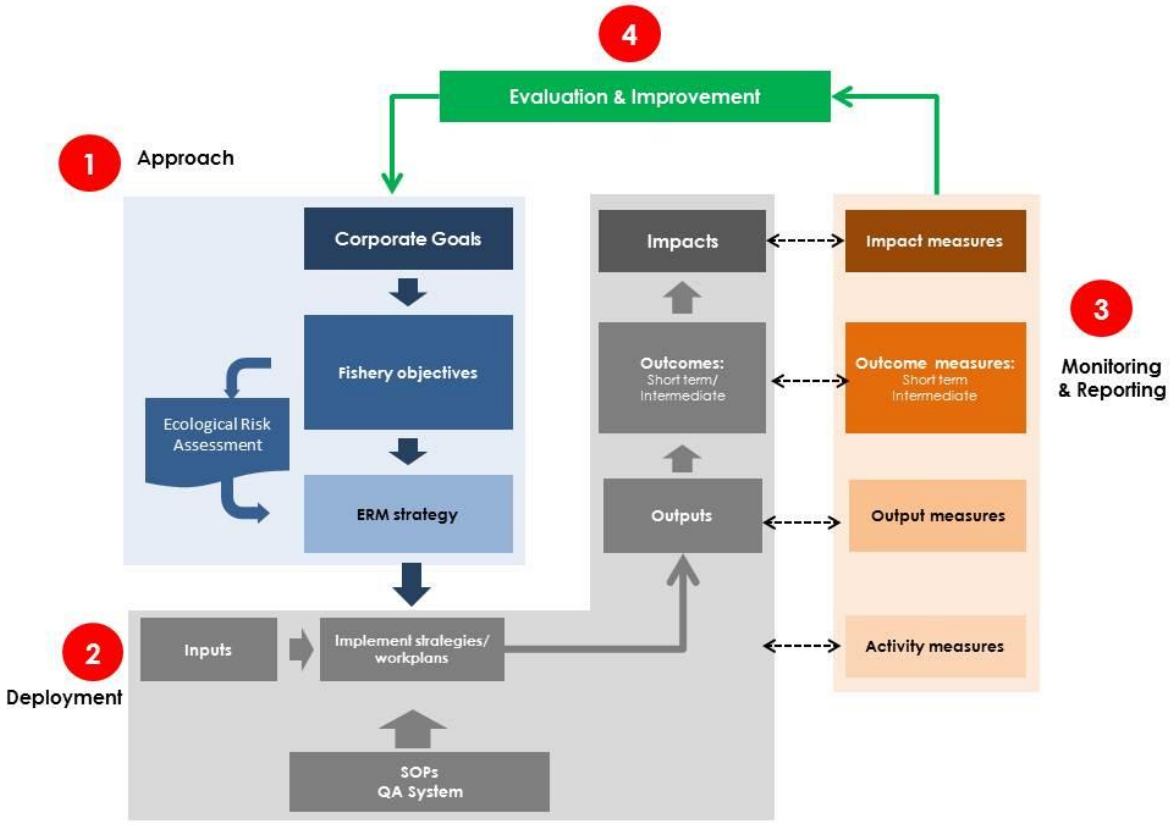

Figure 1 Ecological Risk Management Process Map

1.2 Ecological Risk Assessment Methodology

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

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

The ERA assessment adopts a hierarchical approach (**Figure 2**). With every progressive level, the precision increases along with confidence in the risk scores (noting that not all components of a system progress all the way through the assessment hierarchy). The Level 2 PSA, residual risk assessment and SAFE assessments are detailed below. For the full ERA methodology, including Scoping and Level 1 Scale, Intensity, Consequence, Analysis (SICA), please refer to *Ecological Risk Assessment for Effects of Fishing: Methodology* (Hobday *et al*,2007).

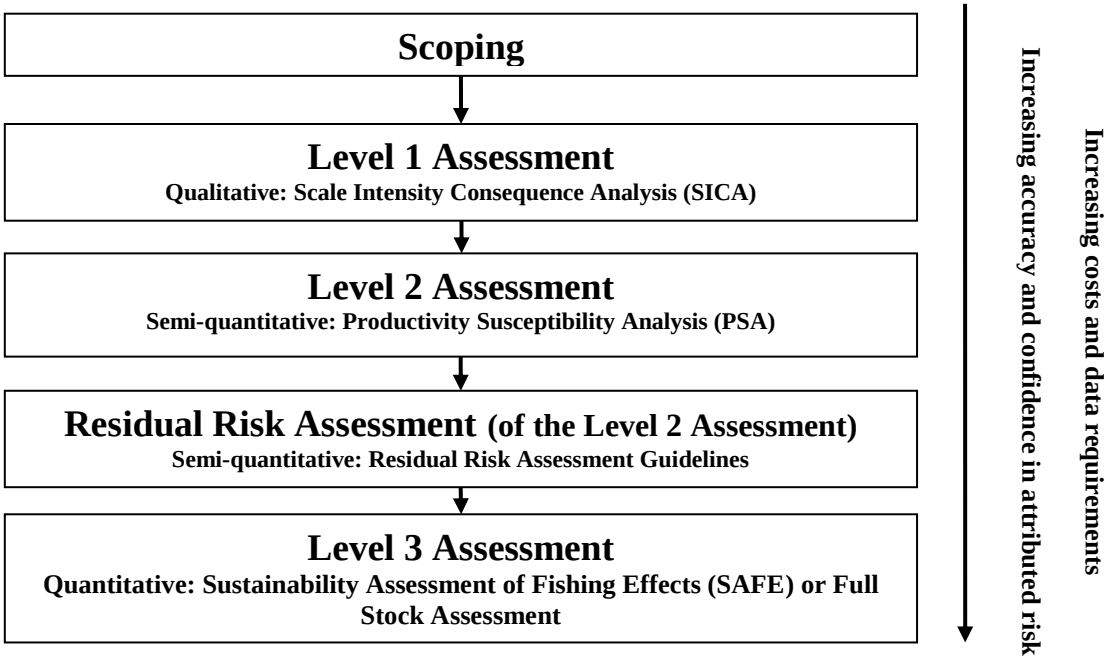

Figure 2 The different levels of risk assessment and the trend in confidence and cost

Level 2 Productivity Susceptibility Analysis (PSA)

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) 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.

The 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'.

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.

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 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.

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. 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, or false-positive, of the actual risk for some species. The management strategies 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 actions or strategies 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).

It may be the case that not all management actions are considered. 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). An example of this is when a species is missing information on its productivity and susceptibility attributes the risk score defaults to high 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. Regardless of their risk scores, AFMA will take all reasonable steps to minimise any future interactions with TEP species through the ERM strategy.

When AFMA reviewed the methodology using example fisheries data in 2007, 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.

Level 2 Residual Risk Analysis of PSA results

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 PSA. Before moving to a SAFE assessment, the residual risks are assessed to account for some of the constraints of the Level 2 PSA (mentioned above). The Level 2 PSA residual risk process incorporates some of the concepts of a Level 3 assessment and is more cost effective than a full SAFE assessment. Furthermore, the Level 2 PSA residual risk results more accurately represent overall risk within a fishery and will help clarify if a higher level assessment is necessary.

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 is applied on a species-by-species basis to determine the 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 are applied to all high risk species by managers in consultation with Resource Assessment Groups (RAG) and Management Advisory Committees (MAC) and fishery experts. Broadly the application processes involved the following steps:

- Sorting the ERA result by high risk, then grouping the high risk species by role (e.g. target, byproduct or discarded species) within the fishery, then by taxonomic group;
- Creating a list of all management arrangements not included in the ERA results for reference when applying the guidelines;
- 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 RAGs and MACs for feedback; and
- Finalising the Level 2 PSA residual risk results for release.

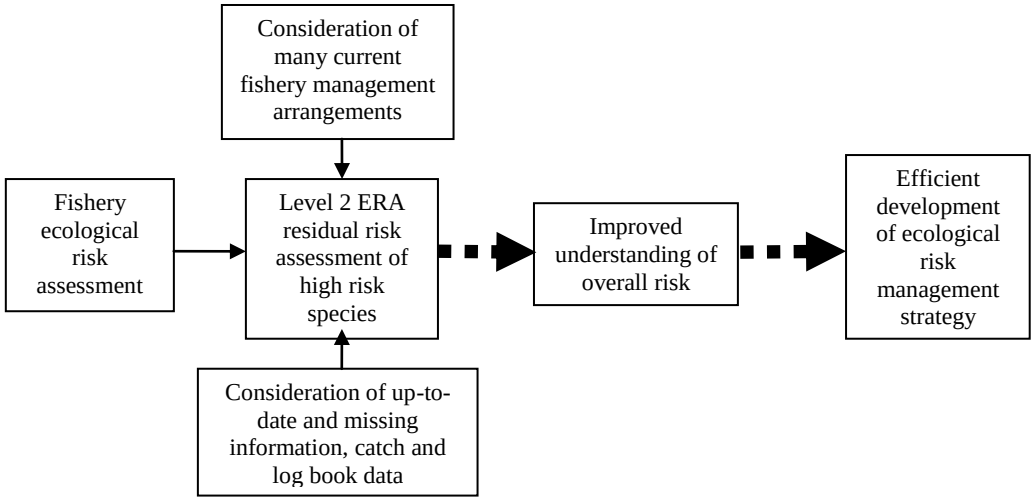

Figure 3. Flow diagram of the Level 2 ERA residual risk process

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.

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) developed by CSIRO to assess multiple species or a fully quantitative assessment of a specific species (similar to a standard stock assessment).

The SAFE methodology can only be applied to teleost (fish) and chondrichthyan (sharks and rays) species as it is difficult to obtain essential growth parameters for other species. For non-teleost and non-chondrichthyan species, the Level 2 PSA residual risk analysis is the highest level of assessment currently available.

1.3 ERA Milestones and Previous ERA Assessments

2001

Funding was received to invest into ecological risk assessments (ERA's). The methodology was developed to be applied to Australian Commonwealth fisheries across 6 years in 2 stages. The first stage (Hobday *et al*. 2004) occurred between 2001 and 2004 and developed the basic methods and approach and applied them to several fisheries managed by the Australian Fisheries Management Authority (AFMA). Stage 2 (Smith *et al.* 2007) occurred between 2004 and 2007 and extended the Ecological Risk Assessment for Effects of Fishing (ERAEF) methods, particularly for Level 2 PSA assessments, and applied the methods to 31 sub-fisheries within 13 of AFMA's managed fisheries.

2007

The report *Ecological Risk Assessment for Effects of Fishing: Report for the Automatic Longline Sub-Fishery of the Commonwealth Gillnet Hook and Trap Sector of the Southern and Eastern Scalefish and Shark Fishery* (Dayley *et al*. 2007) was produced. This report completes 4 stages of the ERA method: Scoping, Level 1, Level 2 and a model based Level 3 analysis.

The residual risk guidelines were developed in consultation with CSIRO and stakeholders to assist AFMA managers in refining the Level 2 PSA results. They were developed to maintain the key features of objectivity and consistency from the ERA process, and to ensure a repeatable and transparent assessment process.

The Level 3 Sustainability Assessment for Fishing Effects (SAFE) method was initially developed for the SESSF in 2007 and applied to teleost and chondrichthyan species impacted by five fishing methods across the SESSF: otter board trawl and Danish seine in the Commonwealth Trawl Sector, otter board trawl in the Great Australian Bight trawl sector, shark gillnet and scalefish automatic longline in the Gillnet, Hook and Trap Sector (Zhou *et al*. 2007).

2010

The report *Residual Risk Assessment of the Level 2 Ecological Risk Assessment Species Results: Report for the Automatic Longline of the Gillnet Hook and Trap Fishery* (AFMA, 2010) was produced. This report uses the results from the Level 2 PSA table and the residual risk guidelines to determine the residual risk category for the species impacted by scalefish automatic longline method.

2012

A Level 2 PSA Residual Risk Analysis of the non-teleost and non-chondrichthyan species was completed (AFMA, 2012). This assessment focussed on species assessed as at high risk in the *2010 Residual Risk Assessment of the Level 2 Ecological Risk Assessment Species Results: Report for the Automatic Longline Fishery* (AFMA, 2010). The aim was to assess whether the ERM framework had been successful in reducing the risk the fishery poses upon the species. This was also a Level 2 PSA residual risk analysis of the non-teleost and non-chondrichthyan species that had been caught or interacted with in the time since the previous ERA was completed

The Level 3 SAFE methodology was updated to include the most recent fishery distribution and effort data, new species from logbook and observer data and the introduction of the Danish seine method into the Great Australian Bight trawl sector (GABT). The analysis was applied to all teleost and chondrichthyan species for six major methods in the SESSF: otter board trawl in the Commonwealth trawl sector, otter board trawl in the Great Australian Bight trawl sector, Danish seine in the Commonwealth Trawl Sector, shark gillnet in the gillnet, hook and trap sector, automatic longline in the gillnet, hook and trap sector, and Danish seine in the Great Australian Bight trawl sector (Zhou *et al.* 2012). The results of this assessment are the basis of this residual risk assessment.

2. 2014 Residual risk analysis

In 2012 a Level 3 SAFE analysis was applied to all teleost and chondrichthyan species in the SESSF regardless of their Level 2 PSA scores. The result of this assessment is a list of high risk species. Without application of the residual risk guidelines, it is likely that a number of the high risk species are false-positives, as management arrangements and bycatch mitigation strategies have not been considered. AFMA has consulted with CSIRO and agreed that it would be appropriate to apply residual risk guidelines and expert overrides to some of those risk scores. This allows management measures and interaction levels to be taken into account to determine the risk level.

As part of the ERA reassessment for the Southern and Eastern Scalefish and Shark Fishery (SESSF) AFMA has applied the residual risk guidelines to all species assessed as high risk in the 2012 SAFE assessment.

AFMA has applied the following methodology:

1. For all species scored as high risk in the 2012 Level 3 SAFE analysis, record the Level 2 PSA risk score from 2007. The productivity and susceptibility scores are unlikely to have changed.

2. Apply the residual risk guidelines to the Level 2 PSA risk scores from 2007.

3. Those species which have had their risk scores downgraded will be removed from the list of priority species to be addressed in the Ecological Risk Management response.

3. Fishery Description

The scalefish automatic longline sector is part of the gillnet hook and trap sector (GHAT) of the larger Commonwealth Southern and Eastern Scalefish and Shark Fishery (SESSF). The area of the scalefish automatic longline sector includes all Commonwealth waters of the Australian Fishing Zone (AFZ) off South Australia, Victoria and Tasmania that are deeper than 183 metres. It also includes waters off southern Queensland (south of Sandy Cape) and New South Wales from approximately the 4,000 m depth contour (60-80 nm from the coast) to the extent of the AFZ. Waters inside this line off the New South Wales and Queensland coasts, and inside 3 nm around South Australia, Victoria and Tasmania, are managed under the jurisdiction of the State Governments.

Current management arrangements restrict fishing by scalefish automatic longline vessels to waters deeper than 183 m to prevent targeting of School and Gummy Shark. A scalefish automatic longline permit allows a maximum of 15 000 hooks at any one time, to target deepwater teleosts. Blue-eye Trevalla and Pink Ling are the primary targets with Ribaldo and Hapuku being other important commercial species.

The major markets for the scalefish automatic longline sector are in southern and eastern Australia. The amount of effort in this sector peaked in 2005 at 9,776,448 hooks set, decreasing to 4,280,916 hooks set in the 2011-12 season.

Fishery Specifics

Gear:	Automatic longline, maximum of 15,000 hooks, Tori line must be used, Best Fishing Gear (BFG) or Mustad auto-longlining systems only.
Area:	Fraser Island to SA/WA border
Depth range:	183m to approximately 700m
Main target species:	Blue-eye Trevalla, Pink Ling

Management:	Input controls: gear restrictions, species specific area closures Output controls: individual transferable quotas

Table 2 Fleet Size, Fishing Effort and Observer Input – 2007-2011. Data Source: ABARES Fish Status Reports 2008 and 2010.

Season	Fleet Size – Number of Scalefish Fishing Concessions*	Fleet Size – Number of Active Vessels*	Effort - Number of Hooks	Observer Program - Number of Hooks
2007-2008	57	-	6,732,100	-
2008-2009	57	-	7,235,460	-
2009-2010	57	22	5,218,613	658,750
2010-2011	57	24	4,882,414	431,070
2011-2012	37	23	4,280,916	103 sea days

*Note that to fish using auto-longline equipment operators require an additional auto-longline permit and these are limited to around 13 permits. The number of active auto-longline boats targeting scalefish has averaged around four between 2007 and 2012 and has dropped to two during 2014.

3.1 Management Arrangements Introduced Since Last ERA

The Upper-Slope Dogfish Management Strategy has been developed by AFMA, in consultation with the fishing industry, scientific experts, conservation NGOs and other stakeholders. Implemented in October 2012, the objectives of the strategy are to rebuild the populations of Harrison's Dogfish (*Centrophorus harissoni)*, and Southern Dogfish (*C. zeehaani).* The strategy also offers some level of protection for Greeneye Spurdog (*Squalus chloroculus*) and Endeavour Dogfish (*Centrophorus moluccensis*). The strategy relies on a network of spatial closures supplemented by a range of operational measures including regulated handling practices, 100 per cent monitoring, move-on provisions and no retention of gulper sharks.

Auto longline operators are required to have a number of mitigation measures in place to reduce interactions with seabirds during both the set and haul. During 2013 additional measures were implemented to assist in reducing seabird mortalities. When hauling gear operators are now required to have a bird excluder device (brickle curtain) deployed at all times. AFMA have implemented an individual responsibility model for seabird interactions which requires operators to set at night for the remainder of a trip if a seabird mortality occurs. If the number of seabird mortalities observed on a vessel exceeds a cumulative rate of 0.01 Seabird per 1000 hooks at any time during the TAP season, that vessel will be required to set at night for the remainder of the TAP season.

Seabird mitigation measures were strengthened further during 2014, with AFMA now requiring all auto longline vessels to have an individual vessel seabird mitigation plan as well as being subject to 100% monitoring achieved through either e-monitoring or an AFMA observer. Operators were also required to achieve a sink rate of 0.3m/sec to a depth of 15m prior to fishing after 1 September 2014.

In 2013 the South-east Commonwealth Marine Reserves Network was established to assist in conserving the regions biodiversity. The network includes 14 marine reserves, offering levels of protection from Multiple Use to Sanctuary Zone. A total of seven marine reserves overlap with the scalefish auto longline fishery and prohibit commercial fishing activity. These areas include:

- Nelson Commonwealth Marine Reserve
- Zeehan Commonwealth Marine Reserve Special Purpose Zone
- Tasman Fracture Commonwealth Marine Reserve Special Purpose Zone
- Huon Commonwealth Marine Reserve Habitat Protection Zone
- South Tasman Rise Commonwealth Marine Reserve
- Freycinet Commonwealth Marine Reserve
- Flinders Commonwealth Marine Reserve

4. Results

Level 1 Scale Intensity Consequence Analysis (SICA)

The following results are derived from the Level 1 assessment undertaken in the *Ecological Risk Assessment for Effects of Fishing: Report for the Automatic Longline Sub-Fishery of the Southern and Eastern Scalefish and Shark Fishery* (Daley *et al*. 2007):

Number of Ecological Units Assessed

Target species:	2
By-product species:	66
Discard species:	26
TEP species:	212
Habitats:	149
Communities:	39

No ecological components were eliminated at Level 1 (there was at least one risk score of 3 – moderate – or above for each component).

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

Those remaining included:

- Fishing (direct impacts on all 5 ecological components and indirect impacts on habitat)
- Translocation of species (impact on species components)
- On-board processing (impact on target species)

Significant external hazards included impacts from other fisheries in the region.

Risks rated as major (risk score 4) were related to direct impacts from primary fishing operations on target species, and risks associated with disease introduction in imported bait on all species components. The latter risks were scored as uncertain. Severe impacts (risk score 5) were confined to impacts of fishing on byproduct/bycatch species.

Impacts from fishing on all species components were assessed in more detail at Level 2.

For more detail regarding scoring refer to the *Ecological Risk Assessment for Effects of Fishing: Methodology* (Hobday *et al*., 2007).

Level 2 Productivity Susceptibility Analysis

Of the 306 species assessed at Level 2 using the PSA analysis, expert/observer overrides were used on 124 species. A total of 56 species were found to be at high risk. Of these, 9 species had more than 3 missing attributes.

Of the 56 high risk species identified in the PSA analysis, 2 were target species, 13 byproduct species, 14 bycatch species, and 27 TEP species. By taxa, 21 were chondrichthyans, 26 marine birds, 8 teleosts and 1 marine mammal.

All except 1 of the 27 high risk TEP species were seabirds, the majority of which are albatross. Seabirds are known as a group to be at risk from line fishing because of their very low productivity and propensity to target bait on hooks. However, mitigation measures as required under the *Threat Abatement Plan (2006) for the incidental catch (or bycatch) of seabirds curing oceanic longline fishing operation* (TAP) are effective in minimising seabird captures in this fishery. The TAP has been in place in this fishery since 2000.

For detailed results and methodology, refer to *Ecological Risk Assessment for the Effects of Fishing. Report for the automatic longline sub-fishery of the Southern and Eastern Scalefish and Shark Fishery* (Daley *et al.*, 2007)

Level 2 PSA Residual Risk (non-teleost and non-chondrichthyans)

The 2012 Level 2 Residual Risk ERA only assessed non-teleost and non-chondrichthyan species and applied the guidelines to species caught during the 2009-2010 and 2010-2011 fishing period, and to species assessed as at high risk in the 2010 Level 2 PSA Residual Risk assessment (AFMA, 2010).

Overall the most common guideline used to assess residual risk was Guideline 7. Twenty six seabird species were assessed as high risk in the Level 2 PSA. All of these species had the risk scores reduced under Guideline 7 as a Threat Abatement Plan (TAP) had been introduced for all bird species which has a high level of compliance within the scalefish auto-longline sector of the gillnet hook and trap sector.

The Australian Fur Seal was added to the assessment because of 59 interactions in 2009. No interactions have been recorded since, and guideline 5, which considers low/negligible interactions, was used to reduce the overall risk to low. Guideline 5 was also used to reduce the risk rating for Hectors Beaked Whale from a high risk rating to a low residual risk rating.

Level 3 Sustainability assessment of fishing effects (SAFE)

The 2012 SAFE assessment was completed for all 161 species (40 chondrichthyan and 1215 teleost) including one new species not previously identified in the scalefish automatic longline sector, regardless of their Level 2 PSA risk score. This is because:

- changes to biological reference points for Teleosts and Chondrichthyans are likely to affect previous risk scores
- the objective was to assess impact in more recent years because fishing effort and distribution may have changed
- the difference costs for doing a SAFE analysis for a few species and doing all species is negligible.

The assessment found that 5 species had an estimated fishing mortality rate greater than F_{crash}, the minimum unsustainable fishing mortality rate which will lead to population extinction in the long term. When uncertainty in both estimated fishing mortality rates and reference points are included in the analysis, 15 species are at least precautionary high risk.

Table 3 High risk species after Level 3 SAFE analysis

Scientific Name	Common Name	Risk Score
Centrophorus harrissoni	Harrison's Dogfish	Extreme High Risk
Centrophorus zeehaani	Southern Dogfish	Extreme High Risk
Dipturus gudgeri	Bight Skate	Extreme High Risk
Squalus chloroculus	Greeneye Spurdog	Extreme High Risk
Deania quadrispinosa	Platypus Shark	Extreme High Risk
Etmopterus lucifer	Blackbelly Lantern Shark	Precautionary Extreme High Risk
Isistius brasiliensis	Cookie-cutter Shark	Precautionary Extreme High Risk
Helicolenus barathri	Bigeye Ocean Perch	Precautionary Extreme High Risk
Cephaloscyllium albipinnum	Whitefin Swell Shark	Precautionary Extreme High Risk
Polyprion oxygeneios	Hapuku	Precautionary Extreme High Risk
Dipturus sp. B	Grey Skate	High Risk
Figaro boardmani	Sawtail Catshark	High Risk
Hydrolagus lemures	Blackfin Ghost Shark	High Risk
Dalatias licha	Black Shark	Precautionary High Risk
Zenopsis nebulosus	Mirror Dory	Precautionary High Risk

Residual risk analysis (teleost and chondrichthyans)

The residual risk summary for the scalefish automatic longline sector is summarised in table 5. Guideline 6 which considers catch and effort limits was used to reduce risk for 5 species. They were:

- *Zenopsis nebulosus* - Mirror Dory
- *Helicolenus barathri* - Bigeye Ocean Perch
- *Dalatias licha* - Black Shark
- *Etmopterus lucifer* - Blackbelly Lantern Shark
- *Deania quadrispinosa* - Platypus Shark

These species are managed as quota species and have a set TAC. Platypus Shark, Blackbelly Lantern Shark and Black Shark are grouped together as deepwater sharks with a combined TAC of 85 t (east) and 215 t (west). They are also subject to a Tier 4 assessment. Mirror Dory is assessed as a Tier 3 species and has a TAC of 1616 t. Bigeye Ocean Perch is assessed as a Tier 4 species and has a TAC of 185 t.

The Cookie-Cutter Shark, *Isistius brasiliensis*, was added to the most recent assessment because it was recorded in log books since the last assessment. The SESSF Resource Assessment Group (SESSFRAG) has considered this species and decided the overall catch and susceptibility to fishing gear is extremely low. Guideline 5 considers interaction/capture and negligible susceptibility, and has been used to reduce the risk rating to medium.

Dr Shijie Zhou at CSIRO headed an FRDC project in 2013 titled "*ERA extension to assess cumulative effects of fishing on species*". The key difference under the updated SAFE methodology was that species distribution area was stratified into different regions so that heterogeneous density could be estimated based on data, whereas the 2012 SAFE assumed fish density was homogenous across their distribution. Gear efficiency was also estimated based on data rather than assumed, as it was in 2012. The updated methodology resulted in two species, Bight Skate and Whitefin Swell Shark, being assessed as at low risk for automatic longline fishing. Guideline two considers additional research, and has been applied here to reduce the risk score for Bight Skate and Whitefin Swell Shark to low.

Overall there has been a change from 15 high risk species prior to the residual risk assessment to 7 high risk species.

Table 4 Residual Risk guidelines applied to species assessed as high risk after SAFE analysis.

Taxonomic Group	Scientific Name	Common Name	Role in Fishery	Productivity	Susceptibility	Level 2 PSA Risk Score	Current and Planned Management Assessment	Level 2 ERA Residual Risk Guideline(s) Applied	Justification	Level 2 Residual Risk Score
Chondrichthyan	*Centrophorus harrissoni*	Harrison's Dogfish	DI	2.57	3	High	Upper slope dogfish management strategy.	Guideline 2 – Additional Scientific Information	The Upper Slope Dogfish Management Strategy was implemented in October 2012, after the Level 3 SAFE assessment was conducted. The effects of this strategy are yet to be quantified, and cannot be used to downgrade the risk of Harrison's Dogfish. The effect of the plan may be considered during the next ERA. This species was assessed as at Extreme high risk from commercial fishing operations under the Level 3 SAFE assessment (Zhou 2012)	Extreme High
Chondrichthyan	*Centrophorus zeehaani*	Southern Dogfish	DI	2.43	3	High	Upper slope dogfish management strategy.	Guideline 2 – Additional Scientific Information	The Upper Slope Dogfish Management Strategy was implemented in October 2012, after the Level 3 SAFE assessment was conducted. The effects of this strategy are yet to be quantified, and cannot be used to downgrade the risk of Southern Dogfish. The effect of the plan may be considered during the next ERA. This species was assessed as at Extreme high risk from commercial fishing operations under the Level 3 SAFE assessment (Zhou 2012)	Extreme High

Chondrichthyan	*Squalus chloroculus*	Greeneye Spurdog	DI	2.43	3	High	Upper slope dogfish management strategy.	Guideline 2 – Additional Scientific Information	The Upper Slope Dogfish Management Strategy was implemented in October 2012, after the Level 3 SAFE assessment was conducted. The effects of this strategy are yet to be quantified, and cannot be used to downgrade the risk of Greeneye Spurdog. The effect of the plan may be considered during the next ERA. This species was assessed as at Extreme high risk from commercial fishing operations under the Level 3 SAFE assessment (Zhou 2012)	Extremely High
Chondrichthyan	*Dipturus gudgeri*	Bight Skate	DI	2.43	3	High		Guideline 2 – Additional Scientific Information	This species was assessed as at low risk from commercial automatic longline fishing operations under an updated SAFE assessment(Zhou 2013)	Low
Chondrichthyan	*Deania quadrispinosa*	Platypus Shark	BP	2.71	3	High	Deepwater Shark Basket TAC Tier 4 Assessment	Guideline 6 - Effort and catch management arrangements	This species was assessed as at Extreme high risk from commercial fishing operations under the Level 3 SAFE assessment (Zhou 2012) However, Level 3 SAFE analysis does not consider TACs. This species is managed as a basket quota species with a TAC of 85t (east) and 215t (west). The TAC has been determined through a scientific Tier 4 assessment, and there is confidence of a high level of compliance in the fishery. The overall risk rating for this species has therefor been reduced to medium. (**see note 1**)	Medium

Chondrichthyan	*Etmopterus lucifer*	Blackbelly Lantern Shark	BP	2.14	3	High	Deepwater Shark Basket TAC Tier 4 Assessment	Guideline 6 – Effort and Catch Management	This species was assessed as at Precautionary Extreme high risk from commercial fishing operations under the Level 3 SAFE assessment (Zhou 2012). However, Level 3 SAFE analysis does not consider TACs. This species is managed as a basket quota species with a TAC of 85t (east) and 215t (west). The TAC has been determined through a scientific Tier 4 assessment, and there is confidence of a high level of compliance in the fishery. The overall risk rating for this species has therefor been reduced to medium. (**see note 1**)	Medium
Chondrichthyan	*Isistius brasiliensis*	Cookie-cutter Shark	DI	2.29	1.67	Med		Guideline 5 – Low susceptibility and interaction	This species was assessed as at Precautionary Extreme high risk from commercial fishing operations under the Level 3 SAFE assessment (Zhou 2012) SESSFRAG has considered this species and decided the overall catch and susceptibility to fishing gear is extremely low. Guideline 5 considers interaction/capture and negligible susceptibility, and has been used to reduce the risk rating to medium.	Medium
Chondrichthyan	*Dalatias licha*	Black Shark	BP	2.57	3	High	Deepwater Shark Basket TAC Tier 4 Assessment	Guideline 6 – Effort and Catch Management	This species was assessed as at precautionary high risk from commercial fishing operations under the Level 3 SAFE assessment (Zhou 2012). Level 3 SAFE analysis does not consider TACs. This species is managed as a basket quota species with a TAC of 85t (east) and 215t (west). The TAC is determined through a scientific Tier 4 assessment. There is confidence of high level of compliance in the fishery. The overall risk rating for	Medium

									this species has therefor been reduced to medium. (**see note 1**).	
Chondrichthyan	*Cephaloscyllium albipinnum*	Whitefin Swell Shark	DI	2.29	3	High		Guideline 2 – Additional Scientific Information	This species was assessed as at low risk from commercial automatic longline fishing operations under an updated SAFE assessment(Zhou 2013)	Low
Chondrichthyan	*Dipturus sp. B*	Grey Skate	DI	2.14	3	High		Guideline 2 – Additional Scientific Information	This species was assessed as at high risk from commercial fishing operations under the Level 3 SAFE assessment (Zhou 2012)	High
Chondrichthyan	*Figaro boardmani*	Sawtail Catshark	DI	2.43	3	high		Guideline 2 – Additional Scientific Information	This species was assessed as at high risk from commercial fishing operations under the Level 3 SAFE assessment (Zhou 2012)	High
Chondrichthyan	*Hydrolagus lemures*	Bight Ghost Shark	BP	2	3	High		Guideline 2 – Additional Scientific Information	This species was assessed as at high risk from commercial fishing operations under the Level 3 SAFE assessment (Zhou 2012).	High

Teleost	*Helicolenus barathri*	Bigeye Ocean Perch	BP	1.71	2.33	Med	Ocean perch TAC Tier 4	Guideline 6 – Effort and Catch Management	This species was assessed as precautionary extreme high risk from commercial fishing operations under the Level 3 SAFE assessment (Zhou 2012). However, Level 3 SAFE analysis does not consider TACs. This species is managed as a quota species with a TAC of 185t. The TAC has been determined through a scientific Tier 4 assessment, and there is confidence of a high level of compliance in the fishery. The overall risk rating for this species has therefor been reduced to medium. (**See note 1)**	Medium
Teleost	*Polyprion oxygeneios*	Hapuku	BP	2	3	High		Guideline 2 – Additional Scientific Information	This species was assessed as precautionary extreme high risk from commercial fishing operations under the Level 3 SAFE assessment (Zhou 2012)	Precautionary Extremely High
Teleost	*Zenopsis nebulosus*	Mirror Dory	BP	1.43	2.33	Med	TAC in place for this species at 1616t	Guideline 6 – Effort and Catch Management	This species was assessed as at precautionary high risk from commercial fishing operations under the Level 3 SAFE assessment (Zhou 2012) Mirror Dory is assessed as a Tier 3 species and has a 1616t TAC across the SESSF. Average annual catch in the SESSF is approximately 513t, with 99.8% of that catch in the trawl fishery. The TAC has been determined through a scientific Tier 3 assessment, and there is confidence of a high level of compliance in the fishery. The overall risk rating for this species has therefor been reduced to medium. (**See note 1)**	Medium

Notes for Table 4

1	Dr Shijie Zhou and Dr Tony Smith of CSIRO have provided comment that it is appropriate a species covered by TAC (species specific or basket) should have it's overall risk rating reduced. TACs are set based on scientific tiered assessments and are effective at mitigating risk.
2	Level 2 PSA risk score has been derived using the formula Risk = $\sqrt{P^2 + S^2}$, where *P* is the productivity risk score and *S* the susceptibility risk score. The risk categories are defined as follows: **High risk:** risk score >3.18 **Medium risk:** 2.64 < risk score < 3.18 **Low risk:** risk score < 2.64.

Table 5 Summary of Residual Risk Results for Teleost and Chondrichthyan Species

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
TEP	0	0	0	0	0	0
BP	3	0	0	2	5	0
DI	0	2	0	5	1	2
Total	3	2	0	7	6	2

5. Conclusion

The methodology used for this 2014 residual risk assessment has been adapted to suit a change in the SAFE assessment process. When first developed, the ERA methodology dictated that only those teleost and chondrichthyan species which were scored as high risk after the Level 2 PSA analysis would progress to the Level 3 SAFE. In 2012, however, all teleost and chondrichthyan species were subject to SAFE. While this is considered as a high level quantitative assessment, there are still some management arrangements, such as catch limits and interaction rates which are not considered. For example, SAFE considers fishing effort but not catch rates. After consultation with CSIRO, it was considered appropriate to apply residual risk guidelines, consistent with Level 2 PSA residual risk assessment, to the species assessed as high risk after the SAFE analysis.

Overall there were 15 species assessed as high risk after the SAFE analysis. After application of the residual risk guidelines, six species were considered at medium risk and two at low risk. Despite several management arrangements, not all species could have their risk scores reduced, and these management arrangements have been noted.

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 risk species as part of the ERM framework. The ERA's will be updated periodically and this will capture how effective the ERM response to high risk species has been.

6. Consultation and clearance

The residual risk analysis commenced in October 2013 and was finalised in December 2014. As part of the consultation process AFMA sought advice on application of residual risk guidelines from CSIRO and presented preliminary results to relevant resource assessment groups (RAGS) for comment. Results were presented at the March 2014 meeting of the Southern and Eastern Scalefish and Shark RAG which includes representatives from industry, science and management. Risk scores for Bight Skate and Whitefin Swell Shark were adjusted in November 2014 when AFMA became aware of an updated SAFE for these species. Final clearance has been approved by George Day, Senior Manager of Demersal and Midwater Fisheries at AFMA.

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	A risk assessment process whereby the productivity and susceptibility attributes of a species are used to calculate risk scores at a species level.
Residual Risk	In the context of this document residual risk means the residual risk after the Level 2 PSA assessment as well as after the Level 3 SAFE.
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 strategies to mitigate the risks are to be further investigated and implemented. If there are no planned or agreed management responses, the assessment moves to Level 3 (for more detail, refer to Hobday *et al.*, 2007).

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