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Ecological Risk Assessment for Effects of Fishing

Report for the Midwater Trawl Sub-fishery of the Small Pelagic Fishery

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Executive summary

This assessment of the ecological impacts of the Small Pelagic Fishery Midwater Trawl sub-fishery was undertaken using the ERAEF method version 9.2. ERAEF stands for "Ecological Risk Assessment for Effect of Fishing", and was developed jointly by CSIRO Marine and Atmospheric Research, and the Australian Fisheries Management Authority. ERAEF provides a hierarchical framework for a comprehensive assessment of the ecological risks arising from fishing, with impacts assessed against five ecological components – key commercial species; by-product and by-catch species; protected species; habitats; and (ecological) communities.

ERAEF proceeds through four stages of analysis: scoping; an expert judgement based Level 1 analysis (SICA – Scale Intensity Consequence Analysis); an empirically based Level 2 analysis (PSA – Productivity Susceptibility Analysis); and a model based Level 3 analysis. This hierarchical approach provides a cost-efficient way of screening hazards, with increasing time and attention paid only to those hazards that are not eliminated at lower levels in the analysis. Risk management responses may be identified at any level in the analysis.

Application of the ERAEF methods to a fishery can be thought of as a set of screening or prioritization steps that work towards a full quantitative ecological risk assessment. At the start of the process, all components are assumed to be at high risk. Each step, or Level, potentially screens out issues that are of low concern. The Scoping stage screens out activities that do not occur in the fishery. Level 1 screens out activities that are judged to have low impact, and potentially screens out whole ecological components as well. Level 2 is a screening or prioritization process for individual species, habitats and communities at risk from direct impacts of fishing. The Level 2 methods do not provide absolute measures of risk. Instead they combine information on productivity and exposure to fishing to assess potential risk – the term used at Level 2 is risk. Because of the precautionary approach to uncertainty, there will be more false positives than false negatives at Level 2, and the list of high risk species or habitats should not be interpreted as all being at high risk from fishing. Level 2 is a screening process to identify species or habitats that require further investigation. Some of these may require only a little further investigation to identify them as a false positive; for some of them managers and industry may decide to implement a management response; others will require further analysis using Level 3 methods, which do assess absolute levels of risk.

This assessment of the SPF Midwater Trawl Sub-fishery includes the following:

- Scoping
- Level 1 results for all components

Fishery Description and comparison with previous assessment period

Gear:	Midwater otter trawl
Area:	Southern Commonwealth waters, from Queensland border, including Tasmania, to 31°S on the west coast of Western Australia: divided into two sub-areas east and west of 146°30'00".
Depth range:	25 to 330 m of bottom depth (*cf* 35 to ~ 357 m)
Fleet size:	One active vessel (*cf* two)
Effort:	~1200 hours trawled in 2015 (*cf* 1372 hours in 2005)
Landings:	~11000 tonnes in 2015 (*cf* 5000 - 12000 tonnes from 2001-2005)
Discard rate:	very low ~ 1.35% (*cf* <1% from 2001-2005)
Key commercial species:	Jack mackerel *Trachurus declivis*, Redbait *Emmelichthys nitidus,* Blue mackerel *Scomber australasicus* (*cf* redbait from 2001-2005)
Management:	Fisheries Management Plan, Harvest Strategy, Bycatch Action Plans, Vessel Management Plans
Output controls:	statutory fishing rights (SFR) and Total Allowable Catch for each quota species per fishing year; regional catch limit grid to reduce risk of localised stock depletion
Input controls:	limited entry, limits on mesh size, SEDs and spatial closures (*cf* no FMP, limited entry from 2001-2005)
Observer program:	100% coverage (*cf* average 33% coverage from 2001-2005)

Table 2.1. Current stock assessment and status of key commercial and bycatch species in the SPF midwater trawl sub-fishery (Patterson *et al.* 2016).

ROLE IN FISHERY	SPECIES	2016 STOCK STATUS	YEAR LAST ASSESSED	DATA INCLUDED AND/OR SOURCE
Key commercial	Jack mackerel (East)	Not subject to overfishing Not overfished	2015	fishery data, 2014 DEPM survey, age-length data, Tier 1
	Jack mackerel (West)	Not subject to overfishing Not overfished	2015	Fishery data, 1970 aerial survey, Tier 2
	Redbait (East)	Not subject to overfishing Not overfished	2015	Fishery data, 2005 & 2006 DEPM surveys, Tier 2
	Redbait (West)	Not subject to overfishing Not overfished	2015	Fishery data, Tier 2
	Blue mackerel (East)	Not subject to overfishing Not overfished	2015	2004 DEPM survey[1], Tier 2
	Blue mackerel (West)	Not subject to overfishing Not overfished	2015	2005 DEPM survey, Tier 2

[1] 2014 DEPM survey for eastern stock has since become available.

Table 1.2 Comparison of ecological units assessed in 2006 and 2016 SICA analyses

COMPONENT	2006 (PREVIOUS)	2016 (CURRENT)
Key/secondary commercial species	1	3
By-product/ bycatch species	16/ 2	8/ 48
Protected species	218	126
Habitats	24 benthic / 2 pelagic	32 benthic / 2 pelagic
Communities	8 benthic / 2 pelagic	10 benthic / 4 pelagic

Level 1 Results

All ecological components were eliminated at Level 1 i.e. there were no risk scores of 3 – moderate – or above for any component (Table 2.3).

All hazards (fishing activities) were eliminated at Level 1 (risk scores 1 or 2).

Significant external hazards were from other fisheries in the region for all components except the key commercial species and coastal development for protected species and habitats. Risks rated as major or above (risk scores 4 or 5) were all related to other fishing activities on protected species and habitats and coastal development for protected species. No severe impacts (risk score 5) were recorded.

Table 2.3 Comparison of previous and current Level 1 (SICA) analyses: components to be examined at Level 2 (PSA)
(- = none identified, Y=Level 2 conducted, N= Level 2 not conducted.)

ECOLOGICAL COMPONENT	2006 (PREVIOUS)	2016 (CURRENT)
Key/secondary commercial species	Level 2 (Y)	-
Byproduct and bycatch	Level 2 (Y)	-
Protected species	Level 2 (Y)	-
Habitats	-	-
Communities	Level 2 (N)	-

Summary

One issue emerges from the ERAEF analysis of the SPF midwater trawl fishery. Direct impact of fishing on protected species wasn't assessed to be of concern in this period of relatively light effort but increasing effort might result in a higher interaction rate and consequently greater risk. Under Australian law, interactions are required to be minimised and that remains an ongoing challenge (but not only for this fishery). There have been interactions with seals and dolphins which resulted in temporary closure of zones within fishery, but overall, the populations of marine mammals and birds were not found to be at significant risk from this fishing activity at the present level of effort.

Also of possible concern in the future with an increase in effort, is the bycatch of species under quota in other overlapping fisheries and of conservation-dependent species. The catches of these

species might need to be considered in assessments to account for cumulative fishing pressure (and from other fisheries). The external impacts from other fisheries were identified as risks in this assessment.

An obvious and significant difference between the assessments of 2006 and 2016 is the greater application of management strategies with a clear direction to sustainably manage resources both for commercial species and for the preservation of threatened species, habitats and communities. These strategies are generally considered international best practice. Additionally, greater observer coverage, monitoring and reporting have also increased and improved the data from which these assessments have been made, ultimately lowering the consequence scores for the components to below the level that would require further assessment. That has also decreased the number of protected species that were assessed.

Managing identified risks

While the results of the ecological risk assessment did not identify any current risks, it did identify areas of possible future concern if the fishery increases and expands. Generally in this assessment process the next steps for each fishery would be to consider and implement appropriate management responses to address the immediate risks using the Ecological Risk Management (ERM) framework developed by AFMA. In this case, there is no reason to proceed to this step.

These results have been presented to and discussed with the SPF Scientific Panel.

1 Overview

1.1 Ecological Risk Assessment for the Effects of Fishing (ERAEF) Framework

1.1.1 The Hierarchical Approach

The Ecological Risk Assessment for the Effects of Fishing (ERAEF) framework involves a hierarchical approach that moves from a comprehensive but largely qualitative analysis of risk at Level 1, through a more focused and semi-quantitative approach at Level 2, to a highly focused and fully quantitative "model-based" approach at Level 3 (Figure 1.1). This approach is efficient because many potential risks are screened out at Level 1, so that the more intensive and quantitative analyses at Level 2 (and ultimately at Level 3) are limited to a subset of the higher risk activities associated with fishing. It also leads to rapid identification of high-risk activities, which in turn can lead to immediate remedial action (risk management response). The ERAEF approach is also precautionary, in the sense that risks will be scored high in the absence of information, evidence or logical argument to the contrary.

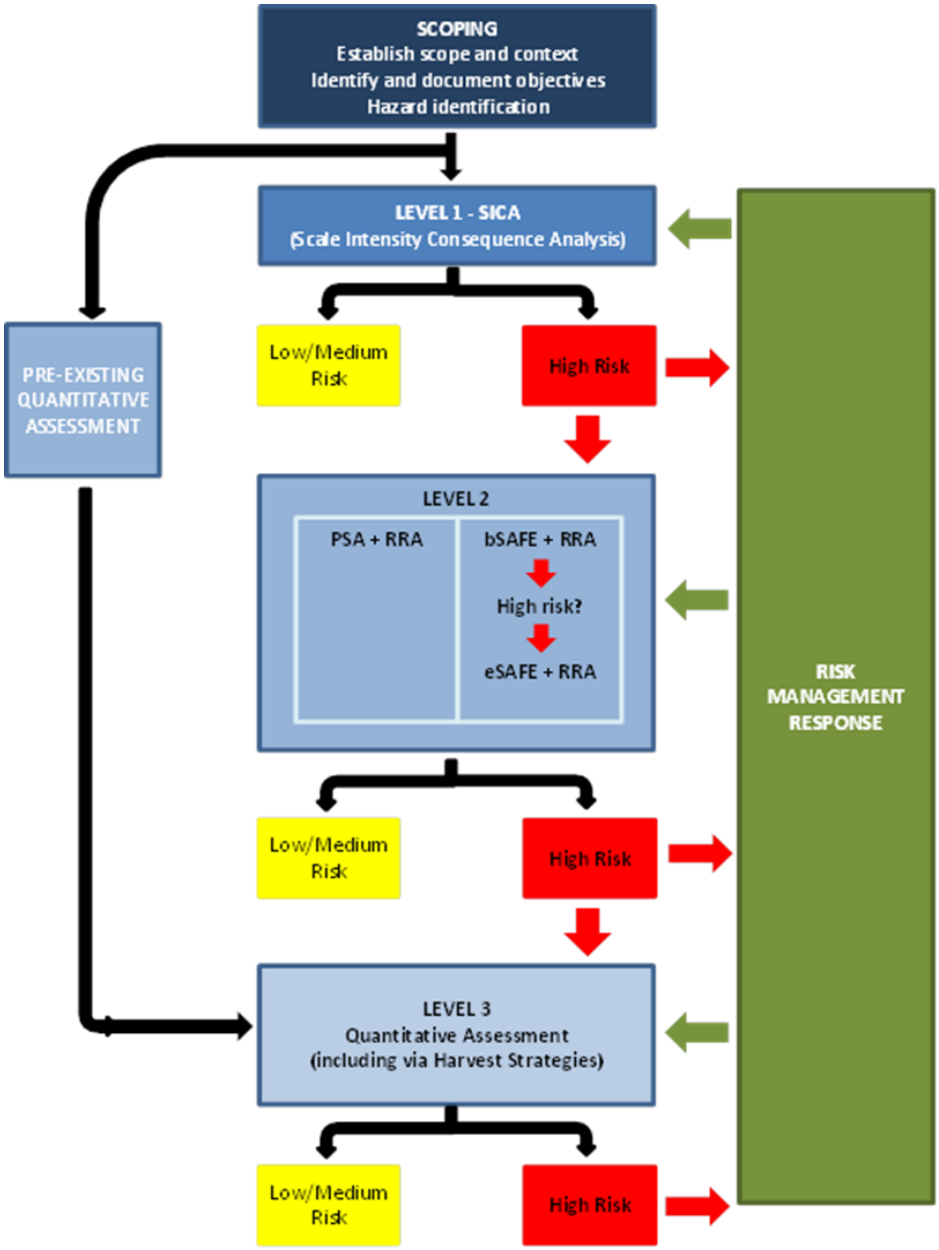


Figure 1.1. Structure of the 3 level hierarchical ERAEF methodology. SICA – Scale Intensity Consequence Analysis; PSA – Productivity Susceptibility Analysis; SAFE – Sustainability Assessment for Fishing Effects; RRA – Residual Risk Analysis. T1 – Tier 1. eSAFE may be used for species classified as high risk by bSAFE.

Conceptual Model

The approach makes use of a general conceptual model of how fishing impacts on ecological systems, which is used as the basis for the risk assessment evaluations at each level of analysis (Levels 1-3). For the ERAEF approach, five general ecological component are evaluated, corresponding to five areas of focus in evaluating impacts of fishing for strategic assessment under EPBC legislation. The five revised *components* are:

- Key commercial species and secondary commercial species
- Byproduct and bycatch species
- protected[1] species (formerly referred to as threatened, endangered and protected[2] species or teps)
- Habitats
- Ecological communities

This conceptual model (

Figure 1.2) progresses from *fishery characteristics* of the fishery or sub-fishery, → *fishing activities* associated with fishing and *external activities*, which may impact the five ecological components (key commercial, byproduct and bycatch species, protected species, habitats, and communities); → *effects of fishing and external activities* which are the direct impacts of fishing and external activities; → *natural processes and resources* that are affected by the impacts of fishing and external activities; → *sub-components* which are affected by impacts to natural processes and resources; → *components*, which are affected by impacts to the sub-components. Impacts to the sub-components and components in turn affect achievement of management objectives.

[1] The term "protected species" refers to species listed under [Part 13] of the EPBC Act (1999) and replaces the term "Threatened, endangered and protected species (teps)" commonly used in past Commonwealth (including AFMA) documents.

[2] Note "protected" (with small "p") refers to all species covered by the EPBC Act (1999) while "Protected" (capital P) refers only to those protected species that are threatened (vulnerable, endangered or critically endangered).

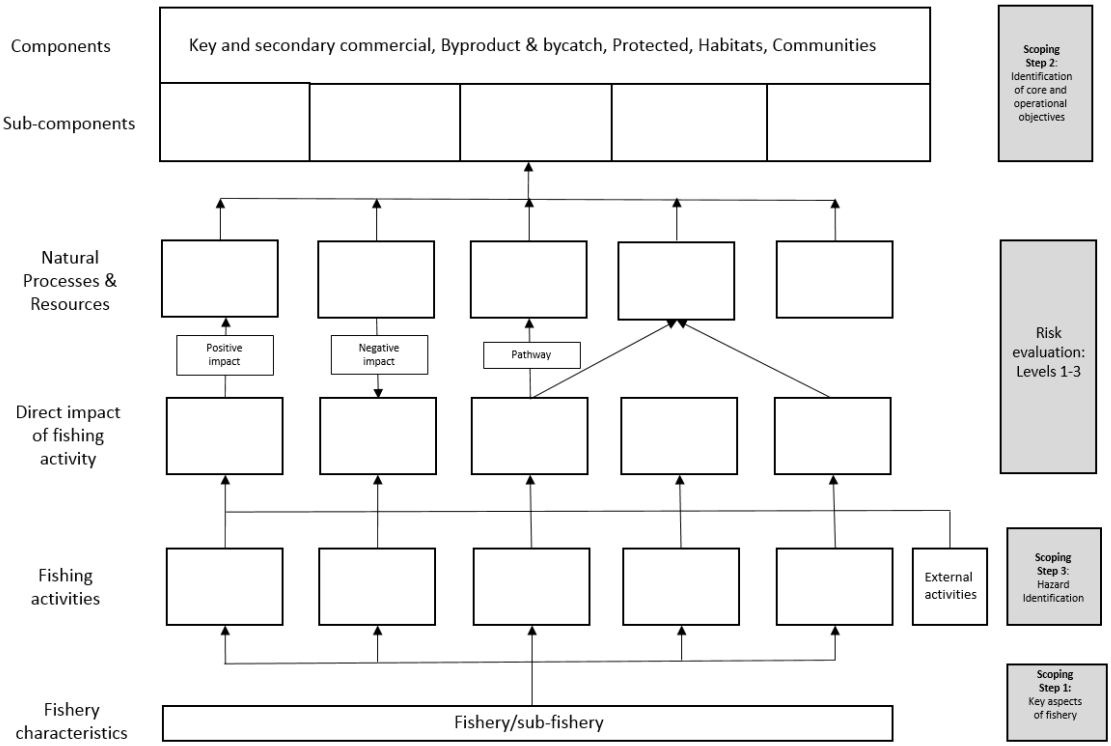


Figure 1.2. Generic conceptual model used in ERAEF.

The external activities that may impact the fishery objectives are also identified at the Scoping stage and evaluated at Level 1. This provides information on the additional impacts on the ecological components being evaluated, even though management of the external activities is outside the scope of management for that fishery.

The assessment of risk at each level takes into account current management strategies and arrangements. A crucial process in the risk assessment framework is to document the rationale behind assessments and decisions at each step in the analysis. The decision to proceed to subsequent levels depends on

- Estimated risk at the previous level
- Availability of data to proceed to the next level
- Management response (e.g. if the risk is high but immediate changes to management regulations or fishing practices will reduce the risk, then analysis at the next level may be unnecessary).

1.1.2 ERAEF stakeholder engagement process

A recognized part of conventional risk assessment is the involvement of stakeholders involved in the activities being assessed. Stakeholders can make an important contribution by providing expert judgment, fishery-specific and ecological knowledge, and process and outcome ownership. The ERAEF method also relies on stakeholder involvement at each stage in the process, as outlined below. Stakeholder interactions are recorded.

1.1.3 Scoping

In the first instance, scoping is based on review of existing documents and information, with much of it collected and completed to a draft stage prior to full stakeholder involvement. This provides all the stakeholders with information on the relevant background issues. Three key outputs are required from the scoping, each requiring stakeholder input.

1. Identification of units of analysis (species, habitats and communities) potentially impacted by fishery activities (Section 2.2.2; Scoping Documents S2A, S2B1, S2B2 and S2C1, S2C2).
2. Selection of objectives (Section 2.2.3; Scoping Document S3). The primary objective to be pursued for species assessed under ERAF is that of ensuring populations are maintained at biomass levels above which recruitment failure is likely, as stated in Chapter 2 (AFMA (2016), ERM Guide). This is consistent with current legislation and fisheries policies and represents a change from when the ERAEF was first developed and there was less policy or legislation based guidance on sustainability objectives, with stakeholders able to choose from a range of “sustainability” objectives (eg: tables 5A-C in Hobday et al. 2007).
3. Selection of activities (hazards) (Section 2.2.4; Scoping Document S4) that occur in the sub-fishery is made using a checklist of potential activities provided. The checklist was developed following extensive review, and allows repeatability between fisheries. Additional activities raised by the stakeholders can be included in this checklist (and would feed back into the original checklist). The background information and consultation with the stakeholders is used to finalize the set of activities. Many activities will be self-evident (e.g. fishing, which obviously occurs), but for others, expert or anecdotal evidence may be required.

1.1.4 Level 1. SICA (Scale, Intensity, Consequence Analysis)

The SICA analysis evaluates the risk to ecological components resulting from the stakeholder-agreed set of activities. Evaluation of the temporal and spatial scale, intensity, sub-component, unit of analysis, and credible scenario (consequence for a sub-component) should be prepared by the draft fishery ERAF report author and reviewed at an appropriate stakeholder meeting (e.g. Resource Assessment Group meeting). Due to the number of activities (up to 24) in each of five components (resulting in up to 120 SICA elements), preparation before involving the full set of stakeholders may allow time and attention to be focused on the uncertain or controversial or high risk elements. Documenting the rationale for each SICA element ahead of time for the straw-man scenarios is crucial to allow the workshop debate to focus on the right portions of the logical progression that resulted in the consequence score.

SICA elements are scored on a scale of 1 to 6 (negligible to extreme) using a "plausible worst case" approach (see ERAEF Methods Document for details; Smith et al. 2007). Level 1 analysis potentially result in the elimination of activities (hazards) and in some cases whole components. Any SICA element that scores 2 or less is documented, but not considered further for analysis or management response.

1.1.5 Level 2. PSA and SAFE (semi-quantitative and quantitative methods)

When the risk of an activity at Level 1 (SICA) on a species component is moderate or higher and no planned management interventions that would remove this risk are identified, an assessment is required at Level 2 (to determine if the risk is real and provide further information on the risk). The tools used to assess risk at Level 2 allow units (e.g. all individual species) within any of the ecological species components (e.g. key/secondary commercial, byproduct/bycatch, and protected species) to be effectively and comprehensively screened for risk. The analysis units are identified at the scoping stage. To date, Level 2 tools have been designed to measure risk from direct impacts of fishing only (i.e. risk of overfishing, leading to an overfished fishery), which in all assessments to date has been the hazard with the greatest risks identified at Level 1[3].

In the period since the first ERAEF was implemented across Commonwealth fisheries, much of the management focus has been on the assessment results associated with Level 2 and Level 2.5 or 3 risk assessment methods, which comprise semi-quantitative

[3] Future iterations of the methodology will include PSAs modified to measure the risk due to other activities, such as gear loss.

or rapid simple quantitative methods (e.g. PSA and SAFE). This level has been subject to the greatest level of change and improvement which are discussed in the following sections. Additional improvements are being developed for implementation in the near future (see Chapter 4.13 of AFMA ERM Guide, AFMA (2016)).

Level 2 was originally designed to rely on a single risk assessment methodology, the Productivity-Susceptibility Analysis (PSA) (see Chapter 4.8.3 of AFMA ERM Guide, AFMA (2016)), however a more quantitative method called the Sustainability Assessment for Fishing Effects (SAFE) (see Chapter 4.8.4 of AFMA ERM Guide, AFMA (2016)) was developed early in the implementation of the ERAEF and classed as a Level 2.5 or Level 3 tool.

Under the revised ERAEF:

bSAFE has now been reclassified as the preferred Level 2 method (over PSA) where sufficient spatial and biological data (to support bSAFE) are available. Typically this has been used for teleost and 7 chondrichthyan species.

Species estimated to be at high risk under bSAFE may then be assessed under eSAFE which may provide reduced estimates of uncertainty pertaining to the actual risk.

Where either the data or species biological characteristics are insufficient to support bSAFE analyses, it is recommended that PSA be applied instead. This will be the case for many protected species, invertebrate bycatch species and some other species.

At Level 2, either PSA or SAFE methods should be applied to any given species, not both.

For high risk species it is a management choice whether to progress to eSAFE, pursue a Level 3 fully quantitative stock assessment, or to take more immediate management action to reduce the risk. The types of considerations required in making that choice (ie: moving up the ERAEF assessment hierarchy or taking direct management action) are outlined in Chapter 5.5 of the AFMA ERM Guide (AFMA (2016).

It is also recognised that a number of additional tools, including some of the “data poor” assessment tools that are used to inform harvest strategies, could potentially be included within the Level 2 toolkit. They are distinguished from Level 3 quantitative tools (i.e. stock assessment models) that are more data rich and able to more precisely quantify uncertainty.

PSA (Productivity Susceptibility Analysis))

Details of the PSA method are described in the accompanying ERAEF Methods Document and also summarised in Section 4.8.3 of the AFMA ERM Guide (AFMA 2016). Stakeholders can provide input and suggestions on appropriate attributes, including novel ones, for evaluating risk in the specific fishery. Attribute values for many of the units (e.g. age at maturity, depth range, mean trophic level) can be obtained from published literature and other resources (e.g. scientific experts) without initial

stakeholder involvement. Stakeholder input is required after preliminary attribute values are obtained. In particular, where information is missing, expert opinion can be used to derive the most "reasonable" conservative estimate. For example, if species attribute values for annual fecundity have been categorized as low, medium or high on the set (<5, 5-500, >500), estimates for species with no data can still be made. Also, estimated fecundity of a broadcast-spawning fish species with unknown fecundity is still likely to be greater than the high fecundity category (>500). Susceptibility attribute estimates, such as "fraction alive when landed", can also be made based on input from experts such as scientific observers. Feedback to stakeholders regarding comments received during the preliminary PSA consultations is considered crucial. The final PSA is completed by scientists and results are presented to the relevant stakeholder group (e.g. RAG and/or MAC) before decisions regarding Level 3 analysis are considered. The stakeholder group may also decide on priorities for analysis at Level 3.

Residual Risk Analysis

There were several limitations due to the semi-quantitative nature of a Level 2 PSA assessment. For example, certain management arrangements which mitigate the risks posed by a fishery, as well as additional information concerning levels of direct mortality, may not be easily taken into account in assessments. To overcome this, Residual risk analyses (RRA) are used to consider additional information, particularly mitigating effects of management arrangements that were not explicitly included in the ERAs or introduced after the ERA process commenced. Priority for this process has typically been focused on those species attributed a high risk rating (those likely to be most at risk from fishing activities). It could in theory be used to also determine if some species have been incorrectly classified as low risk.

Recently revised Residual risk guidelines have been developed (see below) to assist in making accurate judgments of residual risk consistently across all fisheries. At the moment, they are applied to species and not applicable to habitats or communities.

These guidelines are not seen as a definitive guide on the determination of residual risk and it is expected they may not apply in a small number of cases. Care must also be taken when applying them to ensure residual risk results are appropriate in a practical sense. There are a number of conditions which underpin the residual risk guidelines and should be understood before the guidelines are applied:

- All assessments and management measures used within the residual risk assessment must be implemented prior to the assessment with sufficient data to demonstrate the effect. Any planned or proposed measures can be referred to in the assessment but cannot be used to revise the risk score.
- When applied, the guidelines generally result in changes to particular "attribute" scores for a particular species. Only after all of the guidelines have been applied to a particular species, should the overall risk category be re-

calculated. This will ensure consistency, as well as facilitating the application of multiple guidelines.

- Unless there is clear and substantiated information to support applying an individual guideline, then the attribute and residual risk score should remain unchanged. All supporting information considered in applying these Guidelines must be clearly documented and referenced where applicable. This is consistent with the precautionary approach applied in ERAs, with residual risk remaining high unless there is evidence to the contrary ensuring a transparent process is applied.

The results (including supporting information and justifications) from residual risk analyses must be documented in "Residual Risk Reports" for each fishery (or can be integrated into the Level 2 risk assessment report). These will be publically available documents.

SAFE (Sustainability Assessment for Fishing Effects)

The SAFE method developed is split into two categories: base SAFE (bSAFE) and an enhanced SAFE (eSAFE). eSAFE has greater data processing requirements and is recommended to only be used to assess species estimated to be at high risk via the bSAFE. It is also able to more appropriately model spatial availability aspects when sufficient data are available.

bSAFE

Relative to the PSA approach, the bSAFE approach (Zhou and Griffiths, 2008; Zhou et al. 2011):

- is a more quantitative approach (analogous to stock assessment) that is able to provide absolute measures of risk by estimating fishing mortality rates relative to fishing mortality rate reference points (based on life history parameters);
- requires less productivity data than the PSA;
- is able to account for cumulative risk and
- potentially out-performs PSA in several areas, including strength of relationship to Tier 1 assessment classifications (Zhou et al. 2016).

Like PSA, the bSAFE method is a transparent, relatively rapid and cost effective process for screening large numbers of species for risk, and is far less demanding of data and much simpler to apply than a typical quantitative stock assessment.

As such it is recommended that bSAFE be used as the preferred Level 2 assessment tool for all fish species and some invertebrates and reptiles (eg: some sea snakes) with sufficient data.

In estimating fishing mortality, bSAFE utilises much of the same information as the PSA, to estimate:

- spatial overlap between species distribution and fishing effort distribution.
- catchability resulting from the probability of encountering the gear and size-dependent selectivity, and;
- post-capture mortality.

The fishing mortality is essentially the fraction of overlap between fished area and the species distribution area within the jurisdiction, adjusted by catchability and post-capture mortality. Uncertainty around the estimated fishing mortality is estimated by including variances in encounterability, selectivity, survival rate and fishing effort between years.

The three biological reference points are based on a simple surplus production model:

- F_{MSY} – instantaneous fishing mortality rate that corresponds to the maximum number of fish in the population that can be killed by fishing in the long term. The latter is the maximum sustainable fishing mortality (MSM) at B_{MSM}, similar to target species MSY.
- F_{LIM} – instantaneous fishing mortality rate that corresponds to the limit biomass B_{LIM} where B_{LIM} is a assumed to be half of the biomass that supports a maximum sustainable fishing mortality ($0.5B_{MSM}$).
- F_{CRASH} – minimum unsustainable instantaneous fishing mortality rate that, in theory, will lead to population extinction in the long term.

This methodology produces quantified indicators of performance against fishing mortality based reference points and as such does allow calibration with other stock assessment and risk assessment tools that measure fishing mortality. It allows the risk of overfishing to be determined, via the score relative to the reference line. Uncertainty (error bars) are related to the variation in the estimation of the scores for each axis.

It is recommended that species assessed as being potentially at high risk under bSAFE are then progressed to analysis by eSAFE which is able to narrow uncertainties around the risk (but is more time and resource intensive than bSAFE).

Assumptions and issues to be aware of are:

- comparisons of PSA and SAFE analyses for the same fisheries and species support the claim that the PSA method generally avoids false negatives but can result in many false positives. Limited testing of SAFE results against full quantitative stock assessments suggest that there is less “bias” in the method, but that both false negatives and false positives can arise
- SAFE analyses retain some of the key precautionary elements of the PSA method, including assumptions that fisheries are impacting local stocks (within the jurisdictional area of the fishery)

- although the bSAFE analyses provide direct estimates of uncertainty in both the exploitation rate and associated reference points, they are less explicit about uncertainties arising from key assumptions in the method, including spatial distribution and movement of stocks.
- The method assumes there would be no local depletion effects from repeat trawls at the same location (ie: populations rapidly mix between fished and unfished areas). The fishing mortality will likely be overestimated if this assumption is not satisfied (ERA TWG 2015).
- The method also assumes that the mean fish density does not vary between fished area and non-fished area within their distributional range. Hence, the level of risk would be over-estimated for species found primarily in non-fished habitat, while risk would be under-estimated for species that prefer fished habitat (ERA TWG 2015).

The SAFE methodology makes greater assumptions than Tier 1 stock assessments in coming to its F estimates (due to a lack of the data relative to that used in a Tier 1 assessment) and it is not capable of measuring risk of a stock being already overfished (so the type of risk it measures relates only to overfishing, which may then lead to future overfished state). The limitations of SAFE with respect to measuring overfished risks are the same essentially as for PSA.

eSAFE

Enhanced SAFE (eSAFE) appears, based on calibration with Level 3 assessments, to provide improved estimates of fishing mortality relative to the base SAFE (bSAFE) method. The eSAFE requires more spatially explicit data and takes more analysis time than bSAFE, and so might only be used to further assess species that were identified as at high risk using bSAFE (and which have not had further direct management action taken). The eSAFE enhances the bSAFE method by estimating varying fish density across their distribution range as well as species- and gear-specific catch efficiency for each species.

1.1.6 **Level 3**

This stage of the risk assessment is fully-quantitative and relies on in-depth scientific studies on the units identified as at medium or greater risk in the Level 2. It will be both time and data-intensive. Individual stakeholders are engaged as required in a more intensive and directed fashion. Results are presented to the stakeholder group and feedback incorporated, but live modification is not considered likely.

1.1.7 Conclusion and final risk assessment report

The conclusion of the stakeholder consultation process will result in a final risk assessment report for the individual fishery according to the ERAEF methods. It is envisaged that the completed assessment will be adopted by the fishery management group and used by AFMA for a range of management purposes, including to address the requirements of the EPBC Act as evaluated by Department of the Environment and Heritage.

1.1.8 Subsequent risk assessment iterations for a fishery

The frequency at which each fishery must revise and update the risk assessment is not fully prescribed. As new information arises or management changes occur, the risks can be re-evaluated, and documented as before. The fishery management group or AFMA may take ownership of this process, or scientific consultants may be engaged. In any case the ERAEF should again be based on the input of the full set of stakeholders and reviewed by independent experts familiar with the process.

Fishery re-assessments for byproduct and bycatch species under the ERAEF will be undertaken every five years[4] or sooner if triggered by re-assessment triggers. The five year timeframe is based on a number of factors including:

The time it takes to implement risk management measures; for populations to respond to those measures to a degree detectable by monitoring processes; and to collect sufficient data to determine the effectiveness of those measures.

- Alignment with other management and accreditation processes.
- The cost of re-assessments.
- The review period for FMS.

For byproduct and bycatch species, in the periods between scheduled 5 year ERA reviews[5], AFMA will develop and monitor a set of fishery indicators and triggers, on an annual basis, so as to detect any changes (increase or decrease) in the level of risk posed by the fishery to any species. Where indicators exceed specified trigger levels, AFMA will investigate the causes and provide opportunity for RAG comment/advice during that process. Pending outcomes of that review, and RAG advice, AFMA can if

[4] Based on a recommendation by the ERA Technical Working Group, September 2015.

[5] In contrast to key and secondary commercial species managed via catch/effort limits under Harvest Strategies, which depending on species and Harvest Strategy, can be re-assessed any time between 1 and 5 years.

necessary, request a species specific or full fishery re-assessment (i.e. prior to the scheduled re-assessment dates).

The ERA TWG (September 2015) identified five key indicators upon which such triggers could be based, these being changes in:

- Gear type/use
- Mitigation measures (use or type)
- Area fished
- Catch or interaction rate
- Fishing effort

Where possible, the triggers should look to take into account additional sources of risk from interacting non-Commonwealth fisheries. In addition, if a major management change is planned for a fishery, such as a move from input to output controls, the fishery will need to be reassessed prior to that management change coming into effect. In considering each indicator and trigger level, the RAG should consider the following:

- The data upon which the indicator is based must be sufficiently representative of actual changes in catch, effort, area, gear or mitigation methods. Consideration should be given to the level of uncertainty associated with the data underpinning any prospective indicator.
- The trigger level chosen should not be overly sensitive to the normal inter-annual variance that is typical of the indicator and independent of fishing pressure, assuming such variance is unlikely to relate to a significant change in the risk posed by the fishery to any or all species.
- The trigger level should equate to the minimum level of change that the RAG (by its expert opinion) considers might potentially represent a significant change in the risk posed by the fishery.
- The trigger level could represent an absolute change (number/level) in an indicator or a percentage change in an indicator.
- The RAG should consider whether a “temporal” condition should be placed on the trigger (i.e. the trigger is breached 2 years in a row) to further reduce the likelihood of natural population variance or data errors triggering a re-assessment unnecessarily.

The final set of indicators and triggers will be developed for each fishery by AFMA in consultation with its fishery RAG (or for fisheries lacking a RAG, the ERA TWG), in association with the next planned re-assessment (see Table 8 in AFMA ERM Guide, AFMA (2016)). A RAG may choose a subset of these indicators and triggers, or include an additional indicator/trigger(s), based on consideration of the availability and

reliability of data upon which to base any of the above indicators/triggers, however justification of this must be provided.

Research is currently underway to develop specific guidance for RAG to aid in the selection of appropriate triggers, which will in the meantime be determined using RAG expert opinion. In the longer term it may be possible to refine indicators and triggers using the existing PSA and SAFE methods to test which attributes the end risk scores are most sensitive to (ERA TWG 2015)[6]. The RAG will record both the final set of indicators and triggers chosen, and a justification for those, in the RAG minutes. Once the final set of indicators and triggers is determined for a fishery, they will require implementation within the FMS and a monitoring and review process.

[6] ERA TWG recommendation, September 2015

2 Results

The focus of analysis is the fishery as identified by the responsible management authority. The assessment area is defined by the fishery management jurisdiction within the AFZ. The fishery may also be divided into sub-fisheries on the basis of fishing method and/or spatial coverage. These sub-fisheries should be clearly identified and described during the scoping stage. Portions of the scoping and analysis at Level 1 and beyond, is specific to a particular sub-fishery. The fishery is a group of people carrying out certain activities as defined under a management plan. Depending on the jurisdiction, the fishery/sub-fishery may include any combination of commercial, recreational, and/or indigenous fishers.

The results presented below are for Small Pelagic Fishery – Midwater Trawl.

2.1 Stakeholder engagement

Table 2.1 Summary Document SD1. Summary of stakeholder involvement for Small Pelagic Fishery – Midwater Trawl sub-fishery

FISHERY ERA REPORT STAGE	TYPE OF STAKEHOLDER INTERACTION	DATE OF STAKEHOLDER INTERACTION	COMPOSITION OF STAKEHOLDER GROUP (NAMES OR ROLES)	SUMMARY OF OUTCOME
Scoping & SICA	Emails, phone calls	8 June –29 July 2016	AFMA –SPF, Data, and Environment Management	Data summaries, observer reports, clarification of specific management arrangements
	AFMA Meeting	4 -5 August 2016	AFMA, ABARES, CSIRO fishery consultants	Revisions to methodology descriptions
	Email/phone meeting	November 2016	AFMA	Revisions/edits to report including update of literature of stock status reports
	Advisory meeting	15 December 2016	SPF Scientific Panel meeting	Minor revisions to explain differences in protocol for PS

2.2 Scoping

The aim in the Scoping stage is to develop a profile of the fishery being assessed. This provides information needed to complete Levels 1 and 2 and at stakeholder meetings. The focus of analysis is the fishery, which may be divided into sub-fisheries on the basis of fishing method and/or spatial coverage. Scoping involves six steps:

- Step 1 Documenting the general fishery characteristics
- Step 2 Generating "unit of analysis" lists (species, habitat types, communities)
- Step 3 Selection of objectives
- Step 4 Hazard identification
- Step 5 Bibliography
- Step 6 Decision rules to move to Level 1

2.2.1 General Fishery Characteristics (Step 1).

The information used to complete this step may come from the Fishery Management Plan, Assessment Reports, Bycatch Action Plans, and any other relevant background documents. The level and range of information available will vary. Some fisheries/sub-fisheries will have a range of reliable information, whereas others may have limited information.

Scoping Document S1 General Fishery Characteristics

Fishery Name: Small Pelagic Fishery – Midwater Trawl

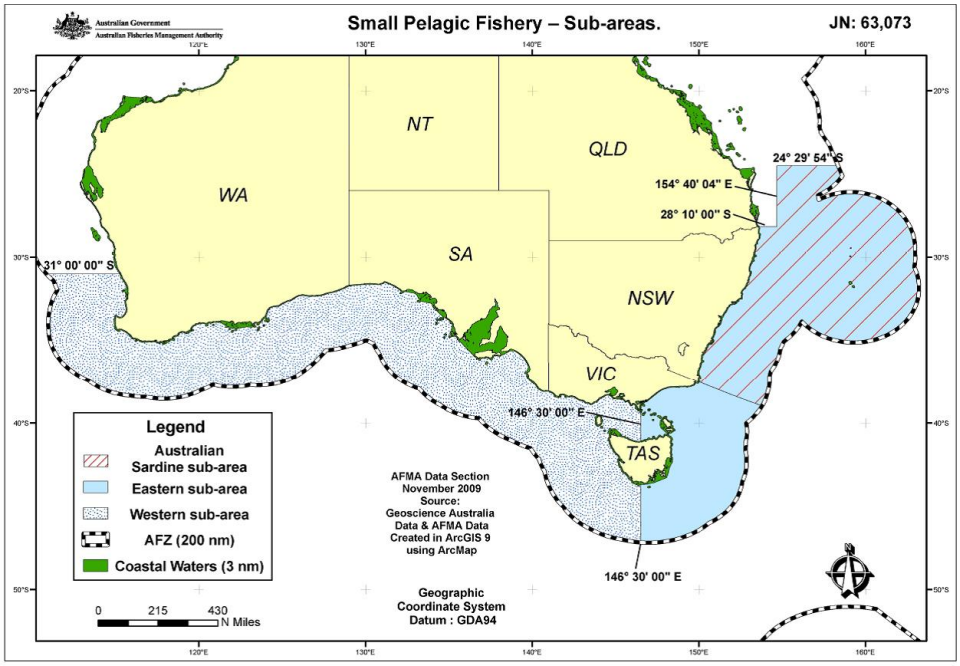
Date of assessment: August 2016

Assessor: C. Bulman (CSIRO)

Table 2.2 General fishery characteristics

GENERAL FISHERY CHARACTERISTICS	
Fishery Name	Small Pelagic Fishery
Sub-fisheries	Two methods of fishing are allowed: purse seine and mid water trawl
Sub-fisheries assessed	Midwater trawl sub-fishery
Start date/history	In 1936, CSIRO surveys located large schools of small pelagics along the western edge of the GAB and off eastern Tasmania. In the 1940s and 1950s purse seining was trialled off NSW and eastern Tasmania. The first catch comprised 4 t of jack mackerel (*Trachurus declivis*) taken near Hobart. The Jack Mackerel Fishery evolved as a purse seine fishery targeting surface schools of jack mackerel off eastern Tasmania. The fishery peaked in the 1990s but soon after, the surface schools of jack mackerel disappeared, due to variable oceanographic conditions affecting their major prey *Nyctiphanes australis*, and the fish remained close to the bottom. This prompted development and expansion of the fishery into other fishing methods and consequently key commercial species and i.e. midwater trawling and redbait.

	The Midwater Trawl sub-fishery of the SPF commenced in 2001/2002 when the first significant catches of redbait (*Emmelichthys nitidus)* were taken off eastern Tasmania. In 2002, two midwater trawling licences were granted and by 2003 and 2004 midwater trawling took the vast majority (>90%) of the SPF total annual catch. Most of the catch was redbait and sold whole to feed farmed bluefin tuna in Port Lincoln. With most of the market for the fishery in Port Lincoln, there was a clear potential for the fishery to expand into other areas, particularly the GAB and areas closer to the market than Tasmania. Therefore, in 2001, the AFMA board pre-emptively developed a Management Policy for remaining areas within the SPF jurisdictional boundary. Under the new management policy framework, AFMA restructured management of most zones of the fishery in 2004. Increased interest, particularly from foreign factory vessels, caused management to issue an investment warning and a freeze on permits followed. In 2005, AFMA established the Small Pelagic Fishery Management Advisory Committee (SPFMAC) and identified the development of a statutory management plan as one of SPFMAC's first tasks. AFMA also finalised the allocation process of statutory fishing rights under the Small Pelagic Fishery Management Plan (SPFMP) which was yet to be implemented. In 2008, the SPF Harvest Strategy was formulated. It has been reviewed and revised in 2015 such that a limit reference point of 0.2B0 and a target of 0.5B0 has been adopted (AFMA 2015). The exploitation rates have also been altered to reflect stock-specific exploitation rates and limit the time species can stay at tier 2. In 2009, the Small Pelagic Fishery Management Plan 2009 was implemented and since, been amended (Australian Fisheries Management Authority 2014b). A Bycatch and Discarding Work Plan was also developed and has been regularly reviewed and revised (Australian Fisheries Management Authority 2014a). Under the SPFMP, stock-based management replaced the previous zonation of the fishery with the fishery divided into two sub-areas east and west of longitude 146°30'E. The fishery was also extended north along the east coast to latitude 24°29'54"S to accommodate an Australian Sardine sub-area and encompassed activities authorised by Informally Managed Fishery permits. However, activity in the midwater fishery declined, the cause of which being attributed to loss of processing plants in Eden, difficulty in finding fish aggregations, and the time for the SFRs to take affect (Expert Panel on a Declared Fishing Activity 2014). On 1 May 2012, AFMA implemented a quota management regime in the SPF. Later that year, a joint venture factory freezer trawler was formally nominated to fish in the SPF. However, in November, the Environment Minister declared a ban on fishing activities of vessels over 130 m and >2000 t storage capacity for two years while an Expert Panel was established to assess the potential effects of such a vessel. Since then the activity remained low until the recent entry of a smaller factory freezer trawler in April 2014. This vessel remains the only vessel fishing in the midwater fishery and is subject to certain licence conditions. One of those conditions, as prescribed in the Vessel management Plan (VMP), is the application of regional catch limits that are designed to distribute effort across the fishery, collect representative data on target species and minimise the potential for local depletion effects. They are reviewed annually and would likely apply to any other vessel entering the fishery. Integral in Vessel Management Plans are conditions to manage interactions with protected species which is a major issue for the midwater fishery. In the early years, relatively small numbers of Australian furseals and dolphins were captured. In response, mitigation options for marine mammal were explored and remain an ongoing area of research. An increase in interactions with Australian fur seals, common dolphins and albatrosses occurred with the commencement of the factory freezer trawler working in the new areas of fishery but mitigation measures were trialled and have been successful in preventing further interactions. These are now defined in the vessel management plans (VMP)(e.g. (Australian Fisheries Management Authority 2016)). As at October 2015, the Small Pelagic Fishery was accredited under the EPBC Act 1999 for Part 13 of the Act (http://www.environment.gov.au/system/files/pages/41b182ca-9bfc-48b2-92a1-8a21f729f337/files/small-pelagic-fishery-part13-2015.pdf) subject to conditions that effective mitigation approaches and devices are in place to minimise interactions with seals, dolphins and birds and that an observer is deployed on new mid-water trawls for first 10 trips with additional coverage or monitoring as appropriate.
Geographic extent of fishery	The Small Pelagic Fishery operates in waters offshore of southern Queensland around southern Australia to Lancelin, Western Australia, including around Tasmania. The fishery is divided into two sub-areas (east and west of latitude 146°30'.



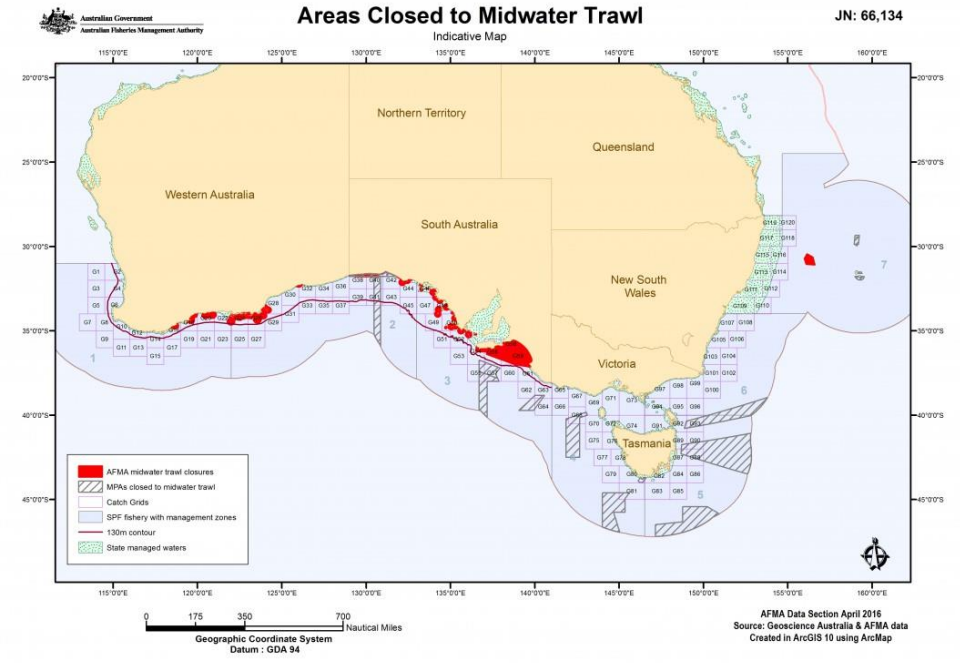
Source: Australian Fisheries Management Authority (2016)

Regions or Zones within the fishery

The SPF is divided into two major zones based on a review of knowledge of stock structure (Bulman et al. 2008): Eastern and Western sub-areas (see previous section).

Further management of catches was implemented through regional catch limits (as set out in the VMP) to enable a spread of data collection throughout the fishery and to minimize the risk of localised depletion. These management areas are only conditional to the vessel currently operating and are reviewed annually but potentially they could be applied to other vessels entering the fishery (pers. comm. Ms S. Weekes, AFMA 16 June 2016).

The regional catch management grid allocates TAC proportionally into grid squares of one degree within seven management sub-zones within the two sub-areas.



Source: Australian Fisheries Management Authority (2016).

Fishing season	Fishing occurs throughout the whole year; fishing season 1 May -30 April.
Key commercial species and stock status	The main species targetted by midwater trawl currently are common jack mackerel (*Trachurus declivis*) and redbait (*Emmelichthys nitidus*). These species may form mixed schools with other mackerel species Peruvian mackerel (*Trachurus murphyi*) and blue mackerel (*Scomber australasicus*). ABARES has assessed all stocks as being sustainable (Patterson *et al.* 2016) . Flood et al. (2014) assessed both common jack mackerel stocks across all relevant jurisdictions as sustainable. A DEPM survey of the entire spawning area of blue mackerel off eastern Australia in 2014 suggested a large spawning biomass although improved estimates of adult biological parameters are needed to enhance assessments (Small Pelagic Fishery Scientific Panel 2015). The 2014 DEPM biomass estimates of jack mackerel off eastern Australia are consistent with those from earlier studies (Ward *et al.* 2015b). There are no spawning biomass estimates for the western stock therefore TACs are set at a precautionary level (Lyle et al. 2014). Stock assessments for redbait in the southeastern region were last made in 2005 and 2006 (Neira et al. 2008a; Neira and Lyle 2011)) but low catches since. There have been no biomass estimates in the southwestern region therefore the stock size estimate is uncertain (Moore and Mazur 2015).
Bait Collection and usage	Not applicable-trawl fishery.
Current entitlements	There are currently 33 entities holding quota SFRs in the fishery. Only one midwater trawl vessel is active.
Current and recent TACs, quota trends by method	**Annual TACs for the SPF (tonnes) for past 5 fishing seasons and current season. E= eastern sub-area. W= western sub-area. *not targetted by midwater trawl @ no TAC**

	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17
Jack mackerel E	4600	10100	9800	10230	18670	18670
Jack mackerel W	5000	5000	5000	5000	3600	3600
Redbait E	8600	6900	5000	5000	3310	3310
Redbait W	5000	5000	5000	5000	2880	2880
Blue mackerel E	2500	2600	2700	2660	2630	2630
Blue mackerel W	4200	6500	6500	6500	6200	6200
Australian sardine E*	400	200	270	1880	1880	1880
Yellowtail scad@	200	-	-	-	-	-

Source: AFMA (2016), Moore and Mazur (2015); Moore and Skirtun (2013).

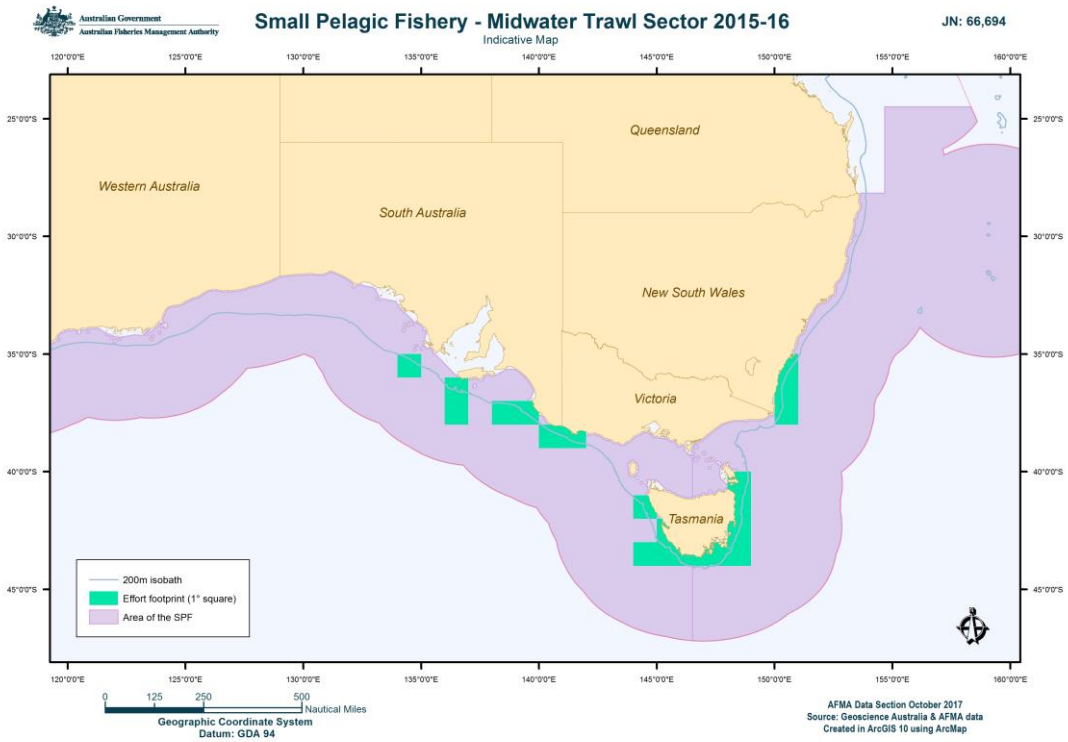
Current and recent fishery effort trends by method

Annual estimates of midwater trawl effort levels in the SPF for past 5 fishing seasons.

YEAR	EAST HOURS	EAST SHOTS	WEST HOURS	WEST SHOTS
2011-12	0	0	0	0
2012-13	0	0	0	0
2013-14	0	0	0	0
2014-15	31	14	19	11
2015-16	638	185	472	131

Source: AFMA data 2016

Spatial Distribution of Effort since 2 April 2015. NB Activity off northern NSW is purse seine.



Source: AFMA

Catch grids (and associated regional catch limits) currently only apply to the Geelong Star through the Vessel Management Plan but would be reconsidered if another mid-water trawl vessel was to enter the fishery. Grid G117 (northern-most active grid on NSW coast) is for purse seine only not MWT. There has been no MWT activity in this grid, and there has been no purse seine activity outside this grid.

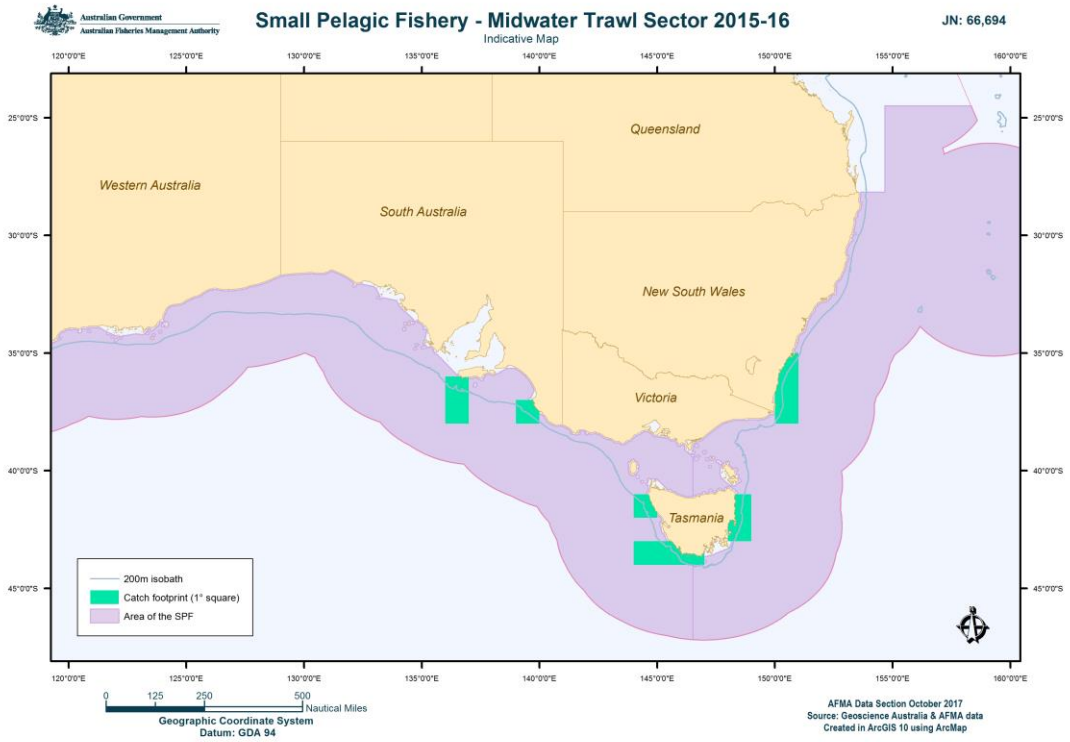
Current and recent fishery catch trends by method

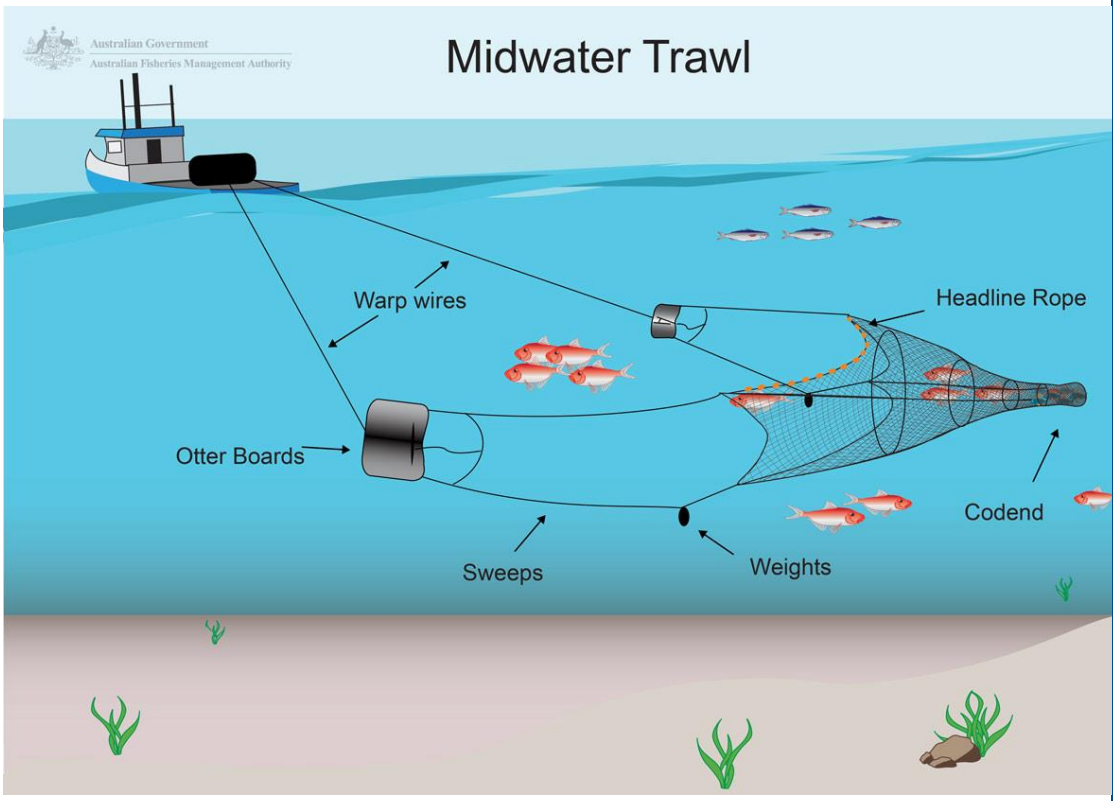
Annual estimates of catches (tonnes) in the SPF by midwater trawl for past 5 fishing seasons.

	2011-12	2012-13	2013-14	2014-15	2015-16
Jack mackerel E	0	0	0	311.018	631.6081
Jack mackerel W	0	0	0		634.330
Redbait E	0	0	0	2.058	216.580
Redbait W	0	0	0		1156.706
Blue mackerel E	0	0	0	202.566	2021.543
Blue mackerel W	0	0	0		979.433

Source: AFMA data 2016.

Since 2011 there has been little activity in the SPF (including the purse seine) until the entry of the factory freezer trawler at the end of the 2014 fishing year (Moore and Mazur 2015).

	Spatial distribution of catches since 2 April 2015.  Source: AFMA Catch grids (and associated regional catch limits) currently only apply to the Geelong Star through the Vessel Management Plan but would be reconsidered if another mid-water trawl vessel was to enter the fishery. Grid G117 (northern-most active grid on NSW coast) is for purse seine only not MWT. There has been no MWT activity in this grid, and there has been no purse seine activity outside this grid.
Current and recent value of fishery ($)	The last gross value of production (GVP) in the SPF was estimated to be $1.3million in 2007–08 (2014–15 dollars) 65% lower than in 2005–06 ($3.6 million) due to a rapid decline in prices and production. Since then the GVP has been confidential (<5 boats) (Patterson *et al.* 2016). The net economic returns in 2007/8 were considered to be low; current rates are uncertain due to lack of information (Patterson *et al.* 2016).
Relationship with other fisheries	Historically, small pelagic species have been taken in significant quantities within both Commonwealth and adjacent state-managed waters, and in small quantities in the trawl sectors of the Southern and Eastern Scalefish and Shark Fishery, the Eastern Tuna and Billfish Fishery, the Western Tuna and Billfish Fishery (caught for bait) and the New South Wales Ocean Hauling Fishery (Moore and Mazur 2015). Estimates of take from the recreational and Indigenous sectors are made from a national survey but not as reliable as those for commercial sectors. Almost all stocks are multijurisdictional and are managed jointly by the Australian and relevant state governments except for the western stock of Australian sardine which is managed by South Australia as the South Australian Sardine Fishery (SASF). The eastern stock of Australian sardine is co-managed by the Australian, New South Wales, Victorian and Tasmanian governments (Moore and Mazur 2015).
Gear	
Fishing gear and methods	Fishing gear Midwater net configurations can vary greatly but in general, mesh size is large in the front of the net - often up to 20-30 m - and progressively declines towards the codend. One example of a net proposed for use in the SPF had a horizontal opening of 80 m and and vertical opening of 35 m (Expert Panel 2014), comparable to those used in other Commonwealth midwater fisheries such as used for blue grenadier. Fishing method

	Midwater trawling involves towing a net behind a boat to catch fish. The net is connected to the boat by the warp wires and the opening to the net is spread using two large boards known as otter boards. The net is towed off the bottom in depths from just off the bottom to near the surface. Midwater trawl nets are usually shaped like a cone or a funnel with a wide opening to catch fish and a narrow end called a codend where fish are collected (http://www.afma.gov.au/portfolio-item/trawling/).Generally, acoustic technology in the form of net monitors is used to provide fishers information on position of the net in the water column, the opening/spread of the net and the volume of fish entering the net. Modern factory freezer vessels pump the catch from the codend to storage tanks on the vessel for processing. During the pumping operation the bag and codend of the trawl net are fully submerged to a depth of around 50 m which avoids attraction of birds to the floating codend.  Source: http://www.afma.gov.au/portfolio-item/trawling/
Fishing gear restrictions	Minimum codend mesh size is 30 mm.
Selectivity of gear and fishing methods	Midwater trawls target midwater fish aggregations identified from echo sounders. Catches are usually almost exclusively the key commercial species but sometimes mixed with other key commercial species and bycatch species.
Spatial gear zone set	The gear is generally set over the shelf and along the edge of the shelf where schools of fish are detected by acoustic sounder or sonar.
Depth range gear set	The depth range of mid-water trawling in the SPF is generally between 100 and 300 metres, in waters up to 370 meters deep.
How gear set	The gear is set in the water column. Potentially the gear can come into contact with the bottom but this does not occur frequently, thus minimal interaction with demersal habitats and species (http://www.afma.gov.au/wp-content/uploads/2016/06/ATT-A-SEMAC-25-meeting-minutes.pdf. accessed 23 June 2016).
Area of gear impact per set or shot	Midwater nets usually only impact the actual water column and rarely contacts the seabed (http://www.afma.gov.au/portfolio-item/trawling/).

Capacity of gear	The largest shot recorded in logbook records during the past 5 years was 120 t. The average size of catches (all species) was 24 t in the west and 48 t in the east (AFMA data 2016).
Effort per annum all boats	**Description effort per annum of all boats in fishery by shots or sets and hooks, for all boats**

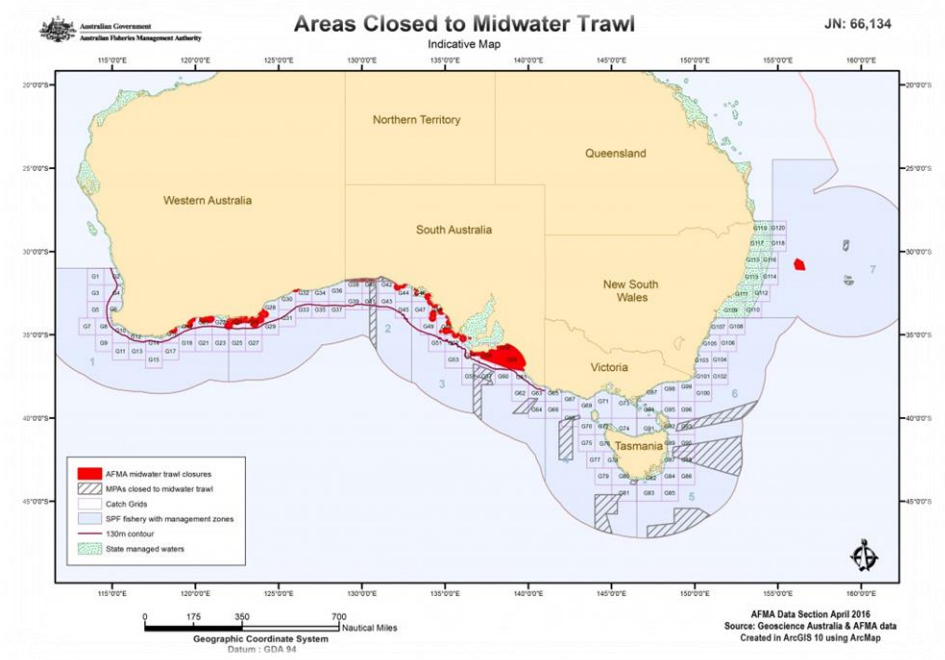
YEAR	EAST HOURS	EAST SHOTS	WEST HOURS	WEST SHOTS
2011-12	0	0	0	0
2012-13	0	0	0	0
2013-14	0	0	0	0
2014-15	31	14	19	11
2015-16	638	185	472	131
2016-17	na	na	na	na

Source: AFMA data 2016

Lost gear and ghost fishing	The gear is designed for midwater use, and thus snagging on the bottom results in damage to the gear. Potentially the gear could be snagged when trialling new or unfamiliar gear. The gear is expensive and economics provide an incentive to prevent gear loss and to recover lost gear.
Issues	
Commercial species issues	Uncertainty of stock structure Jack mackerel is the most well-known species: an old study of eastern stock found a Wahlund effect that indicates potentially genetically distinct spawning populations. Less is known of blue mackerel stock structure and nothing about redbait stock structure (Expert Panel on a Declared Fishing Activity 2014; Moore and Mazur 2015). Population/stock estimates The western stocks of jack mackerel, blue mackerel, and all redbait stocks have not had recent biomass assessments but fishing effort has been so low as to present little risk of overfishing. Lack of time series of biomass surveys from which to derive abundance indices makes monitoring and assessment these potentially highly variable stocks difficult. Eastern redbait stocks were assessed by DEPM surveys in 2005 and 2006 (Neira et al. 2008b) although catches have been low since that period. No surveys for western stock of redbait have been conducted but the status of this stock is considered not overfished(Patterson *et al.* 2016). Eastern blue mackerel stocks were assessed by DEPM survey of the spawning area of in 2014 (Ward *et al.* 2015a). Results suggested a large spawning biomass although improved estimates of adult biological parameters are still needed (Small Pelagic Fishery Scientific Panel 2015). Catches have been about 15% of recommended Biological Catch (RBC)(Patterson *et al.* 2016) . Eastern jack mackerel stocks were assessed by DEPM in 2014 (Ward *et al.* 2015b) and found to be consistent with previous DEPMs. There have been no DEPMs for western stock therefore precautionary TACs are set (Lyle et al. 2014). Catches have been very small proportion of RBC in either sub-area (Department of Environment 2015; Moore and Mazur 2015; Patterson *et al.* 2016). Eastern Australian sardine stocks were assessed by DEPM in 2014 (Ward *et al.* 2015a; Ward *et al.* 2015b). Sardine is not considered a key commercial species by the midwater trawl method however catches from this area and from Victorian, Tasmanian and New South Wales waters are deducted from the TAC. The western stock is co-managed by South and Western Australia, and no catches are permitted to be retained under a Commonwealth licence (Australian Fisheries Management Authority 2016). Bycatch trigger limits of 100 tonnes per jurisdiction apply after which the waters to 130m will be closed for the duration of the season.
Byproduct and bycatch issues and interactions	Since 2014, silver warehou *Seriolella punctata*, rubyfish *Plagiogeneion rubiginosum*, latchet *Pterygotrigla polyommata*, frigate mackerel *Auxis thazard*, Gould's squid *Nototodarus gouldi*, Australian bonito *Sarda australis*, hapuku *Polyprion oxygeneios*, blue grenadier *Macruronus novaezelandiae* were the byproduct species. They contributed 0.32% of the retained catch and 0.31% of the total caught (retained and discarded). Silver warehou was the most retained byproduct species although only contributed to 0.2% of the retained catch (AFMA logbook data 2016).

	The discarded catch was 1.6 % of total caught (i.e. retained and discarded). It comprised 73% key commercial species (due to loss, downgrading) and 5% were byproduct species. The remaining 22% were the bycatch species predominantly Australian sardine which is not a commercial species in the midwater trawl sub-fishery. Protected species comprised 0.003% of total caught (retained and discarded). Silver warehou is managed in the SESSF at Tier 1 (for 2014-15 season =2329 t) (Georgeson *et al.* 2015). The current catches have been trending well below the RBCs for past few years and there appears to have been a nine-year run of lower than average recruitment (SlopeRAG Meeting November 2015). Blue Grenadier is also managed as Tier 1 in the SESSF (6800t in 2014-15 (Georgeson *et al.* 2015) & 8796 in 2015-16 (AFMA 2016: http://www.afma.gov.au/portfolio-item/blue-grenadier/. About 20% of the RBC was caught in 2014-15 season.
Protected species issues and interactions	Two reports by the Expert Panel on a Declared Commercial Fishing Activity found that 241 species of threatened, endangered or protected species occur throughout the SPF but relatively few interact with fisheries (Expert Panel on a Declared Fishing Activity 2014; 2015). Previously, only a few interactions were recorded with Australian fur seals, common dolphin but recent increased fishing effort in the SPF resulted in more reported interactions (Australian fur seals, common dolphin and albatross) (AFMA logbook data 2016). Mitigation measures prescribed by the Vessel Management Plan (VMP) were immediately implemented. These measures included prohibition of night fishing, additional electronic monitoring, 6 month bans in the event of further mortalities of dolphins. The VMP now prescribes "trigger" limits of mortality (replacing ban on night fishing), area closures and net-setting protocols, codes of practice, and physical mitigation measures such as pingers, seal excluders and bird bafflers. Protected species have been landed as bycatch in this fishery in the period 2010-2016: migratory: shortfin mako and conservation dependent species: southern bluefin tuna, blue warehou, eastern gemfish) (AFMA 2016). The shortfin mako, longfin mako and porbeagle were listed as a migratory species under Part 13 of the EPBC Act on 29 January 2010 (https://www.legislation.gov.au/Details/F2010L00033) following the inclusion of the species in Appendix II of the Convention of Migratory Species (an international agreement to which Australia is a signatory). Interactions with the species and life status of discards must be recorded. There is a mandatory requirement that live individuals are released unharmed and commercial fishers can only retain individuals that are captured dead (http://www.environment.gov.au/biodiversity/threatened/species/pubs/79073-listing-advice.pdf).
Habitat issues and interactions	None identified in previous ERAEF assessment. The gear is designed to fish in the water column. In a rare event that the gear does come into contact with the bottom, the impact on benthic habitats is likely to be minimal compared to demersal trawling. The Department of Environment in their recent assessment of the SPF (Department of Environment 2015) found the methods used in the SPF mitigated any concerns of physical habitat modification from fishing impacts raised by Marine Bioregional Plan for the Temperate East Marine Region 2012 and the Marine Bioregional Plan for the South-west Marine Region 2012.
Community issues and interactions	Small pelagic fish are a key functional link between the planktonic trophic levels and the higher predators such as SBT, marine mammals and seabirds in the southern marine ecosystem. The shared nature of this resource, its ecological importance within the broader marine environment, and its trophic importance in supporting other more valuable fisheries, make the species of the SPF a valuable component of Australia's marine ecosystem that needed further examination. The expansion of the fishery in the mid-2000s, resulted in several FRDC-funded studies on the SPF, including the role of the SPF fishes in the ecosystem (Bulman et al. 2011). This study used ecosystem models in the eastern (EBS EwE) and the western (GAB EwE) subareas to investigate the dynamics of SPF–focussed foodwebs. These ecosystem models are based on dietary matrices that incorporate all current knowledge of the species diets and consequently, trophic relationships. Further ecosystem modelling was undertaken in a study commissioned by the Marine Stewardship Council to investigate the ecosystem effects of harvesting low trophic level species including jack mackerel, sardine and redbait, using the EBS and the ATLANTIS-SE models (Smith et al. 2011). Atlantis was also used to model scenarios with regard to biomass estimates of jack mackerel in the eastern zone (Fulton 2013) and revisions to the SPF Harvest Strategy (Smith et al. 2015). Upon the nomination of a "supertrawler" to enter the SPF in 2012 and the subsequent public furore, the Minister for Environment declared an interim ban while a panel was established to investigate the potential ecosystem effects of vessel fishing activity. The Panel reviewed and summarised all existing ecosystem modelling for the SPF (Expert Panel on a Declared Fishing Activity 2014). Ecosystem and management strategy evaluation modelling studies suggested that the species-specific exploitation rates in the SPF are unlikely to cause adverse impacts on the ecosystem (Giannini et al. 2010; Johnson et al. 2010; Smith et al. 2011; Smith et al. 2015) although central-placed foragers such as the fur seals and some seabirds that breed onshore and in proximity to fishing grounds might be potentially at risk at critical times. Until 2014 there has been little activity in the SPF and catches have been low presenting little risk to these species but the current VMP partially addresses this issue through the Regional Catch limits and allocations.

	The Department of Environment in their recent assessment of the SPF (Department of Environment 2015) found the active management of the SPF mitigated any concerns raised by fishing impacts on the key ecological features in the area of the Small Pelagic Fishery identified by Marine Bioregional Plan for the Temperate East Marine Region 2012 and the Marine Bioregional Plan for the South-west Marine Region 2012.
Discarding	There is little discarding of the key commercial species but bycatch species may be discarded. Rates of discarding are <1.35% overall (AFMA data 2016). Discarding of bycaught species is prohibited while the gear is in the water (VMP Geelong Star 2016).
Management: planned and those implemented	
Management Objectives	The management objectives from AFMA's SPF Management Plan are the same as the Fisheries Management Act 1991: (1) The following objectives must be pursued by the Minister in the administration of this Act and by AFMA in the performance of its functions: (a) implementing efficient and cost-effective fisheries management on behalf of the Commonwealth; and (b) ensuring that the exploitation of fisheries resources and the carrying on of any related activities are conducted in a manner consistent with the principles of ecologically sustainable development (which include the exercise of the precautionary principle), in particular the need to have regard to the impact of fishing activities on non-target species and the long term sustainability of the marine environment; and (c) maximizing the net economic returns to the Australian community from the management of Australian fisheries; and (d) ensuring accountability to the fishing industry and to the Australian community in AFMA's management of fisheries resources; and (e) achieving government targets in relation to the recovery of the costs of AFMA. (2) In addition to the objectives mentioned in subsection (1), or in section 78 of this Act, the Minister, AFMA and Joint Authorities are to have regard to the objectives of: (a) ensuring, through proper conservation and management measures, that the living resources of the AFZ are not endangered by over-exploitation; and (b) achieving the optimum utilization of the living resources of the AFZ; and (c) ensuring that conservation and management measures in the AFZ and the high seas implement Australia's obligations under international agreements that deal with fish stocks; and (d) to the extent that Australia has obligations: (i) under international law; or (ii) under the Compliance Agreement or any other international agreement; in relation to fishing activities by Australian-flagged boats on the high seas that are additional to the obligations referred to in paragraph (c)—ensuring that Australia implements those first-mentioned obligations; but must ensure, as far as practicable, that measures adopted in pursuit of those objectives must not be inconsistent with the preservation, conservation and protection of all species of whales.
Fishery management plan	Small Pelagic Fishery Management Plan 2009 was amended in 2014 and is still current (Australian Fisheries Management Authority 2014b). It outlines the management requirements and procedures for the fishery including: • specific ecosystem requirements • TAC • right to fish in the fishery • availability of SFRs • transfer and lease of SFRs • obligations applying to holders of SFRs • directions not to engage in fishing. In addition, the revised Small Pelagic Harvest Strategy 2008 (SPFHS) (Australian Fisheries Management Authority 2015) describes arrangements for harvesting target species and some byproduct species in line with the Commonwealth Fisheries Harvest Strategy Policy and Guidelines 2007. The objective of the HS is the sustainable and profitable utilization of the Small Pelagic Fishery in perpetuity through the implementation of a harvest strategy that maintains key commercial stocks at ecologically sustainable levels and, within this context, maximizes the net economic returns to the Australian community (see Enabling Processes for further details).

<table>
<tr><td>Input controls</td><td>Operators are required to hold Commonwealth trawl entitlements SFRs when midwater trawling for small pelagics in the area of other Commonwealth trawl fisheries.
Vessels >130 m are not permitted in the Australian Fishing Zone.</td></tr>
<tr><td>Output controls</td><td>TAC for key commercial species
<table><tr><th></th><th>2011-12</th><th>2012-13</th><th>2013-14</th><th>2014-15</th><th>2015-16</th><th>2016-17</th></tr><tr><td>Jack mackerel E</td><td>4600</td><td>10100</td><td>9800</td><td>10230</td><td>18670</td><td>18670</td></tr><tr><td>Jack mackerel W</td><td>5000</td><td>5000</td><td>5000</td><td>5000</td><td>3600</td><td>3600</td></tr><tr><td>Redbait E</td><td>8600</td><td>6900</td><td>5000</td><td>5000</td><td>3310</td><td>3310</td></tr><tr><td>Redbait W</td><td>5000</td><td>5000</td><td>5000</td><td>5000</td><td>2880</td><td>2880</td></tr><tr><td>Blue mackerel E</td><td>2500</td><td>2600</td><td>2700</td><td>2660</td><td>2630</td><td>2630</td></tr><tr><td>Blue mackerel W</td><td>4200</td><td>6500</td><td>6500</td><td>6500</td><td>6200</td><td>6200</td></tr><tr><td>Australian sardine E</td><td>400</td><td>200</td><td>270</td><td>1880</td><td>1880</td><td>1880</td></tr></table></td></tr>
<tr><td>Technical measures</td><td>Mesh size in cod-end is restricted to not less than 30 mm.
 

Until May 2016, all spatial colures that applied to the SESSF midwater trawl fishery applied by default to the SPF as a consequence of the requirement for SPF operators to also hold a SESSF concession (see map above). Subsequently, a review of the closures found that the majority of the closures not relevant to this sub-fishery given the depth and nature of species targeted being different to those in the SESSF, and subsequently a number of these closures were removed. The closures that remain include the Australian sea lion closures, Coorong dolphin closure in the Western sub-area and the Derwent Hunter Seamount closure all (implemented via the VMP).
Additional restrictions were also applied: trawling was not permitted during hours of darkness nor for six months in any management zoned in which there were a fatal interactions with dolphins (SPF (Closures) Direction No. 1 2015). The night time fishing ban was subsequently removed.

Obligations with regard to report the capture of Harrison’s dogfish, Southern Dogfish and Endeavour dogfish and evidence of benthic impacts apply but these have so far never occurred.</td></tr>
<tr><td>Regulations</td><td>The Fisheries Management Regulations 1992 prescribes detail on the management arrangements implemented in Commonwealth fisheries. Specifically they cover; bans on vessels over 130 m, administration of and standard conditions for fishing concessions including VMS operation, carrying observers, processing fish, marine</td></tr>
</table>

	environment impacts, payments and fees, registers and administration and allocation of statutory fishing rights (SFRs), discarding offal at sea (not attributed to this fishery). Additional regulations were introduced regarding navigation in closures. Additional rules are contained in the Management Plan and SFR conditions. Under the EPBC Act 1999, interactions with a protected species must be reported within seven days of the incident occurring to the Department of Environment. A Memorandum of Understanding between AFMA and the Department for the Reporting of Fisheries Interactions with Protected Species (Reporting MOU) streamlines those reporting requirements (DoE 2015). AFMA reports its protected species interactions to the Department on a quarterly basis. Amendments to the International Maritime Organisation's International Convention for the Prevention of Pollution from Ships (MARPOL) Annex V which came into force on 1 January 2013 prohibit the discharge of all garbage, from all ships, into the sea (except as provided otherwise, under specific circumstances). Garbage is all kinds of food wastes, domestic wastes and operational wastes, all plastics, cargos residues, incinerator ashes, cooking oil, fishing gear, and animal carcasses generated during the normal operation of the ship and liable to be disposed of continuously or periodically except those substances which are defined or listed in other Annexes to the present Convention but not fish as a results of fishing or aquaculture activities. https://www.amsa.gov.au/environment/regulations/garbage-management-plans/sample.asp. Fishing gear is included in the definition of 'garbage' for the Convention http://www.environment.gov.au/system/files/resources/d945695b-a3b9-4010-91b4-914efcdbae2f/files/tap-review-marine-debris.pdf. Vessels of over 100 gross tonnage or which carries over 15 persons must have a Garbage Management Plan. Compliance by fishing vessels with the requirements of MARPOL Annex V and domestic marine pollution legislation on Commonwealth-licensed Australian fishing boats is monitored through the observer program (AFMA). Almost 100% compliance has been observed amongst domestic vessels while observers are on board (Jones, 1994) but this is only a minor part of observers' duties and may not be representative. Fishers are encouraged to record loss of gear in vessel logbooks, however it is only compulsory for vessels operating in the Southern Ocean under the management of the Convention for the Conservation of Antarctic Marine Living Resources (CCAMLR). http://www.environment.gov.au/system/files/resources/d945695b-a3b9-4010-91b4-914efcdbae2f/files/marine-debris-background-paper.pdf
Initiatives and strategies	SPF Management Arrangements Booklet 2016-17 documents all regulations. The SPF Bycatch and Discarding Workplans 2014-16 documents mandatory measures to minimize the risk of interactions with seabirds, seals and dolphins. An AFMA-approved Vessel Management Plan (VMP) is required for any vessel operating in the SPF midwater trawl sub-fishery. The current VMP documents and specifies mandatory mitigation measures and operational procedures currently applicable, and includes: • not discharging biological material into the water while fishing gear is in the water • clean net of stickers • quick deployment and retrieval of gear • use of marine mammal excluder devices • use of net bindings • deployment if least one type of physical mitigation measure over each trawl door warp and both types for the net sonde cable • absence of dolphins when setting gear • observance of regional catch limits • observance of spatial exclusions • observer coverage for ten trips or first 12 months, • e-monitoring systems, • mandatory notification of protected species interactions as prescribed. The Management Arrangements and VMPs are reviewed annually to allow for improvement. Bycatch and Discarding Workplans are reviewed every 6 months with a full assessment of the overall effectiveness of the workplan actions in addressing the associated bycatch risks or discard reduction at 24 months.
Enabling processes	<u>Monitoring</u> The SPF management arrangement booklet requires that observer coverage target of at least 20% of effort in the midwater trawl fishery. For new boats entering the fishery or existing boats moving into significantly new areas, observer coverage must be at least the first 10 trips. The current version of the VMP requires that: • an AFMA observer is on board at all times. • an AFMA approved e-monitoring system is operating during all fishing activity.

- all interactions with listed and protected species are recorded via e-logs or in the daily fishing log and submitted to AFMA with the relevant fishing log sheets.
- all interactions with protected species are reported to AFMA within 24 hours.

Assessment

Two DEPM surveys have been conducted during the past 5 years to establish spawning biomass in eastern stocks of jack mackerel, blue mackerel and sardine but not of redbait. The last DEPM survey for redbait was 2005. The recent surveys have provided estimates of spawning biomass consistent with those conducted earlier, and are the basis for the annual assessment and TAC setting process under the SPF HS (see below).

Summary of tier framework from the current SPF Harvest Strategy (Australian Fisheries Management Authority 2015)

The SPF HS applies to each zone of the fishery and is used to develop advice on Recommended Biological Catches (RBCs) and Total Allowable Catches (TACs) for each quota species. RBCs derived from the SPF HS apply to fish stocks throughout their range and to mortality resulting from all types of fishing. There is also capacity to establish finer scale spatial management within zones on the basis of new information about stock structure or practicalities of stock assessment. The current HS applies to:

- Jack mackerels (Trachurus declivis, and T. murphyi,)
- Blue mackerel (Scomber australasicus)
- Redbait (Emmelichthys nitidus)
- Australian sardine (Sardinops sagax) in Commonwealth waters adjacent to NSW.

An Annual Fishery Assessment is required for the RBC setting processes under Tier 1, Tier 2 and Tier 2b - Atlantis. It covers the previous financial year (i.e. 1 July to 30 June). Progressive information available from the season to date, if available, may also be considered. The Annual Fishery Assessment must include:

- length frequency and otolith information from catches for each stock fished.
- catch and effort data as well as annual information on the age structure of catch
- spatial and temporal patterns of effort/catch, and
- should aim to determine the likelihood of localised depletion or change in the size/age structure of the catch that cannot be adequately explained by reasons other than a decline in abundance.

Adequate sampling of catches for size/age data is required for the species/zone to remain at the Tier 1, Tier 2 level.

The tiered HS framework includes four tier levels with different information needs and harvest control rules:

• Tier 1, based on a quantitative stock assessment and an Annual Fishery Assessment, provides the greatest certainty in RBC setting and allows the highest potential harvest rate

• Tier 2 provides a medium level of assessment based on an Annual Fishery Assessment and allows a lower potential harvest rate

• Tier 2(b) – Atlantis provides a lower levels of assessment based on an Annual Fishery Assessment and Atlantis - SPF modelling

• Tier 3 is the lowest level of assessment and applies when the requirements of other Tier levels are not met.

NB The SPF HS is currently in review.

Tier 1 maximum exploitation rates

SPECIES	WESTERN ZONE	EASTERN ZONE	MAXIMUM TIME AT TIER 1 WITHOUT A DEPM
Australian sardine	N/A	20%	5 seasons
Blue mackerel	15%	15%	5 seasons
Jack mackerels	12%	12%	5 seasons
Redbait	10%	10%	5 seasons

Source: Australian Fisheries Management Authority (2015)

<table>
<tr><td></td><td>

Tier 2 maximum RBC exploitation rates

SPECIES	WESTERN ZONE	EASTERN ZONE	MAXIMUM TIME AT TIER 2
Australian sardine	N/A	10%	5 seasons
Blue mackerel	7.5%	7.5%	5 seasons
Jack mackerels	6%	6%	10 seasons
Redbait	5%	5%	10 seasons

Source: Australian Fisheries Management Authority (2015)
</td></tr>
<tr><td>Other initiatives or agreements</td><td>State, national or international conventions or agreements that impact on the management of the fishery/sub-fishery being evaluated.
Almost all stocks are multijurisdictional and are managed jointly by the Australian and relevant state governments except for the western stock of Australian sardine which is managed by South Australia as the South Australian Sardine Fishery (SASF). The eastern stock of Australian sardine is co-managed by the Australian, New South Wales, Victorian and Tasmanian governments (Moore and Mazur 2015).</td></tr>
<tr><td colspan="2">Data</td></tr>
<tr><td>Logbook data</td><td>Catch and effort data and all interactions with protected species are recorded on a shot by shot basis in Daily Logbooks. Data has been compiled into a centralised database by AFMA and is updated annually to a CSIRO O & A. Summaries of the data have been made available by AFMA for this ERAEF assessment as the validation of the latest update to the CSIRO database was not available.</td></tr>
<tr><td>Observer data</td><td>The purpose of the Observer Program is to “provide fisheries managers, research organizations, environmental agencies, the fishing industry and the wider community with independent, reliable, verified and accurate information on the fishing catch, effort and practice of a wide range of boats operating inside, and periodically outside, the Australian Fishing Zone” (AFMA http://www.afma.gov.au/fisheries-services/observer-services/: accessed 29 June 2016).
AFMA observers are highly experienced in fishery observer work in Australia. They:
• collect data on independent boat activity and catch data (not recorded in official logbooks)
• collect data and samples for research programs, supporting marine management and other issues relevant to environmental awareness and fisheries management
• monitor compliance of the boat with its fishing concession.
Observer data is collated in AFMA's centralised database and data have been made available outside AFMA in the form of observer trip reports and as raw data.
Coverage: The current SPF FM Booklet states that the observer coverage target is at least 20% of effort. For new boats entering the fishery or existing boats moving into significantly new areas, observer coverage for at least the first 10 trips is required. This is in accordance with the EPBC Act 1999. Current rates are 100%.</td></tr>
<tr><td>Other data</td><td>SARDI collate detailed biological data including DEPM surveys on the four key commercial species which are assessed annually (Ward et al. 2014).</td></tr>
</table>

2.2.2 Unit of Analysis Lists (Step 2)

The units of analysis for the sub-fishery are listed by component:

- Species Components (key commercial, byproduct, bycatch and protected components). [Scoping document S2A Species]
- Habitat Component: habitat types. [Scoping document S2B Habitats]
- Community Component: community types. [Scoping document S2C Communities]

The number of units of analysis examined in this report is shown by component in the following Table.

Table 2.3 Number of units of analysis examined in this report confirmed by the AFMA & SPF Scientific Panel

KEY COMMERCIAL	BY-PRODUCT	BY-CATCH	PROTECTED	HABITATS	COMMUNITIES
3	8	48	126	22	14

Scoping Document S2A Species list

Each species identified during the scoping is added to the ERAEF database for further analyses if required. A CAAB code (Code for Australian Aquatic Biota) is required to input the information. The CAAB codes for each species may be found at http://www.marine.csiro.au/caab/

Key commercial species

This list was compiled by AFMA.

Table 2.4 Key Commercial (C1 and C2) species in the Small Pelagic Fishery Midwater Trawl sub-fishery. Note the use of specific and groups, however, there are three species in total.

ERAEF SPECIES ID	ROLE IN FISHERY (COMPONENT)	TAXA	FAMILY NAME	SCIENTIFIC NAME	COMMON NAME	CAAB CODE	SOURCE
155	C1	Teleost	Emmelichthyidae	*Emmelichthys nitidus*	Redbait	37345001	AFMA
	C1	Teleost	Emmelichthyidae	*Emmelichthys* spp.	Redbait (mixed)	37345901	AFMA
1088	C1	Teleost	Carangidae	*Trachurus declivis*	Jack mackerel	37337002	AFMA
	C1	Teleost	Carangidae	*Trachurus declivis & Trachurus murphyi*	Jack Mackerels	37337912	AFMA
210	C1	Teleost	Scombridae	*Scomber australasicus*	Blue Mackerel	37441001	AFMA

NB There are no C2 (secondary commercial species in this sub-fishery)

Byproduct species

Byproduct refers to any part of the catch which is kept or sold by the fisher but which is not a key commercial species. This list was compiled by AFMA.

Table 2.5 Byproduct species in the Small Pelagic Fishery Midwater Trawl sub-fishery.

ERAEF species ID	Role in fishery (Component)	Taxa	Family name	Scientific name	Common Name	CAAB code	Reference
1069	BP	Teleost	Centrolophidae	*Seriolella punctata*	Silver Warehou	37445006	AFMA logbooks
	BP	Teleost	Emmelichthyidae	*Plagiogeneion rubiginosum*	Rubyfish	37345003	AFMA logbooks
	BP	Teleost		*Pterygotrigla polyommata*	Latchet	37288006	AFMA logbooks
	BP	Teleost		*Auxis thazard*	Frigate Mackerel	37441009	AFMA logbooks
11	BP	Invertebrate	Ommastrephidae	*Nototodarus gouldi*	Arrow Squid	23636004	AFMA logbooks
	BP	Teleost		*Sarda australis*	Australian bonito	37441020	AFMA logbooks
	BP	Teleost		*Polyprion oxygeneios*	Hapuku	37311006	AFMA logbooks
982	BP	Teleost	Merluciidae	*Macruronus novaezelandiae*	Blue Grenadier	37227001	AFMA logbooks

Bycatch species

Bycatch as defined in the Commonwealth Policy on Fisheries Bycatch 2000 refers to:

- that part of a fisher's catch which is returned to the sea either because it has no commercial value or because regulations preclude it being retained; and
- that part of the 'catch' that does not reach the deck but is affected by interaction with the fishing gear

However, in the ERAEF method, the part of the key commercial or byproduct catch that is discarded is included in the assessment of the key commercial or byproduct species. The list of bycatch species was compiled by AFMA. The generic groups have not been expanded in this case. Bycatch overall was low (~42 tonnes) and specific catches were often very low e.g. 1 kg of Dasyatidae or Apogonidae; too generic e.g. 15 kg of mixed reef fish; or of invertebrates, e.g. Salpidae, Octopodidae. Expansion for the groups where catches were >100 kg (and of species whose distributions were in >50 m), would result in an extra 109 species added to the list but has not been provided here. The highest bycatch was sardine at 24 t but is considered in the annual stock assessment for this species and is an insignificant portion of the TAC.

Table 2.6 Bycatch species (BC) in the Small Pelagic Fishery Midwater Trawl sub-fishery

ERAEF SPECIES ID	ROLE IN FISHERY (COMPONENT)	TAXA	FAMILY NAME	SCIENTIFIC NAME	COMMON NAME	CAAB CODE	REFERENCE
	BC	Teleost	Clupeidae	*Sardinops sagax*	Australian Sardine	37085002	AFMA logbooks
	BC	Teleost	Emmelichthyidae	*Plagiogeneion* spp	Rubyfish (mixed)	37345900	AFMA logbooks
208	BC	Chondrichthyan	Carcharhinidae	*Carcharhinus brachyurus*	Bronze Whaler	37018001	AFMA logbooks
	BC	Teleost	Berycidae	*Centroberyx affinis*	Redfish	37258003	AFMA logbooks
69	BC	Teleost	Alopiidae	*Alopias* spp.	Thresher Sharks (mixed)	37012901	AFMA logbooks
214	BC	Chondrichthyan	Carcharhinidae, Hemigaleidae	Carcharhinidae, Hemigaleidae - undifferentiated	Whaler and weasel sharks	37018000	AFMA logbooks
1097	BC	Chondrichthyan	Carcharhinidae	*Carcharhinus obscurus*	Dusky Whaler	37018003	AFMA logbooks

ERAEF SPECIES ID	ROLE IN FISHERY (COMPONENT)	TAXA	FAMILY NAME	SCIENTIFIC NAME	COMMON NAME	CAAB CODE	REFERENCE
1037	BC	Teleost	Gempylidae	*Thyrsites atun*	Barracouta	37439001	AFMA logbooks
	BC	Teleost	Molidae	*Mola ramsayi*	Short Sunfish	37470001	AFMA logbooks
150	BC	Invertebrate	Salpidae	Salpidae - undifferentiated	Salps	35103000	AFMA logbooks
1087	BC	Chondrichthyan	Carcharhinidae	*Galeocerdo cuvier*	Tiger Shark	37018022	AFMA logbooks
	BC	Teleost	Tetraodontidae	Tetraodontidae - undifferentiated	Toadfishes unspecified	37467000	AFMA logbooks
958	BC	Chondrichthyan	Multi-family	Skates & rays, unspecified	Skates and rays	37990018	AFMA logbooks
215	BC	Teleost	Xiphiidae	*Xiphias gladius*	Swordfish	37442001	AFMA logbooks
1068	BC	Teleost	Zeidae	*Zenopsis nebulosus*	Mirror Dory	37264003	AFMA logbooks
	BC	Teleost	Balistidae, Monacanthidae	Balistidae, Monacanthidae - undifferentiated	Leatherjackets	37465000	AFMA logbooks
233	BC	Teleost	Carangidae	*Decapterus* spp.	Scad (mixed)	37337901	AFMA logbooks
252	BC	Invertebrate	Octopodidae	Octopodidae - undifferentiated	Octopuses	23659000	AFMA logbooks
	BC	Teleost	Diodontidae	Diodontidae - undifferentiated	Porcupine Fish	37469000	AFMA logbooks
	BC	Teleost	Mobulidae	*Manta birostris*	Giant Manta Ray	37041004	AFMA logbooks
	BC	Invertebrate	Porifera	Porifera - undifferentiated	Sponges	10000000	AFMA logbooks
	BC	Teleost	Monacanthidae	*Nelusetta ayraudi*	Ocean Jacket	37465006	AFMA logbooks
	BC	Teleost	Myctophidae	Myctophidae - undifferentiated	Lanternfishes	37122000	AFMA logbooks
	BC	Teleost	Gempylidae	*Ruvettus pretiosus*	Oilfish	37439003	AFMA logbooks
	BC	Teleost	Carangidae	*Pseudocaranx georgianus*	Silver Trevally	37337062	AFMA logbooks
	BC	Teleost	Ophiliidae	*Genypterus blacodes*	Pink Ling	37228002	AFMA logbooks
	BC	Teleost	Trichiuridae	*Lepidopus caudatus*	Frostfish	37440002	AFMA logbooks
	BC	Teleost	Cyttidae	*Cyttus australis*	Silver Dory	37264002	AFMA logbooks
	BC	Teleost	Mixed	Mixed reef fish	Fish (mixed)	37999999	AFMA logbooks

ERAEF SPECIES ID	ROLE IN FISHERY (COMPONENT)	TAXA	FAMILY NAME	SCIENTIFIC NAME	COMMON NAME	CAAB CODE	REFERENCE
	BC	Chondrichthyan	Triakidae	*Mustelus antarcticus*	Gummy Shark	37017001	AFMA logbooks
	BC	Teleost	Platycephalidae	Platycephalidae - undifferentiated	Flatheads	37296000	AFMA logbooks
	BC	Teleost	Triglidae	*Chelidonichthys kumu*	Red Gurnard	37288001	AFMA logbooks
	BC	Chondrichthyan	Carcharhinidae	*Prionace glauca*	Blue Shark	37018004	AFMA logbooks
	BC	Teleost	Cheilodactylidae	*Nemadactylus macropterus*	Jackass Morwong	37377003	AFMA logbooks
	BC	Teleost	Pristiophoridae	*Pristiophorus cirratus*	Common Sawshark	37023002	AFMA logbooks
	BC	Teleost	Oplegnathidae	*Oplegnathus woodwardi*	Knifejaw	37369002	AFMA logbooks
	BC	Teleost	Lutjanidae	*Etelis* spp	Long TailRubies/Snapper	37346914	AFMA logbooks
	BC	Teleost	Trachipteridae	*Trachipterus arawatae*	Southern Ribbonfish	37271001	AFMA logbooks
	BC	Teleost	Regalecidae	*Regalecus glesne*	Oarfish	37272002	AFMA logbooks
	BC	Teleost	Carangidae	*Seriola dumerili*	Amberjack	37337025	AFMA logbooks
	BC	Chondrichthyan	Callorhinchidae	*Callorhinchus milii*	Elephantfish	37043001	AFMA logbooks
	BC	Teleost	Serranidae	*Caprodon longimanus*	Longfin Perch	37311095	AFMA logbooks
	BC	Teleost	Acropomatidae	*Apogonops anomalus*	Three-spine Cardinalfishes	37311053	AFMA logbooks
	BC	Chondrichthyan	Squalidae	*Squalus mitsukurii*	Greeneye Dogfish	37020007	AFMA logbooks
	BC	Teleost	Sebastidae	*Helicolenus percoides*	Reef Ocean Perch	37287001	AFMA logbooks
	BC	Chondrichthyan	Dasyatidae	Dasyatidae - undifferentiated	Stingrays	37035000	AFMA logbooks
	BC	Teleost	Berycidae	*Centroberyx lineatus*	Swallowtail	37258005	AFMA logbooks
	BC	Chondrichthyan	Pristiophoridae	*Pristiophorus nudipinnis*	Southern Sawshark	37023001	AFMA logbooks
	BC	Teleost	Trachichthyidae	*Paratrachichthys macleayi*	Sandpaper fish	37255003	AFMA logbooks

Protected species

Protected species are those species listed as Threatened, Endangered or Protected under the EPBC Act, and also those that are listed migratory, marine, cetacean or conservation dependent. They are often poorly listed by fisheries due to low frequency of direct interaction.

A list of Protected species was generated from the AFMA logbooks and observer logs initially (see AFMA ERM update) (highlighted in Table 2.7). These were species that had either interacted with the gear or were observed in the vicinity of the fishing vessels. Family groups were then expanded with species from the relevant family that appeared in the previous (2006) SPF ERAEF assessment and by reviewing other relevant such as the Reports of the Expert Panel on a Declared Fishing Activity (2014, 2015) but had not been individually identified (see Expanded families section in Table 2.7). This expansion includes many species that have never been observed to interact with the fishery.

Other protected species, whose geographic range potentially overlapped with the fishery or had a proven or perceived susceptibility to the fishing gear in similar fisheries elsewhere but that were not observed at all during the assessment period, were not included. Compared to the previous assessment where all species that were reported as potentially occurring within the fishery jurisdiction were listed, this method has resulted in a significant reduction in the number of species listed for assessment.

Table 2.7 Protected Species (PS) in the Small Pelagic Fishery Midwater Trawl sub-fishery. Known sightings and/or direct interactions from observers/logbooks are highlighted (n=41).

ERAEF SPECIES ID	ROLE IN FISHERY (COMPONENT)	TAXA	FAMILY NAME	SCIENTIFIC NAME	COMMON NAME	CAAB CODE	REFERENCE
	PS	Chondrichthyan		*Galeorhinus galeus*	School shark,	37017008	from EP report
	PS	Chondrichthyan		*Isurus oxyrinchus*	Shortfin mako, mako shark	37010001	observer report
1067	PS	Chondrichthyan	Rhincodontidae	*Rhincodon typus*	Whale shark	37014001	observer report
	PS	Teleost	Gempylidae	*Rexea solandri*	Gemfish	37439002	from EP report
	PS	Teleost	Scombridae	*Thunnus maccoyii*	Southern bluefin tuna	37441004	from EP report
	PS	Teleost	Centrolophidae	*Seriolella brama*	Blue Warehou	37445005	AFMA logs
	PS	Marine bird	Diomedeidae	*Diomedeidae - undifferentiated*	Albatrosses	40040000	AFMA logs

ERAEF SPECIES ID	ROLE IN FISHERY (COMPONENT)	TAXA	FAMILY NAME	SCIENTIFIC NAME	COMMON NAME	CAAB CODE	REFERENCE
1032	PS	Marine bird	Diomedeidae	*Thalassarche bulleri*	Buller's Albatross	40040001	observer report
1033	PS	Marine bird	Diomedeidae	*Thalassarche cauta*	Shy Albatross	40040002	observer report
1086	PS	Marine bird	Diomedeidae	*Thalassarche steadi*	White-capped Albatross	not in CAAB list	AFMA observer report
1034	PS	Marine bird	Diomedeidae	*Thalassarche chlororhynchos*	Yellow-nosed Albatross	40040003	AFMA observer report
1035	PS	Marine bird	Diomedeidae	*Thalassarche chrysostoma*	Grey-headed Albatross	40040004	AFMA observer report
451	PS	Marine bird	Diomedeidae	*Diomedea exulans*	Wandering Albatross	40040006	AFMA observer report
1085	PS	Marine bird	Diomedeidae	*Thalassarche melanophrys*	Black-browed Albatross	40040007	AFMA observer report
1008	PS	Marine bird	Diomedeidae	*Phoebetria fusca*	Sooty Albatross	40040008	AFMA observer report
1009	PS	Marine bird	Diomedeidae	*Phoebetria palpebrata*	Light-mantled Albatross	40040009	AFMA observer report
		Marine bird	Procellariidae	Procellaridae-undifferentiated	Petrels and shearwaters	40041000	AFMA observer report
		Marine bird	Procellariidae	Procellaridae-undifferentiated	Prions	40041000	AFMA observer report
595	PS	Marine bird	Procellariidae	*Daption capense*	Cape Petrel	40041003	AFMA observer report
73	PS	Marine bird	Procellariidae	*Macronectes giganteus*	Southern Giant-Petrel	40041007	AFMA observer report
981	PS	Marine bird	Procellariidae	*Macronectes halli*	Northern Giant-Petrel	40041008	AFMA observer report
1003	PS	Marine bird	Procellariidae	*Pachyptila turtur*	Fairy Prion	40041013	AFMA observer report
1006	PS	Marine bird	Procellariidae	*Pelecanoides urinatrix*	Common Diving-Petrel	40041017	AFMA observer report
1041	PS	Marine bird	Procellariidae	*Procellaria aequinoctialis*	White-chinned Petrel	40041018	AFMA observer report
1055	PS	Marine bird	Procellariidae	*Puffinus carneipes*	Flesh-footed Shearwater	40041038	AFMA observer report
1059	PS	Marine bird	Procellariidae	*Puffinus pacificus*	Wedge-tailed Shearwater	40041045	AFMA observer report
998	PS	Marine bird	Sulidae	*Morus serrator*	Australasian Gannet	40047002	AFMA observer report

ERAEF SPECIES ID	ROLE IN FISHERY (COMPONENT)	TAXA	FAMILY NAME	SCIENTIFIC NAME	COMMON NAME	CAAB CODE	REFERENCE
		Marine bird	Laridae	Laridae-undifferentiated	Terns	40128000	AFMA observer report
		Marine bird	Laridae	*Catharacta maccormicki*	Antarctic skua/South Polar skua	40128004	AFMA observer report
974	PS	Marine bird	Laridae	*Larus novaehollandiae*	Silver Gull	40128013	AFMA observer report
975	PS	Marine bird	Laridae	*Larus pacificus*	Pacific Gull	40128014	AFMA observer report
		Marine bird	Laridae	Stercorarius pomarinus	Pomarine jaeger	40128021	AFMA observer report
		Marine bird	Laridae	*Sterna bengalensis*	Lesser crested stern	40128024	AFMA observer report
1017	PS	Marine bird	Laridae	*Sterna bergii*	Crested Tern	40128025	AFMA observer report
		Marine bird	Laridae	*Gelochelidon nilotica*	Gull billed tern	40128031	AFMA observer report
984	PS	Marine mammal	Balaenopteridae	*Megaptera novaeangliae*	Humpback Whale	41112006	AFMA observer report
		Marine mammal	Delphinidae	Delphinidae-undifferentiated	Dolphins	41116000	AFMA observer report
612	PS	Marine mammal	Delphinidae	*Delphinus delphis*	Common Dolphin	41116001	AFMA observer report
	PS	Marine mammal	Otariidae	Otariidae and Phocidae	Seals	41132999	AFMA observer logs
216	PS	Marine mammal	Otariidae	*Arctocephalus forsteri*	New Zealand Fur-seal	41131001	DEH previous ERA
253	PS	Marine mammal	Otariidae	*Arctocephalus pusillus doriferus*	Australian Fur Seal	41131003	AFMA observer report
Expanded Families							
753	PS	Marine bird	Diomedeidae	*Diomedea epomophora*	Southern Royal Albatross	40040005	DEH - previous ERA
755	PS	Marine bird	Diomedeidae	*Diomedea gibsoni*	Gibson's Albatross	40040010	DEH previous ERA
628	PS	Marine bird	Diomedeidae	*Diomedea antipodensis*	Antipodean Albatross	40040011	DEH previous ERA
799	PS	Marine bird	Diomedeidae	*Diomedea sanfordi*	Northern Royal Albatross	40040012	DEH previous ERA
1084	PS	Marine bird	Diomedeidae	*Thalassarche impavida*	Campbell Albatross	40040013	DEH previous ERA

ERAEF SPECIES ID	ROLE IN FISHERY (COMPONENT)	TAXA	FAMILY NAME	SCIENTIFIC NAME	COMMON NAME	CAAB CODE	REFERENCE
1031	PS	Marine bird	Diomedeidae	*Thalassarche carteri*	Indian Yellow-nosed Albatross	40040014	DEH previous ERA
1673	PS	Marine bird	Diomedeidae	*Thalassarche platei* (formerly nov. sp)	Pacific Albatross	40 040015	DEH previous ERA
894	PS	Marine bird	Diomedeidae	*Thalassarche salvini*	Salvin's albatross	40040016	DEH previous ERA
889	PS	Marine bird	Diomedeidae	*Thalassarche eremita*	Chatham albatross	40040017	DEH previous ERA
1428	PS	Marine bird	Diomedeidae	*Diomedea amsterdamensis*	Amsterdam Albatross	40040018	DEH previous ERA
1429	PS	Marine bird	Diomedeidae	*Diomedea dabbenena*	Tristan Albatross	40040019	DEH previous ERA
1580	PS	Marine bird	Procellariidae	*Calonectris leucomelas*	Streaked shearwater	40041002	DEH previous ERA
314	PS	Marine bird	Procellariidae	*Fulmarus glacialoides*	Southern fulmar	40041004	DEH previous ERA
939	PS	Marine bird	Procellariidae	*Halobaena caerulea*	Blue Petrel	40041005	DEH previous ERA
1052	PS	Marine bird	Procellariidae	*Lugensa brevirostris*	Kerguelen Petrel	40041006	DEH previous ERA
	PS	Marine bird	Procellariidae	*Pachyptila belcheri*	Slender-billed prion	40041009	from EP report
	PS	Marine bird	Procellariidae	*Pachyptila desolata*	Antarctic prion	40041011	from EP report
	PS	Marine bird	Procellariidae	*Pachyptila salvini*	Salvin’s prion	40041012	from EP report
	PS	Marine bird	Procellariidae	*Pachyptila vittata*	Broad-billed prion	40041014	from EP report
494	PS	Marine bird	Procellariidae	*Procellaria cinerea*	Grey petrel	40041019	DEH previous ERA
1042	PS	Marine bird	Procellariidae	*Procellaria parkinsoni*	Black Petrel	40041020	DEH previous ERA
1043	PS	Marine bird	Procellariidae	*Procellaria westlandica*	Westland Petrel	40041021	DEH previous ERA
1691	PS	Marine bird	Procellariidae	*Pseudobulweria rostrata*	Tahiti Petrel	40041022	DEH previous ERA
1045	PS	Marine bird	Procellariidae	*Pterodroma cervicalis*	White-necked Petrel	40041025	DEH previous ERA
504	PS	Marine bird	Procellariidae	*Pterodroma lessoni*	White-headed petrel	40041029	DEH previous ERA
1046	PS	Marine bird	Procellariidae	*Pterodroma leucoptera*	Gould's Petrel	40041030	DEH previous ERA

ERAEF SPECIES ID	ROLE IN FISHERY (COMPONENT)	TAXA	FAMILY NAME	SCIENTIFIC NAME	COMMON NAME	CAAB CODE	REFERENCE
1047	PS	Marine bird	Procellariidae	*Pterodroma macroptera*	Great-winged Petrel	40041031	DEH previous ERA
1048	PS	Marine bird	Procellariidae	*Pterodroma mollis*	Soft-plumaged Petrel	40041032	DEH previous ERA
1049	PS	Marine bird	Procellariidae	*Pterodroma neglecta*	Kermadec Petrel (western)	40041033	DEH previous ERA
1050	PS	Marine bird	Procellariidae	*Pterodroma nigripennis*	Black-winged Petrel	40041034	DEH previous ERA
1051	PS	Marine bird	Procellariidae	*Pterodroma solandri*	Providence Petrel	40041035	DEH previous ERA
1053	PS	Marine bird	Procellariidae	*Puffinus assimilis*	Little Shearwater (Tasman Sea)	40041036	DEH previous ERA
1054	PS	Marine bird	Procellariidae	*Puffinus bulleri*	Buller's Shearwater	40041037	DEH previous ERA
1056	PS	Marine bird	Procellariidae	*Puffinus gavia*	Fluttering Shearwater	40041040	DEH previous ERA
1057	PS	Marine bird	Procellariidae	*Puffinus griseus*	Sooty Shearwater	40041042	DEH previous ERA
1058	PS	Marine bird	Procellariidae	*Puffinus huttoni*	Hutton's Shearwater	40041043	DEH previous ERA
1060	PS	Marine bird	Procellariidae	*Puffinus tenuirostris*	Short-tailed Shearwater	40041047	DEH previous ERA
918	PS	Marine bird	Hydrobatidae	*Fregetta grallaria*	White-bellied Storm-Petrel (Tasman Sea)	40042001	DEH previous ERA
917	PS	Marine bird	Hydrobatidae	*Fregetta tropica*	Black-bellied Storm-Petrel	40042002	DEH previous ERA
555	PS	Marine bird	Hydrobatidae	*Garrodia nereis*	Grey-backed storm petrel	40042003	DEH previous ERA
556	PS	Marine bird	Hydrobatidae	*Oceanites oceanicus*	Wilson's storm petrel (subantarctic)	40042004	DEH previous ERA
1004	PS	Marine bird	Hydrobatidae	*Pelagodroma marina*	White-faced Storm-Petrel	40042007	DEH previous ERA
1432	PS	Marine bird	Phaethontidae	*Phaethon rubricauda*	Red-tailed Tropicbird	40045002	DEH previous ERA
1549	PS	Marine bird	Sulidae	*Morus capensis*	Cape gannet	40047001	DEH previous ERA
1433	PS	Marine bird	Sulidae	*Sula dactylatra*	Masked Booby	40047004	DEH previous ERA
912	PS	Marine bird	Phalacrocoracidae	*Phalacrocorax fuscescens*	Black faced cormorant	40048003	DEH previous ERA

ERAEF SPECIES ID	ROLE IN FISHERY (COMPONENT)	TAXA	FAMILY NAME	SCIENTIFIC NAME	COMMON NAME	CAAB CODE	REFERENCE
1438	PS	Marine bird	Laridae	*Anous minutus*	Black Noddy	40128001	DEH previous ERA
203	PS	Marine bird	Laridae	*Anous stolidus*	Common noddy	40128002	DEH previous ERA
67	PS	Marine bird	Laridae	*Anous tenuirostris*	Lesser noddy	40128003	DEH previous ERA
325	PS	Marine bird	Laridae	*Catharacta skua*	Great Skua	40128005	DEH previous ERA
973	PS	Marine bird	Laridae	*Larus dominicanus*	Kelp Gull	40128012	DEH previous ERA
1582	PS	Marine bird	Laridae	*Procelsterna cerulea*	Grey ternlet	40128018	DEH previous ERA
1014	PS	Marine bird	Laridae	*Sterna albifrons*	Little tern	40128022	DEH previous ERA
1015	PS	Marine bird	Laridae	*Sterna anaethetus*	Bridled Tern	40128023	DEH previous ERA
1018	PS	Marine bird	Laridae	*Sterna caspia*	Caspian Tern	40128026	DEH previous ERA
	PS	Marine bird	Laridae	*Sterna dougallii*	Roseate tern	40128027	from EP report
1020	PS	Marine bird	Laridae	*Sterna fuscata*	Sooty tern	40128028	DEH previous ERA
1021	PS	Marine bird	Laridae	*Sterna hirundo*	Common tern	40128029	DEH previous ERA
	PS	Marine bird	Laridae	*Sternula nereis nereis*	Australian fairy tern	40128030	from EP report
1023	PS	Marine bird	Laridae	*Sterna paradisaea*	Arctic tern	40128032	DEH previous ERA
1024	PS	Marine bird	Laridae	*Sterna striata*	White-fronted Tern	40128033	DEH previous ERA
1025	PS	Marine bird	Laridae	*Sterna sumatrana*	Black-naped tern	40128034	DEH previous ERA
937	PS	Marine mammal	Delphinidae	*Grampus griseus*	Risso's Dolphin	41116005	DEH previous ERA
970	PS	Marine mammal	Delphinidae	*Lagenodelphis hosei*	Fraser's Dolphin	41116006	DEH previous ERA
832	PS	Marine mammal	Delphinidae	*Lagenorhynchus cruciger*	Hourglass dolphin	41116007	DEH previous ERA
971	PS	Marine mammal	Delphinidae	*Lagenorhynchus obscurus*	Dusky Dolphin	41116008	DEH previous ERA
61	PS	Marine mammal	Delphinidae	*Lissodelphis peronii*	Southern Right Whale Dolphin	41116009	DEH previous ERA
1002	PS	Marine mammal	Delphinidae	*Orcinus orca*	Killer Whale	41116011	DEH previous ERA

ERAEF SPECIES ID	ROLE IN FISHERY (COMPONENT)	TAXA	FAMILY NAME	SCIENTIFIC NAME	COMMON NAME	CAAB CODE	REFERENCE
1007	PS	Marine mammal	Delphinidae	*Peponocephala electra*	Melon-headed Whale	41116012	DEH previous ERA
1044	PS	Marine mammal	Delphinidae	*Pseudorca crassidens*	False Killer Whale	41116013	DEH previous ERA
1076	PS	Marine mammal	Delphinidae	*Sousa chinensis*	Indo-Pacific Humpback Dolphin	41116014	DEH previous ERA
1080	PS	Marine mammal	Delphinidae	*Stenella attenuata*	Spotted Dolphin	41116015	DEH previous ERA
1081	PS	Marine mammal	Delphinidae	*Stenella coeruleoalba*	Striped Dolphin	41116016	DEH previous ERA
1082	PS	Marine mammal	Delphinidae	*Stenella longirostris*	Long-snouted Spinner Dolphin	41116017	DEH previous ERA
1083	PS	Marine mammal	Delphinidae	*Steno bredanensis*	Rough-toothed Dolphin	41116018	DEH previous ERA
1091	PS	Marine mammal	Delphinidae	*Tursiops truncatus*	Bottlenose Dolphin	41116019	DEH previous ERA
1494	PS	Marine mammal	Delphinidae	*Tursiops aduncus*	Indian Ocean bottlenose dolphin	41116020	DEH previous ERA
	PS	Marine mammal	Otariidae	*Arctocephalus gazella*	Antarctic fur seal	41131002	EP report(2014)
263	PS	Marine mammal	Otariidae	*Arctocephalus tropicalis*	Subantarctic fur seal	41131004	DEH previous ERA
1000	PS	Marine mammal	Otariidae	*Neophoca cinerea*	Australian Sea-lion	41131005	DEH previous ERA
295	PS	Marine mammal	Phocidae	*Hydrurga leptonyx*	Leopard seal	41136001	DEH previous ERA
	PS	Marine mammal	Phocidae	*Leptonychotes weddelli*	Weddell seal	41136002	EP report (2014)
	PS	Marine mammal	Phocidae	*Lobodon carcinophagus*	Crabeater seal	41136003	EP report(2014)
993	PS	Marine mammal	Phocidae	*Mirounga leonina*	Elephant seal	41136004	DEH previous ERA
	PS	Marine mammal	Phocidae	*Ommatophoca rossii*	Ross seal	41136005	from EP report

Scoping Document S2B1. Benthic Habitats

Risk assessment for benthic habitats considers both the seafloor structure and its attached invertebrate fauna. Because data on the types and distributions of benthic habitat in Australia's Commonwealth fisheries are generally sparse, and because there is no universally accepted benthic classification scheme, the ERAEF methodology has used the most widely available type of data – seabed imagery – classified in a similar manner to that used in bioregionalisation and deep seabed mapping in Australian Commonwealth waters. Using this imagery, benthic habitats are classified based on an SGF score, using sediment, geomorphology, and fauna. Where seabed imagery is not available, a second method (Method 2) is used to develop an inferred list of potential habitat types for the fishery. For details of both methods, see Hobday *et al* (2007).

Table 2.8 Benthic habitats for the Small Pelagic Fishery Midwater Trawl sub-fishery.

All habitats occur within the jurisdictional boundary of the sub-fishery; however, effort is pelagic with only occasional benthic contact from Midwater Trawl nets. NB Highlighted - needs confirming –outer shelf habitats have been added from Williams et al 2010.

ERAEF RECORD NO.	ERAEF HABITAT NUMBER	SUB-BIOME	FEATURE	HABITAT TYPE	SGF SCORE	DEPTH (M)	IMAGE AVAILABLE	REFERENCE IMAGE LOCATION
0011	001	inner-shelf	shelf	gravel, current rippled, mixed faunal community	313	25- 100	Y	SE Image Collection
0023	002	inner-shelf	shelf	Sedimentary rock, outcrop, large sponges	691	25- 100	Y	SE Image Collection
0035	003	inner-shelf	shelf	Sedimentary rock, outcrop, mixed faunal community	693	25- 100	Y	SE Image Collection
0047	004	inner-shelf	shelf	Sedimentary rock, outcrop, large sponges	671	25- 100	Y	SE Image Collection
0059	005	inner-shelf	shelf	cobble, debris flow, large sponges	441	25- 100	Y	SE Image Collection
0071	006	inner-shelf	shelf	coarse sediments, subcrop, large sponges	251	25- 100	Y	SE Image Collection
0083	007	inner-shelf	shelf	gravel, debris flow, mixed faunal community	343	25- 100	Y	SE Image Collection
0095	009	inner-shelf	shelf	coarse sediments, wave rippled, sedentary	227	25- 100	Y	SE Image Collection
0994	010	Inner shelf	shelf	Coarse sediments, directed scour, No fauna	210	25- 100	Y	GAB image collection
0120	011	inner-shelf	shelf	coarse sediments, wave rippled, large sponges	221	25- 100	Y	SE Image Collection
0132	012	inner-shelf	shelf	fine sediments, unrippled, large sponges	101	25- 100	Y	SE Image Collection

ERAEF RECORD NO.	ERAEF HABITAT NUMBER	SUB-BIOME	FEATURE	HABITAT TYPE	SGF SCORE	DEPTH (M)	IMAGE AVAILABLE	REFERENCE IMAGE LOCATION
0144	013	inner-shelf	shelf	coarse sediments, unrippled, large sponges	201	25- 100	Y	SE Image Collection
0156	014	inner-shelf	shelf	fine sediments, wave rippled, large sponges	111	25- 100	Y	SE Image Collection
0168	016	inner-shelf	shelf	fine sediments, unrippled, mixed faunal community	103	25- 100	Y	SE Image Collection
2137	089	inner shelf	Shelf	Coarse sediments, irregular, bryozoan turf	236	25-100	Y	WA Image Collection
0868	090	inner-shelf	shelf	coarse sediments, current rippled, bioturbators	219	25- 100	N	SE Image Collection
0880	091	inner-shelf	shelf	fine sediments, irregular, large sponges	131	25- 100	N	SE Image Collection
0892	092	inner-shelf	shelf	fine sediments, irregular, small sponges	132	25- 100	N	SE Image Collection
0904	093	inner-shelf	shelf	fine sediments, unrippled, bioturbators	109	25- 100	N	SE Image Collection
0916	094	inner-shelf	shelf	fine sediments, unrippled, small sponges	102	25- 100	N	SE Image Collection
2133	095	inner shelf	Shelf	Fine sediments, Wave rippled, No fauna	120	25-100	Y	WA Image Collection
0941	096	inner-shelf	shelf	fine sediments, wave rippled, small sponges	122	25- 100	N	SE Image Collection
0953	097	inner-shelf	shelf	gravel, wave rippled, bioturbators	329	25- 100	Y	SE Image Collection
0965	098	inner-shelf	shelf	gravel, wave rippled, no fauna	320	25- 100	Y	SE Image Collection
		Outer-shelf	shelf	fine sediments, current rippled, bioturbators	119	100-200	Y	Williams et al 2010
		Outer-shelf	shelf	gravel, current rippled, bioturbators	319		Y	Williams et al 2010
		Outer-shelf	shelf	Fine sediments, subcrop, large sponges	151		Y	Williams et al 2010
		Outer-shelf	shelf	Cobble, outcrop, crinoids	464		Y	Williams et al 2010
		Outer-shelf	canyon	Sedimentary rock, low outcrop, small sponges	672		Y	Williams et al 2010
		Upper-slope	slope	Coarse sediments, irregular, small erect fauna	236		Y	Williams et al 2010
		Upper-slope	slope	Mud, irregular, mobile	038		Y	Williams et al 2010
		Upper-slope	canyon	Sedimentary rock, subcrop, large sponges	651		Y	Williams et al 2010

Scoping Document S2B2. Pelagic Habitats

Table 2.9 Pelagic habitats for the Small Pelagic Fishery Midwater Trawl sub-fishery.

Shading denotes habitats occurring within the jurisdictional boundary of the sub-fishery that are subject to effort from Midwater Trawling.

ERAEF HABITAT NUMBER	PELAGIC HABITAT TYPE	DEPTH (M)	COMMENTS	REFERENCE
P1	Eastern Pelagic Province - Coastal	0 – 200		2006 ERAEF Assessment
P2	Eastern Pelagic Province - Oceanic	0 – > 600	this is a compilation of the range covered by Oceanic Community (1) and (2)	2006 ERAEF Assessment
P7	Southern Pelagic Province - Coastal	0 – 200	this is a compilation of the range covered by Coastal pelagic Tas and GAB	2006 ERAEF Assessment
P8	Southern Pelagic Province - Oceanic	0 – > 600	this is a compilation of the range covered by Oceanic Communities (1), (2), and (3)	2006 ERAEF Assessment
P9	Southern Pelagic Province - Seamount Oceanic	0 – > 600	this is a compilation of the range covered by Seamount Oceanic Communities (1), (2), and (3)	2006 ERAEF Assessment
P12	Eastern Pelagic Province - Seamount Oceanic	0 – > 600	this is a compilation of the range covered by Seamount Oceanic Communities (1) and (2)	2006 ERAEF Assessment

Scoping Document S2C1. Demersal communities

In ERAEF, communities are defined as the set of species assemblages that occupy the large scale provinces and biomes identified from national bioregionalisation studies. The biota includes mobile fauna, both vertebrate and invertebrate, but excludes sessile organisms such as corals that are largely structural and are used to identify benthic habitats. The same community lists are used for all fisheries, with those selected as relevant for a particular fishery being identified on the basis of spatial overlap with effort in the fishery. The spatial boundaries for demersal communities are based on IMCRA boundaries for the shelf, and on slope bioregionalisation for the slope (IMCRA 1998; Last *et al*. 2005). The spatial boundaries for the pelagic communities are based on pelagic bioregionalisation and on oceanography (Condie *et al*. 2003; Lyne and Hayes 2004). Fishery and region specific modifications to these boundaries are described in detail in Hobday *et al*. (2007) and briefly outlined in the footnotes to the community Tables below.

Table 2.10 Demersal communities which underlie the pelagic communities in the Small Pelagic Midwater Trawl sub-fishery (✓). Shaded cells indicate all communities within the provinces.

	PROVINCE																		
DEMERSAL COMMUNITY	CAPE	NORTH EASTERN TRANSITION	NORTH EASTERN	CENTRAL EASTERN TRANSITION	CENTRAL EASTERN	SOUTH EASTERN TRANSITION	CENTRAL BASS	TASMANIAN	WESTERN TAS TRANSITION	SOUTHERN	SOUTH WESTERN TRANSITION	CENTRAL WESTERN	CENTRAL WESTERN TRANSITION	NORTH WESTERN	NORTH WESTERN TRANSITION	TIMOR	TIMOR TRANSITION	HEARD & MCDONALD IS	MACQUARIE IS
Inner Shelf 0 – 110m [1,2]																			
Outer Shelf 110 – 250m [1,2,]					✓	✓		✓	✓	✓									
Upper Slope 250 – 565m [3]					✓	✓		✓	✓	✓									
Mid–Upper Slope 565 – 820m[3]																			
Mid Slope 820 – 1100m[3]																			
Lower slope/ Abyssal > 1100m[6]																			
Reef 0 -110m[7, 8]																			

DEMERSAL COMMUNITY	PROVINCE																		
	CAPE	NORTH EASTERN TRANSITION	NORTH EASTERN	CENTRAL EASTERN TRANSITION	CENTRAL EASTERN	SOUTH EASTERN TRANSITION	CENTRAL BASS	TASMANIAN	WESTERN TAS TRANSITION	SOUTHERN	SOUTH WESTERN TRANSITION	CENTRAL WESTERN	CENTRAL WESTERN TRANSITION	NORTH WESTERN	NORTH WESTERN TRANSITION	TIMOR	TIMOR TRANSITION	HEARD & MCDONALD IS	MACQUARIE IS
Reef 110-250m[8]																			
Seamount 0 – 110m																			
Seamount 110- 250m																			
Seamount 250 – 565m																			
Seamount 565 – 820m																			
Seamount 820 – 1100m																			
Seamount 1100 – 3000m																			
Plateau 0 – 110m																			
Plateau 110- 250m[4]																			
Plateau 250 – 565m[4]																			
Plateau 565 – 820m[5]																			
Plateau 820 – 1100m[5]																			

1 Four inner shelf communities occur in the Timor Transition (Arafura, Groote, Cape York and Gulf of Carpentaria) and three inner shelf communities occur in the Southern (Eyre, Eucla and South West Coast). At Macquarie Is: 2inner & outer shelves (0-250m), and 3 upper and midslope communities combined (250-1000m). At Heard/McDonald Is: 4outer and upper slope plateau communities combined to form four communities: Shell Bank, inner and outer Heard Plateau (100-500m) and Western Banks (200-500m), 5mid and upper plateau communities combined into 3 trough, southern slope and North Eastern plateau communities (500-1000m), and 6 3 groups at Heard Is: Deep Shell Bank (>1000m), Southern and North East Lower slope/abyssal, 7Great Barrier Reef in the North Eastern Province and Transition and 8 Rowley Shoals in North Western Transition.

Scoping Document S2C2. Pelagic communities

Table 2.11 Pelagic communities in which fishing activity occurs in Small Pelagic midwater trawl sub-fishery (✓). Shaded cells indicate all communities that exist in the province.

PELAGIC COMMUNITY	PROVINCE							
	NORTHEASTERN	EASTERN	SOUTHERN	WESTERN	NORTHERN	NORTHWESTERN	HEARD AND MCDONALD IS2	MACQUARIE IS
Coastal pelagic 0-200m[1,2]		✓	✓					
Oceanic (1) 0 – 600m		✓						
Oceanic (2) >600m								
Seamount oceanic (1) 0 – 600m								
Seamount oceanic (2) 600-3000m								
Oceanic (1) 0 – 200m			✓					
Oceanic (2) 200-600m								
Oceanic (3) >600m								
Seamount oceanic (1) 0 – 200m								
Seamount oceanic (2) 200 – 600m								
Seamount oceanic (3) 600-3000m								
Oceanic (1) 0-400m								
Oceanic (2) >400m								
Oceanic (1) 0-800m								

PELAGIC COMMUNITY	PROVINCE							
	NORTHEASTERN	EASTERN	SOUTHERN	WESTERN	NORTHERN	NORTHWESTERN	HEARD AND MCDONALD IS2	MACQUARIE IS
Oceanic (2) >800m								
Plateau (1) 0-600m								
Plateau (2) >600m								
Heard Plateau 0-1000m[3]								
Oceanic (1) 0-1000m								
Oceanic (2) >1000m								
Oceanic (1) 0-1600m								
Oceanic (2) >1600m								

[1] Northern Province has five coastal pelagic zones (NWS, Bonaparte, Arafura, Gulf and East Cape York) and Southern Province has two zones (Tas, GAB). [2] At Macquarie Is: coastal pelagic zone to 250m. [3] At Heard and McDonald Is: coastal pelagic zone broadened to cover entire plateau to maximum of 1000m.

2.2.3 Identification of Objectives for Components and Sub-components (Step 3)

Objectives are identified for each sub-fishery for the five ecological components (key commercial, bycatch/byproduct, and protected species, habitats, and communities) and sub-components, and are clearly documented. It is important to identify objectives that managers, the fishing industry, and other stakeholders can agree on, and that scientists can quantify and assess. The criteria for selecting ecological operational objectives for risk assessment are that they:

- be biologically relevant;
- have an unambiguous operational definition;
- be accessible to prediction and measurement; and
- that the quantities they relate to be exposed to the hazards.

For fisheries that have completed ESD reports, use can be made of the operational objectives stated in those reports.

Each 'operational objective' is matched to example indicators. Scoping Document S3 provides suggested examples of operational objectives and indicators. Where operational objectives are already agreed for a fishery (Existing Management Objectives), those should be used (e.g. Strategic Assessment Reports). The objectives need not be exactly specified, with regard to numbers or fractions of removal/impact, but should indicate that an impact in the sub-component is of concern/interest to the sub-fishery. The rationale for including or discarding an operational objective is a crucial part of the table and must explain why the particular objective has or has not been selected for in the (sub) fishery. Only the operational objectives selected for inclusion in the (sub) fishery are used for Level 1 analysis (Level 1 SICA Document L1.1).

Scoping Document S3 Components and Sub-components: Identification of Objectives

Table 2.12 Objectives for components and sub-components. NB Operational objectives that have been eliminated are shaded out.

COMPONENT	CORE OBJECTIVE *"What is the general goal?"*	SUB-COMPONENT	OPERATIONAL OBJECTIVES *"What you are specifically trying to achieve"*	INDICATORS *"What you are going to use to measure performance"*	RATIONALE **Rationale flagged as 'EMO' where Existing Management Objective in place**
Key commercial species	Maintain key commercial stocks at ecologically sustainable levels Avoid recruitment failure of the target species Avoid negative consequences for species or population sub-components	1. Population size	1.1 No trend in biomass 1.2 Maintain biomass above a specified level 1.3 Maintain catch at specified level 1.4 Species do not approach extinction or become extinct	DEPM Biomass, CPUE, yield, Length frequency,	1.1 conservative TACs when no biomass estimates available (tier 3) 1.2 EMO-set exploitation rates providing for limit reference point of 20% of unfished biomass and a target reference point of 50% of unfished biomass 1.3 EMO – TAC set to no greater than 10- 20% of biomass (Species-specific) to ensure a high probability the population is maintained. 1.4 Ecological sustainability is implicit in previous objectives 1.2. & 1.3
		2. Geographic range	2.1 Geographic range of the population, in terms of size and continuity does not change outside acceptable bounds	Presence of population across known distribution range	2.1 Fishery managed in two zones and there are regional catch limits for target species per one degree square throughout all fishery for specified vessel
		3. Genetic diversity	3.1 Genetic diversity does not change outside acceptable bounds	Frequency of genotypes in the population, effective population size (Ne), number of spawning units	3.1 Not currently monitored in this fishery, difficult and expected to respond at a slower rate than some of the other indicators.

COMPONENT	CORE OBJECTIVE *"What is the general goal?"*	SUB-COMPONENT	OPERATIONAL OBJECTIVES *"What you are specifically trying to achieve"*	INDICATORS *"What you are going to use to measure performance"*	RATIONALE **Rationale flagged as 'EMO' where Existing Management Objective in place**
		4. Age/size/sex structure	4.1 Age/size/sex structure does not change outside acceptable bounds (e.g. more than X% from reference structure)	Biomass, numbers or relative proportion in age/size/sex classes Biomass of spawners Mean size, sex ratio	4.1 Maintain population size and age structure. Fishery catches can be dominated by few age classes. Need to ensure this does not adversely impact on the entire population
		5. Reproductive Capacity	5.1 Fecundity of the population does not change outside acceptable bounds (e.g. more than X% of reference population fecundity) Recruitment to the population does not change outside acceptable bounds	Egg production of population Abundance of recruits	5.1 TACs and Trigger catch limits are set conservatively in the knowledge that the target species have large natural fluctuations in numbers. A change in fecundity might result in lower recruitment to the fishery
		6. Behaviour /Movement	6.1 Behaviour and movement patterns of the population do not change outside acceptable bounds	Presence of population across space, movement patterns within the population (e.g. attraction to bate, lights)	6.1 Populations of target species move widely in response to currents. Trigger TACs set to minimize impacts on spatially or temporally more vulnerable schools
Byproduct and Bycatch species	Avoid recruitment failure of the byproduct and bycatch species Avoid negative consequences for species or population sub-components	1. Population size	1.1 No trend in biomass 1.2 Maintain biomass above a specified level 1.3 Maintain catch at specified level 1.4 Species do not approach extinction or become extinct	Biomass, numbers, density, CPUE, yield	1.1 Byproduct/bycatch trigger levels set to ensure catch remains a small proportion of total catch. 1.2 Total catch set to ensure biomass or target and byproduct/bycatch remain at sustainable levels. 1.3 Not desirable to maintain by-catch/by-product at specified level - minimise by-catch/by-product 1.4 EMO - Fishing is conducted in a manner that does not threaten stocks of by-product / by-

COMPONENT	CORE OBJECTIVE *"What is the general goal?"*	SUB-COMPONENT	OPERATIONAL OBJECTIVES *"What you are specifically trying to achieve"*	INDICATORS *"What you are going to use to measure performance"*	RATIONALE **Rationale flagged as 'EMO' where Existing Management Objective in place**
					catch species (AFMA 2002).
		2. Geographic range	2.1 Geographic range of the population, in terms of size and continuity does not change outside acceptable bounds	Presence of population across space	2.1 Not currently monitored. No specific management objective based on the geographic range of by-catch/by-product species.
		3. Genetic structure	3.1 Genetic diversity does not change outside acceptable bounds	Frequency of genotypes in the population, effective population size (N_e), number of spawning units	3.1 Not currently monitored. No reference levels established. No specific management objective based on the genetic structure of by-catch species.
		4. Age/size/sex structure	4.1 Age/size/sex structure does not change outside acceptable bounds (e.g. more than X% from reference structure)	Biomass, numbers or relative proportion in age/size/sex classes Biomass of spawners Mean size, sex ratio	4.1 Not currently monitored. No reference levels established. No specific management objective for the age/size structure of byproduct/bycatch species
		5 Reproductive Capacity	5.1 Fecundity of the population does not change outside acceptable bounds (e.g. more than X% of reference population fecundity) Recruitment to the population does not change outside acceptable bounds	Egg production of population Abundance of recruits	5.1. Not currently monitored in the fishery. No specific management measures identified to assess changes in reproductive capacity of byproduct/bycatch species
		6. Behaviour /Movement	6.1 Behaviour and movement patterns of the population do not change outside acceptable bounds	Presence of population across space, movement patterns within the population (e.g. attraction to bait, lights)	6.1 Not currently monitored in the fishery. No specific management measures identified to assess changes in reproductive capacity of byproduct/bycatch species
Protected species	Avoid recruitment failure of protected species	1. Population size	1.1 No trend in biomass 1.2 Maintain biomass above a specified level	Biomass, numbers, density, CPUE, yield	1.1 A positive trend in biomass is desirable for protected species. 1.2 Maintenance of protected species

COMPONENT	CORE OBJECTIVE *"What is the general goal?"*	SUB-COMPONENT	OPERATIONAL OBJECTIVES *"What you are specifically trying to achieve"*	INDICATORS *"What you are going to use to measure performance"*	RATIONALE **Rationale flagged as 'EMO' where Existing Management Objective in place**
	Avoid negative consequences for protected species or population sub-components Avoid negative impacts on the population from fishing		1.3 Maintain catch at specified level 1.4 Species do not further approach extinction or become extinct		biomass above specified level not currently a fishery operational objective. 1.3 Objective is avoidance of catch 1.4 EMO - The fishery is conducted in a manner that avoids mortality of, or injuries to, endangered, threatened or protected species (AFMA 2002).
		2. Geographic range	2.1 Geographic range of the population, in terms of size and continuity does not change outside acceptable bounds	Presence of population across space, i.e. the GAB	2.1 Change in geographic range of protected species may have serious consequences e.g. population fragmentation and/or forcing species into sub-optimal areas.
		3. Genetic structure	3.1 Genetic diversity does not change outside acceptable bounds	Frequency of genotypes in the population, effective population size (N_e), number of spawning units	3.1 Because population size of protected species is often small, PSs are sensitive to loss of genetic diversity. Genetic monitoring may be an effective approach to measure possible fishery impacts.
		4. Age/size/sex structure	4.1 Age/size/sex structure does not change outside acceptable bounds (e.g. more than X% from reference structure)	Biomass, numbers or relative proportion in age/size/sex classes Biomass of spawners Mean size, sex ratio	4.1 Monitoring the age/size/sex structure of protected species/populations may be a useful management tool allowing the identification of possible fishery impacts and that cross-section of the population most at risk.
		5. Reproductive Capacity	5.1 Fecundity of the population does not change outside acceptable bounds (e.g. more than X% of reference population fecundity) 5.2 Recruitment to the population does not change outside acceptable bounds	Egg production of population Abundance of recruits	5.1 & 5.2 The reproductive capacity of protected species is of concern to the Small Pelagics Fishery because potential fishery induced changes in reproductive ability (e.g. reduction in bait fish reduction in seabird brooding success) may have immediate

COMPONENT	CORE OBJECTIVE *"What is the general goal?"*	SUB-COMPONENT	OPERATIONAL OBJECTIVES *"What you are specifically trying to achieve"*	INDICATORS *"What you are going to use to measure performance"*	RATIONALE **Rationale flagged as 'EMO' where Existing Management Objective in place**
					impact on the population size of protected species.
		6. Behaviour /Movement	6.1 Behaviour and movement patterns of the population do not change outside acceptable bounds	Presence of population across space, movement patterns within the population (e.g. attraction to bait, lights)	6.1 Midwater trawl capture methods may attract protected species and alter behaviour and movement patterns, resulting in the attraction of offshore species to inshore areas e.g. great white shark. The overall effect may be to further fragment the population. Fishing operations may also influence the behaviour of calving whales by visual/sound stimuli.
		7. Interactions with fishery	7.1 Interactions between protected species and the fishery are minimised. 7.2 Survival after interactions is maximised 7.3 Interactions do not affect the viability of the population or its ability to recover	Number of interactions Survival rate of species after interactions Number of interactions, biomass or numbers in population	7.1, 7.2, 7.3 EMO - The fishery is conducted in a manner that avoids mortality of, or injuries to, endangered, threatened or protected species).
Habitats	Avoid negative impacts on the quality of the environment Avoid reduction in the amount and quality of habitat	1. Water quality	1.1 Water quality does not change outside acceptable bounds	Water chemistry, noise levels, debris levels, turbidity levels, pollutant concentrations, light pollution from artificial light	1.1 EMO - The fishery is conducted, in a manner that minimises the impact of fishing operations on ecological communities (AFMA 2002). Few water quality issues because of the dispersed nature of the fishery and low levels in fishing effort.
		2. Air quality	2.1 Air quality does not change outside acceptable bounds	Air chemistry, noise levels, visual pollution, pollutant concentrations, light pollution from artificial light	2.1 Not currently perceived as an important habitat sub-component as midwater operations not believed to strongly influence air quality.

COMPONENT	CORE OBJECTIVE *"What is the general goal?"*	SUB-COMPONENT	OPERATIONAL OBJECTIVES *"What you are specifically trying to achieve"*	INDICATORS *"What you are going to use to measure performance"*	RATIONALE **Rationale flagged as 'EMO' where Existing Management Objective in place**
		3. Substrate quality	3.1 Sediment quality does not change outside acceptable bounds	Sediment chemistry, stability, particle size, debris, pollutant concentrations	3.1 Midwater trawling generally does not impact on the substrate unless gear lost so there is not perceived effects from this fishery.
		4. Habitat types	4.1 Relative abundance of habitat types does not vary outside acceptable bounds	Extent and area of habitat types, % cover, spatial pattern, landscape scale	4.1 Midwater trawling operations not perceived to result in change of habitat frequency.
		5. Habitat structure and function	5.1 Size, shape and condition of habitat types does not vary outside acceptable bounds	Size structure, species composition and morphology of biotic habitats	5.1 Midwater trawling activities may result in local disruption to pelagic processes
Communities	Avoid negative impacts on the composition/ function/ distribution/ structure of the community	1. Species composition	1.1 Species composition of communities does not vary outside acceptable bounds	Species presence/absence, species numbers or biomass (relative or absolute) Richness Diversity indices Evenness indices	1.1 EMO - The fishery is conducted, in a manner that minimises the impact of fishing operations on ecological communities (AFMA 2002).
		2. Functional group composition	2.1 Functional group composition does not change outside acceptable bounds	Number of functional groups, species per functional group (e.g. autotrophs, filter feeders, herbivores, omnivores, carnivores)	2.1 The presence/abundance of 'functional group' members may fluctuate widely, however in terms of maintenance of ecosystem processes it is important that the aggregate effect of a functional group is maintained.
		3. Distribution of the community	3.1 Community range does not vary outside acceptable bounds	Geographic range of the community, continuity of range, patchiness	3.1 There may be changes to the geographic extent of pelagic community components due to associated fishing activities.
		4. Trophic/size structure	4.1 Community size spectra/trophic structure does not vary outside acceptable bounds	Size spectra of the community Number of octaves, Biomass/number in each size class Mean trophic level	4.1 Extraction of Small Pelagics may reduce the prey of the higher level predator functional group in the Zone 4 potentially resulting in migratory or behavioural shifts in predator species like SBT and seals.

COMPONENT	CORE OBJECTIVE ***"What is the general goal?"***	SUB-COMPONENT	OPERATIONAL OBJECTIVES ***"What you are specifically trying to achieve"***	INDICATORS ***"What you are going to use to measure performance"***	RATIONALE **Rationale flagged as 'EMO' where Existing Management Objective in place**
				Number of trophic levels	
		5 Bio- and geo-chemical cycles	5.1 Cycles do not vary outside acceptable bounds	Indicators of cycles, salinity, carbon, nitrogen, phosphorus flux	5.1 Purse seine and midwater trawl operations not perceived to have a measurable effect on bio and geochemical cycles.

2.2.4 **Hazard Identification (Step 4)**

Hazards are the activities undertaken in the process of fishing, and any external activities, which have the potential to lead to harm.

The effects of fishery/sub-fishery specific hazards are identified under the following categories:

- capture
- direct impact without capture
- addition/movement of biological material
- addition of non-biological material
- disturbance of physical processes
- external hazards

These fishing and external activities are scored on a presence/absence basis for each fishery/sub-fishery. An activity is scored as a zero if it does not occur and as a one if it does occur. The rationale for the scoring is also documented in detail and must include if/how the activity occurs and how the hazard may impact on organisms/habitat.

Scoping Document S4. Hazard Identification Scoring Sheet

Fishery Name: Small Pelagics Fishery

Sub-fishery Name: Midwater trawl sub-fishery

Date: 22 July 2016

Table 2.13 Hazard identification

DIRECT IMPACT OF FISHING	FISHING ACTIVITY	SCORE (0/1)	DOCUMENTATION OF RATIONALE
Capture	Bait collection	0	Bait not required by this fishery.
	Fishing	1	Actual fishing, i.e. capture of small pelagic species resulting from deployment and retrieval of midwater trawl net including key commercial, bycatch, byproduct and protected species caught but not landed.
	Incidental behaviour	0	Vessel too large and operating offshore for recreational fishing by crew
Direct impact without capture	Bait collection	0	Not required for this fishery method.
	Fishing	1	Disorientation/injury/mortality as a result of momentary entanglement in net but animal may free itself, e.g. dolphin, escaping key commercial species. Birds may strike trawl warps or vessel.
	Incidental behaviour	0	Vessel too large and offshore for recreational fishing by crew
	Gear loss	1	Minor components: occasionally lost included lengths of rope and wires, equipment. Major gear loss: none reported.
	Anchoring/ mooring	0	Fishery generally operates in deeper water; vessel does not anchor at night when not fishing.
	Navigation/steaming	1	Steaming/navigation to find aggregations of fish may result in collisions (e.g. seabirds or whales vessel interactions), seabird collisions with night-time lights/navigation lights.
Addition/ movement of biological material	Translocation of species	0	No bait used. Vessel travels extensively throughout the Fishery.
	On board processing	0	Fish frozen whole on-board. Discarding of offal prohibited.
	Discarding catch	1	Discarding prior to processing is limited and controlled by VMP regulations but may attract predators.
	Stock enhancement	0	None occurs
	Provisioning	0	None occurs
	Organic waste disposal	0	Disposal of organic wastes does not occur under MARPOL regulations.
Addition of non-biological material	Debris	0	General rubbish generated during general fishing vessel operations is incinerated on deck and disposed of ashore.
	Chemical pollution	0	Waste discharge from vessel controlled under VMP and MARPOL.
	Exhaust	1	Vessel introduces exhaust into the environment.
	Gear loss	1	Minor components: occasionally lost included lengths of rope and wires, equipment. Major gear loss: none reported.

	Navigation/ steaming	1	Trawling operations involves vessel navigating to and from fishing grounds.
	Activity/ presence on water	1	Vessel introduces noise and visual stimuli into the environment.
Disturb physical processes	Bait collection	0	Bait not required by fishery.
	Fishing	1	Trawling unlikely to disturb/disrupt local physical water flow patterns, e.g. vertical mixing.
	Boat launching	0	Not applicable. Vessels in fishery come from designated ports.
	Anchoring/ mooring	0	Does not occur on fishing grounds.
	Navigation/ steaming	1	Vessels navigates to and from fishing grounds.
External Hazards (specify the particular example within each activity area)	Other capture fishery methods	1	Key commercial Species may be captured by purse-seine methods. Also caught as bait fishery in ETBF. Byproduct species in the SPF are managed in other fisheries (e.g. SESSF blue eye, warehous, blue grenadier, and orange roughy).
	Aquaculture	0	
	Coastal development	1	Unlikely to have significant impact with current distribution of effort which is offshore.
	Other extractive activities	1	Offshore fishery but offshore petroleum/gas exploration occurs in Bass Strait/GAB
	Other non-extractive activities	1	Coastal shipping may disrupt feeding schools.
	Other anthropogenic activities	1	Limited whale watching and charter fishing occurs in the general region.

Table 2.14 Examples of fishing activities (Modified from Fletcher et al. 2002)

DIRECT IMPACT OF FISHING	FISHING ACTIVITY	EXAMPLES OF ACTIVITIES INCLUDE
Capture		**Activities that result in the capture or removal of organisms. This includes cryptic mortality due to organisms being caught but dropping out prior to the gear's retrieval (i.e. They are caught but not landed)**
	Bait collection	Capture of organisms due to bait gear deployment, retrieval and bait fishing. This includes organisms caught but not landed.
	Fishing	Capture of organisms due to gear deployment, retrieval and actual fishing. This includes organisms caught but not landed.
	Incidental behaviour	Capture of organisms due to crew behaviour incidental to primary fishing activities, possible in the crew's down time; e.g. crew may line or spear fish while anchored, or perform other harvesting activities, including any land-based harvesting that occurs when crew are camping in their down time.
Direct impact, without capture		**This includes any activities that may result in direct impacts (damage or mortality) to organisms without actual capture.**
	Bait collection	Direct impacts (damage or mortality) to organisms due to interactions (excluding capture) with bait gear during deployment, retrieval and bait fishing. This includes: damage/mortality to organisms through contact with the gear that doesn't result in capture, e.g. Damage/mortality to benthic species by gear moving over them, organisms that hit nets but aren't caught.
	Fishing	Direct impacts (damage or mortality) to organisms due to interactions (excluding capture) with fishing gear during deployment, retrieval and fishing. This includes: damage/mortality to organisms through contact with the gear that doesn't result in capture, e.g. Damage/mortality to benthic species by gear moving over them, organisms that hit nets but are not caught.
	Incidental behaviour	Direct impacts (damage or mortality) without capture, to organisms due to behaviour incidental to primary fishing activities, possibly in the crew's down time; e.g. the use of firearms on scavenging species, damage/mortality to organisms through contact with the gear that the crew uses to fish during their down time. This does not include impacts on predator species of removing their prey through fishing.
	Gear loss	Direct impacts (damage or mortality), without capture on organisms due to gear that has been lost from the fishing boat. This includes damage/mortality to species when the lost gear contacts them or if species swallow the lost gear.
	Anchoring/ mooring	Direct impact (damage or mortality) that occurs and when anchoring or mooring. This includes damage/mortality due to physical contact of the anchor, chain or rope with organisms, e.g. An anchor damaging live coral.
	Navigation/ steaming	Direct impact (damage or mortality) without capture may occur while vessels are navigating or steaming. This includes collisions with marine organisms or birds.
Addition/ movement of biological material		**Any activities that result in the addition or movement of biological material to the ecosystem of the fishery.**

	Translocation of species (boat movements, reballasting)	The translocation and introduction of species to the area of the fishery, through transportation of any life stage. This transport can occur through movement on boat hulls or in ballast water as boats move throughout the fishery or from outside areas into the fishery.
	On board processing	The discarding of unwanted sections of key commercial after on board processing introduces or moves biological material, e.g. heading and gutting, retaining fins but discarding trunks.
	Discarding catch	The discarding of unwanted organisms from the catch can introduce or move biological material. This includes individuals of key commercial and byproduct species due to damage (e.g. shark or marine mammal predation), size, high grading and catch limits. Also includes discarding of all non-retained bycatch species. This also includes discarding of catch resulting from incidental fishing by the crew. The discards could be alive or dead.
	Stock enhancement	The addition of larvae, juveniles or adults to the fishery or ecosystem to increase the stock or catches.
	Provisioning	The use of bait or berley in the fishery.
	Organic waste disposal	The disposal of organic wastes (e.g. food scraps, sewage) from the boats.
Addition of non-biological material		**Any activities that result in non-biological material being added to the ecosystem of the fishery, this includes physical debris, chemicals (in the air and water), lost gear, noise and visual stimuli.**
	Debris	Non-biological material may be introduced in the form of debris from fishing vessels or mother ships. This includes debris from the fishing process: e.g. cardboard thrown over from bait boxes, straps and netting bags lost. Debris from non-fishing activities can also contribute to this e.g. Crew rubbish – discarding or food scraps, plastics or other rubbish. Discarding at sea is regulated by MARPOL, which forbids the discarding of plastics.
	Chemical pollution	Chemicals can be introduced to water, sediment and atmosphere through: oil spills, detergents other cleaning agents, any chemicals used during processing or fishing activities.
	Exhaust	Exhaust can be introduced to the atmosphere and water through operation of fishing vessels
	Gear loss	The loss of gear will result in the addition of non-biological material, this includes hooks, line, sinkers, nets, otter boards, light sticks, buoys etc.
	Navigation /steaming	The navigation and steaming of vessels will introduce noise and visual stimuli into the environment. Boat collisions and/or sinking of vessels. Echo-sounding may introduce noise that may disrupt some species (e.g. whales, orange roughy)
	Activity /presence on water	The activity or presence of fishing vessels on the water will noise and visual stimuli into the environment.

Disturb physical processes		**Any activities that will disturb physical processes, particularly processes related to water movement or sediment and hard substrate (e.g. boulders, rocky reef) processes.**
	Bait collection	Bait collection may disturb physical processes if the gear contacts seafloor-disturbing sediment, or if the gear disrupts water flow patterns.
	Fishing	Fishing activities may disturb physical processes if the gear contacts seafloor-disturbing sediment, or if the gear disrupts water flow patterns.
	Boat launching	Boat launching may disturb physical processes, particularly in the intertidal regions, if dredging is required, or the boats are dragged across substrate. This would also include foreshore impacts where fishers drive along beaches to reach fishing locations and launch boats. Impacts of boat launching that occurs within established marinas are outside the scope of this assessment.
	Anchoring /mooring	Anchoring/mooring may affect the physical processes in the area that anchors and anchor chains contact the seafloor.
	Navigation /steaming	Navigation /steaming may affect the physical processes on the benthos and the pelagic by turbulent action of propellers or wake formation.
External hazards		**Any outside activities that will result in an impact on the component in the same location and period that the fishery operates. The particular activity as well as the mechanism for external hazards should be specified.**
	Other capture fishery methods	Take or habitat impact by other commercial, indigenous or recreational fisheries operating in the same region as the fishery under examination
	Aquaculture	Capture of feed species for aquaculture. Impacts of cages on the benthos in the region
	Coastal development	Sewage discharge, ocean dumping, agricultural runoff
	Other extractive activities	Oil and gas pipelines, drilling, seismic activity
	Other non-extractive activities	Defence, shipping lanes, dumping of munitions, submarine cables
	Other anthropogenic activities	Recreational activities, such as scuba diving leading to coral damage, power boats colliding with whales, dugongs, turtles. Shipping, oil spills

2.2.5 Bibliography (Step 5)

All references used in the scoping assessment are included in the References section.

Key documents can be found on the AFMA web page at www.afma.gov.au and include the following:

- SPF Fishery Management Plan
- SPF Management Booklet
- SPF Harvest Strategy
- Vessel Management Plan
- AFMA At a glance web page http://www.afma.gov.au/fisheries/etbf/at_a_glance.php
- SPF Discarding and Bycatch Action Plan

Other publications that provided information:

- Data Summary Reports (logbook and observer)
- Observer trip reports
- BRS Fishery Status Reports
- SPF Assessments
- DoE Assessments
- Expert Panel Reports

2.2.6 Decision rules to move to Level 1(Step 6)

Any hazards that are identified at Step 4 Hazard Identification as occurring in the fishery are carried forward for analysis at Level 1.

In this case, 15 out of 26 possible internal activities were identified as occurring in this fishery. Four out of 6 external activities were identified. Thus, a total of 19 activity-component scenarios will be considered at Level 1. This results in 95 total scenarios (of 160 possible) to be developed and evaluated using the unit lists (species, habitats, communities).

2.3 Level 1 Scale, Intensity and Consequence Analysis (SICA)

Level 1 aims to identify which hazards lead to a significant impact on any species, habitat or community. Analysis at Level 1 is for whole components (key commercial; bycatch and byproduct; protected species; habitat; and communities), not individual sub-components. Since Level 1 is used mainly as a rapid screening tool, a “worst case” approach is used to ensure that elements screened out as low risk (either activities or

components) are genuinely low risk. Analysis at Level 1 for each component is accomplished by considering the most vulnerable sub-component and the most vulnerable unit of analysis (e.g. most vulnerable species, habitat type or community). This is known as credible scenario evaluation in conventional risk assessment. In addition, where judgments about risk are uncertain, the highest level of risk that is still regarded as plausible is chosen. For this reason, the measures of risk produced at Level 1 cannot be regarded as absolute.

At Level 1 each fishery/sub-fishery is assessed using a scale, intensity and consequence analysis (SICA). SICA is applied to the component as a whole by choosing the most vulnerable sub-component (linked to an operational objective) and most vulnerable unit of analysis. The rationale for these choices must be documented in detail. These steps are outlined below. Scale, intensity, and consequence analysis (SICA) consists of thirteen steps. The first ten steps are performed for each activity and component, and correspond to the columns of the SICA table. The final three steps summarise the results for each component.

Step1: Record the hazard identification score (absence (0) presence (1) scores) identified at step 3 at the scoping level (Scoping Document S3) onto the SICA table

Step 2: Score spatial scale of the activity

Step 3: Score temporal scale of the activity

Step 4: Choose the sub-component most likely to be affected by activity

Step 5: Choose the most vulnerable unit of analysis for the component e.g. species, habitat type or community assemblage

Step 6: Select the most appropriate operational objective

Step 7: Score the intensity of the activity for that sub-component

Step 8: Score the consequence resulting from the intensity for that subcomponent

Step 9: Record confidence/uncertainty for the consequence scores

Step 10. Document rationale for each of the above steps

Step 11. Summary of SICA results

Step 12. Evaluation/discussion of Level 1

Step 13. Components to be examined at Level 2

2.3.1 Record the hazard identification score (absence (0) presence (1) scores) identified at step 3 in the scoping level onto the SICA Document (Step 1)

Record the hazard identification score absence (0) presence (1) identified at Step 3 at the scoping level onto the SICA sheet. A separate sheet will be required for each component (key commercial, bycatch and byproduct, and protected species, habitat, and communities). Only those activities that scored a 1 (presence) will be analysed at Level 1.

2.3.2 Score spatial scale of activity (Step 2)

The greatest spatial extent must be used for determining the spatial scale score for each identified hazard. For example, if fishing (e.g. capture by longline) takes place within an area of 200 nm by 300 nm, then the spatial scale is scored as 4. The score is then recorded onto the SICA Document and the rationale documented.

Table 2.15 Spatial scale score of activity

<1 NM:	1-10 NM:	10-100 NM:	100-500 NM:	500-1000 NM:	>1000 NM:
1	2	3	4	5	6

Maps and graphs may be used to supplement the information (e.g. sketches of the distribution of the activity relative to the distribution of the component) and additional notes describing the nature of the activity should be provided. The spatial scale score at Step 2 is not used directly, but the analysis is used in making judgments about level of intensity at Step 7. Obviously, two activities can score the same with regard to spatial scale, but the intensity of each can differ vastly. The reasons for the score are recorded in the rationale column of the SICA spreadsheet.

2.3.3 Score temporal scale of activity (Step 3)

The highest frequency must be used for determining the temporal scale score for each identified hazard. If the fishing activity occurs daily, the temporal scale is scored as 6. If oil spillage occurs about once per year, then the temporal scale of that hazard scores a 3. The score is then recorded onto the SICA Document and the rationale documented.

Table 2.16 Temporal scale score of activity

DECADAL (1 DAY EVERY 10 YEARS OR SO)	EVERY SEVERAL YEARS (1 DAY EVERY SEVERAL YEARS)	ANNUAL (1-100 DAYS PER YEAR)	QUARTERLY (100-200 DAYS PER YEAR)	WEEKLY (200-300 DAYS PER YEAR)	DAILY (300-365 DAYS PER YEAR)
1	2	3	4	5	6

It may be more logical for some activities to consider the aggregate number of days that an activity occurs. For example, if the activity "fishing" was undertaken by 10 boats during the same 150 days of the year, the score is 3. If the same 10 boats each spend 30 non-overlapping days fishing, the temporal scale of the activity is a sum of 300 days, indicating that a score of 6 is appropriate. In the case where the activity occurs over many days, but only every 10 years, the number of days by the number of years in the cycle is used to determine the score. For example, 100 days of an activity every 10 years averages to 10 days every year, so that a score of 3 is appropriate.

The temporal scale score at Step3 is not used directly, but the analysis is used in making judgments about level of intensity at Step 7. Obviously, two activities can score the same with regard to temporal scale, but the intensity of each can differ vastly. The reasons for the score are recorded in the rationale column.

2.3.4 Choose the sub-component most likely to be affected by activity (Step 4)

The most vulnerable sub-component must be used for analysis of each identified hazard. This selection must be made on the basis of expected highest potential risk for each 'direct impact of fishing' and 'fishing activity' combination, and recorded in the 'sub-component' column of the SICA Document. The justification is recorded in the rationale column.

2.3.5 Choose the unit of analysis most likely to be affected by activity and to have highest consequence score (Step 5)

The most vulnerable 'unit of analysis' (i.e. most vulnerable species, habitat type or community) must be used for analysis of each identified hazard. The species, habitats, or communities (depending on which component is being analysed) are selected from **Scoping Document S2 (A – C)**. This selection must be made on the basis of expected highest potential risk for each 'direct impact of fishing' and 'fishing activity' combination, and recorded in the 'unit of analysis' column of the SICA Document. The justification is recorded in the rationale column.

2.3.6 Select the most appropriate operational objective (Step 6)

To provide linkage between the SICA consequence score and the management objectives, the most appropriate operational objective for each sub-component is chosen. The most relevant operational objective code from **Scoping Document S3** is recorded in the 'operational objective' column in the SICA document. Note that SICA can only be performed on operational objectives agreed as important for the (sub) fishery during scoping and contained in **Scoping Document S3**. If the SICA process identifies reasons to include sub-components or operational objectives that were previously not included/eliminated then these sub-components or operational objectives must be re-instated.

2.3.7 Score the intensity of the activity for the component (Step7)

The score for intensity of an activity considers the direct impacts in line with the categories shown in the conceptual model (**Figure 2**) (capture, direct impact without capture, addition/movement of biological material, addition of non-biological material, disturbance to physical processes, external hazards). The intensity of the activity is judged based on the scale of the activity, its nature and extent. Activities are scored as per intensity scores below.

Table 2.17 Intensity score of activity (Modified from Fletcher *et al*. 2002)

LEVEL	SCORE	DESCRIPTION
Negligible	1	remote likelihood of detection at any spatial or temporal scale
Minor	2	occurs rarely or in few restricted locations and detectability even at these scales is rare
Moderate	3	moderate at broader spatial scale, or severe but local
Major	4	severe and occurs reasonably often at broad spatial scale
Severe	5	occasional but very severe and localized or less severe but widespread and frequent
Catastrophic	6	local to regional severity or continual and widespread

This score is then recorded on the **Level 1 (SICA) Document** and the rationale documented.

2.3.8 Score the consequence of intensity for that component (Step 8)

The consequence of the activity is a measure of the likelihood of not achieving the operational objective for the selected sub-component and unit of analysis. It considers the flow on effects of the direct impacts from Step 7 for the relevant indicator (e.g. decline in biomass below the selected threshold due to direct capture). Activities are scored as per consequence scores below. A more detailed description of the consequences at each level for each component (key commercial, bycatch and byproduct, protected species, habitats, and communities) is provided as a guide for

scoring the consequences of the activities in the description of consequences table (see **Table 5** Appendix C).

Table 2.18 Consequence score for ERAEF activities (Modified from Fletcher *et al*. 2002).

LEVEL	SCORE	DESCRIPTION
Negligible	1	Impact unlikely to be detectable at the scale of the stock/habitat/community
Minor	2	Minimal impact on stock/habitat/community structure or dynamics
Moderate	3	Maximum impact that still meets an objective (e.g. sustainable level of impact such as full exploitation rate for a target species).
Major	4	Wider and longer term impacts (e.g. long-term decline in CPUE)
Severe	5	Very serious impacts now occurring, with relatively long time period likely to be needed to restore to an acceptable level (e.g. serious decline in spawning biomass limiting population increase).
Intolerable	6	Widespread and permanent/irreversible damage or loss will occur-unlikely to ever be fixed (e.g. extinction)

The score should be based on existing information and/or the expertise of the risk assessment group. The rationale for assigning each consequence score must be documented. The conceptual model may be used to link impact to consequence by showing the pathway that was considered. In the absence of agreement or information, the highest score (worst case scenario) considered plausible is applied to the activity.

2.3.9 Record confidence/uncertainty for the consequence scores (Step 9)

The information used at this level is qualitative and each Step is based on expert (fishers, managers, conservationists, scientists) judgment. The confidence rating for the consequence score is rated as 1 (low confidence) or 2 (high confidence) for the activity/component. The score is recorded on the SICA Document and the rationale documented. The confidence will reflect the levels of uncertainty for each score at Steps 2, 3, 7 and 8.

Table 2.19 Description of Confidence scores for consequences.

CONFIDENCE	SCORE	RATIONALE FOR THE CONFIDENCE SCORE
Low	1	Data exists, but is considered poor or conflicting No data exists Disagreement between experts
High	2	Data exists and is considered sound Consensus between experts Consequence is constrained by logical consideration

2.3.10 **Document rationale for each of the above Steps (Step 10)**

The rationale forms a logical pathway to the consequence score. It is provided for each choice at each Step of the SICA analysis

2.3.11 Level 1 (SICA) Documents

Table 2.20 L1.1 - Key commercial species Component

DIRECT IMPACT OF FISHING	FISHING ACTIVITY	PRESENCE (1) ABSENCE (0)	SPATIAL SCALE OF HAZARD (1-6)	TEMPORAL SCALE OF HAZARD (1-6)	SUB-COMPONENT	UNIT OF ANALYSIS	OPERATIONAL OBJECTIVE (FROM S2.1)	INTENSITY SCORE (1-6)	CONSEQUENCE SCORE (1-6)	CONFIDENCE SCORE (1-2)	RATIONALE
Capture	Bait collection	0									
	Fishing	1	5	3	Population size	Redbait (west)	1.2	2	2	1	Fishing occurred on the shelf and shelf break across half western sub-area (<1000 nm) and concentrated in a few locations e.g. off Kangaroo Island and SW Tas. Fishing occurred annually (5 y average <100 d per year). Highest catch of all SPF species in western sub-area (~40% of 2015-16 TAC) but no recent biomass estimates and considered uncertain. Western stock at Tier 2: TAC derived from harvest rate of 1.5% of Atlantis model biomass (Tier 2B). Intensity considered minor (occurs in a few restricted locations) and consequences minimal on stock structure. Confidence was considered low because no biomass assessment and stock considered uncertain.
	Incidental behaviour	0									
Direct impact without capture	Bait collection	0									
	Fishing	1	5	3	Population size	Redbait (west)	1.2	2	1	1	Fishing occurred on the shelf and shelf break across whole western sub-area but concentrated in a few locations e.g. off Kangaroo Island. Fishing occurred annually (5 y average <100 d per

											year). Escapement from fishing gear may result in physical damage and subsequent mortality but escapement rates unknown. Redbait (west stocks) considered most uncertain and therefore vulnerable. Intensity considered minor assuming it occurs during every trawl. Consequences negligible - unlikely to be detectable against background variability. Confidence low because no data exists on survival of escaped small pelagic fish.
	Incidental behaviour	0									
	Gear loss	1	2	2	Population size	Redbait (west)	1.2	1	1	2	No major gear lost (net): minor gear loss consisted of small lengths of sisal rope and net-sonde wire and a net monitor and possibility of torn nets from pinning up. Major gear loss (of whole nets) most likely to affect population size of small pelagic species from lost catch, minor gear loss unlikely to impact. Intensity negligible - no reports of major gear and rare minor gear loss. Consequence Negligible - unlikely to be detectable at the scale of the small pelagic stocks. Confidence was scored as high 100% observer coverage, all gear losses reported.
	Anchoring/ mooring	0									
	Navigation/ steaming	1	5	3	Behaviour/ movement	Redbait (west)	6.1	2	1	2	Navigation /steaming occurred on the shelf and shelf break across whole western sub-area but concentrated in a few locations e.g. off Kangaroo Island. Occurred annually (5 y average <100 d per year). Collision or avoidance from navigation/steaming was considered unlikely to affect behaviour/ movement of small pelagic species but redbait (west) considered the most vulnerable stock. Intensity-minor. Consequence-negligible – any impact unlikely to result in

											detectable change to behaviour and movement of the stock. Confidence was scored as high because it was considered (within logical constraints) unlikely for there to be strong negative interactions between navigation/steaming and small pelagic species.
Addition/ movement of biological material	Translocation of species	0									
	On board processing	0	0	0							
	Discarding catch	1	5	3	Population size	Redbait (west)	1.2	2	1	1	Fishing occurred on the shelf and shelf break across whole western sub-area but concentrated in a few locations e.g. off Kangaroo Island. Fishing occurred annually (5 y average <100 d per year). Discarding (of key commercial species) was considered most likely to affect population size of key commercial species. Redbait (west) considered the most uncertain and highest catch of all SPF species in western sub-area (~40% of 2015-16 TAC). Intensity of discarding redbait: minor - <0 .05% proportion of redbait catch is discarded. Consequence; negligible – unlikely to be detectable against total catch. Confidence high; 100% observer coverage of logbook records and current stock assessment.
	Stock enhancement	0									
	Provisioning	0									
	Organic waste disposal	0									Prohibited under MARPOL not reported by observers
Addition of non-	Debris	0									Prohibited under MARPOL not reported by observers

biological material	Chemical pollution	0									Prohibited under MARPOL not reported by observers
	Exhaust	1	5	3	Behaviour/ movement	All key commercial species	6.1	1	1	2	Fishing occurred on the shelf and shelf break across eastern subareas but concentrated in a few locations e.g. off southern NSW and SW Tas. Fishing occurred annually (5 y average <100 d per year). Exhaust emission is mostly gas that enters the atmosphere directly, or just below the surface. Dissolving exhaust particulates in the water are diluted very quickly, and the ability to detection considered extremely unlikely. Intensity negligible. Consequence negligible i.e. any consequence on small pelagics unlikely to be detectable. Confidence considered high -logical consideration.
	Gear loss	1	2	2	Population size	All key commercial species	1.2	1	1	2	No major gear lost (net): minor gear loss consisted of small lengths of sisal rope and net-sonde wire and a net monitor and possibility of torn nets from pinning up. Aggregation around lost material on the surface may cause change in behaviour by aggregating species however unlikely to impact small pelagics in midwater. Major gear loss (of whole nets) unlikely to affect population size of small pelagic species, minor gear loss too low to impact. Intensity: negligible. Consequence considered negligible on small pelagic species stock - any consequence on small pelagics unlikely to be detectable. Confidence high-all lost gear reported.

	Navigation/ steaming	1	5	3	Behaviour/ movement	All key commercial species	6.1	2	1	2	Navigation/ steaming occurred on the shelf and shelf break across whole western sub-area but concentrated in a few locations e.g. off Kangaroo Island and occurred annually (5 y average <100 d per year). Navigation/ steaming most likely to disrupt behaviour/ movement of small pelagic species from noise or echo sounding. Intensity: minor-occurs while fishing and steaming. Consequence: Negligible-unlikely to be differentiated from natural variability in schooling behaviour. Confidence: high because schooling behaviour well-monitored during fishing operations.
	Activity/ presence on water	1	5	3	Behaviour/ movement	All key commercial species	6.1	2	1	2	Fishing occurred on the shelf and shelf break across whole western sub-area but concentrated in a few locations e.g. off Kangaroo Island. Fishing occurred annually (5 y average <100 d per year). Noise introduced by the activity/presence on water of fishing vessels was expected to pose greatest potential risk for the Behaviour/movement of small pelagic species resulting in disruption to feeding and/or movement. Intensity minor hazard was considered over a large range/scale although vessel presence considered to only impact a small < 1 nm area and because small pelagic species are highly mobile strong avoidance ability was expected at the scale of 1 nm. Consequence negligible- vessel presence impacts unlikely to be detectable for small pelagic species. Confidence high -logical consideration of localised vessel presence/activity impacts unlikely to affect behaviour/movement of highly mobile small pelagic species.
	Bait collection	0									

Disturb physical processes	Fishing	1	5	3	Behaviour/ movement	All key commercial species	6.1	1	1	2	Fishing occurred on the shelf and shelf break across whole western sub-area but concentrated in a few locations e.g. off Kangaroo Island. Fishing occurred annually (5 y average <100 d per year). Disturbance of water column via fishing was expected to pose greatest potential risk for the behaviour/movement of small pelagic species resulting in momentary disruption to feeding and/or movement. Intensity: minor - although the hazard was considered over a large range/scale, fishing considered to only impact physical processes over a small < 1 nm area and more likely to result in capture. Consequence was also considered negligible with any consequence of water column disturbance unlikely to be detectable against normal water flow patterns. Confidence high- logical consideration of localised disruption of water column impacts highly mobile pelagic species.
	Boat launching	0									
	Anchoring/ mooring	0									
	Navigation/st eaming	1	5	4	Behaviour/ movement	All key commercial species	6.1	1	1	2	Fishing occurred on the shelf and shelf break across whole western sub-area but concentrated in a few locations e.g. off Kangaroo Island. Fishing occurred annually (5 y average <100 d per year). Disturbance of water (wake formation) from navigation/steaming of fishing vessels was considered not to pose a risk to pelagic species occurring at depth but only to species schooling at the surface. Intensity was scored as negligible because although the hazard was considered over a large range/scale, the impact would only be in immediate vicinity of vessel which is targeting midwater schools. Consequence was

											also considered negligible with any impact of wake formation unlikely to be detectable for small pelagic species. Confidence high -logical consideration.
External Impacts	Other fisheries	1	6	6	Population size	Jack mackerel, Blue mackerel	1.2	3	2	2	Jack mackerel often captured incidentally or as target in several other fisheries e.g. trawl sectors of the Commonwealth Southern and Eastern Scalefish and Shark Fishery, the Eastern Tuna and Billfish Fishery, the Commonwealth Western Tuna and Billfish Fishery, the New South Wales Ocean Haul Fishery and state-managed sardine fisheries which occur daily throughout the whole range of the SPF. Recreational fishery for blue mackerel may be a significant consideration. Intensity considered moderate. Consequence considered minor–total fishing mortality on stocks are taken into account when determining sustainable catch limits and current TACs were under-caught. Confidence considered high because of formal stock assessment for jack mackerel and bycatch reports from other fisheries.
	Aquaculture	0									
	Coastal development	1	6	5	Geographic range	Sardine (east)	2.1	3	2	1	Coastal development occurs throughout most of the coast although concentrated in certain areas. Influences such as runoff or pollution may affect primary productivity of the local environment. Considered to pose greatest risk by influencing geographic range of sardines via alteration to prey abundance or habitat quality. Intensity moderate. Consequence considered minor – impact on distribution of sardine unlikely to be detectable against natural variability of environment. Confidence low because of a lack of data.

	Other extractive activities	1	4	6	Behaviour /movement	All eastern stocks	6.1	1	1	1	Oil and gas wells and pipelines occur in restricted areas (e.g. Bass Strait exclusion zone ~100 nm) but generally not overlapping with the main effort in the fishery or core distribution of species. Pelagic species usually school and are highly mobile and therefore behaviour/movement most likely to be affected by noise associated with extractive or associated shipping activities. Intensity: negligible as impacted area of activity is relatively very small and fish would avoid an area if a spill occurred or were affected by noise of operations. Consequence: negligible unlikely to detect impact. Confidence low- no data.

Table 2.21 L1.2 - Byproduct and Bycatch Component

DIRECT IMPACT OF FISHING	FISHING ACTIVITY	PRESENCE (1) ABSENCE (0)	SPATIAL SCALE OF HAZARD (1-6)	TEMPORAL SCALE OF HAZARD (1-6)	SUB-COMPONENT	UNIT OF ANALYSIS	OPERATIONAL OBJECTIVE (FROM S2.1)	INTENSITY SCORE (1-6)	CONSEQUENCE SCORE (1-6)	CONFIDENCE SCORE (1-2)	RATIONALE
Capture	Bait collection	0									
	Fishing	1	6	3	Population size	Silver warehou	1.2	2	2	2	Fishing occurred on the shelf and shelf break across most of jurisdiction (>1000nm) but more concentrated in a few areas e.g. off Kangaroo Island, SW Tas and southern NSW. Fishing occurred annually (5 y average <100 d per year). Byproduct species include benthopelagic SEF and SPF quota species which have comprehensive management plans and detailed assessments e.g. silver warehou (Tier 1) , blue grenadier (Tier 1), Australian Sardine (east) (SPF Tier1). Catches of Silver warehou greatest in the western sub-area but total is ~4% of SESSF catch but not accounted for in SESSF assessment. Current silver warehou catch in SESSF <25% of RBC. Intensity of activity minor-occurred in a few locations. Consequence: minor - the catches are relatively small but possible need to consider impacts on SESSF. Confidence: high-100% observer coverage
	Incidental behaviour	0									
Direct impact	Bait collection	0									

without capture	Fishing	1	6	3	Population size	Silver warehou	1.2	2	2	1	Fishing occurred on the shelf and shelf break across most of jurisdiction (>1000nm) but more concentrated in a few areas e.g. off Kangaroo Island, SW Tas and southern NSW. Fishing occurred annually (5 y average <100 d per year). Post-escapement mortality might be expected to have highest potential risk for the population on silver warehou (highest bycatch species). Intensity minor and consequence considered minor as 'school' impacts would be localised and change not detectable at the scale of the fishery. Confidence: low - no data on non-capture fishing effects.
	Incidental behaviour	0									
	Gear loss	1	2	2	Population size	Silver warehou	1.2	1	1	2	No major gear lost (net): minor gear loss consisted of small lengths of sisal rope and net-sonde wire and a net monitor and possibility of torn nets from pinning up. Major gear loss (of whole nets) most likely to affect population size from lost catch, minor gear loss unlikely to impact. Intensity negligible -no reports of major gear and rare minor gear loss. Consequence negligible - unlikely to be detectable at the scale of the small pelagic stocks. Confidence was scored high as all gear losses reported by observers.
	Anchoring/ mooring	0									
	Navigation/ steaming	1	6	3	Population size	Australian Bonito, Frigate mackerel	1.2	1	1	2	Fishing occurred on the shelf and shelf break across most of jurisdiction (>1000nm) but more concentrated in a few areas e.g. off Kangaroo Island, SW Tas and southern NSW. Fishing occurred annually (5 y average <100 d per year). Direct impact without capture (vessel strike) due to navigation/steaming was considered most likely to affect Australian bonito, Frigate mackerel which are oceanic neritic species and may occur close to the surface. Intensity- negligible. Consequence negligible – any impact unlikely to result in detectable change to

											population. Confidence was scored as high; no evidence of vessel strike on observer records.
Addition/ movement of biological material	Translocation of species	0									
	On board processing	0									
	Discarding catch	1	6	3	Behaviour/ movement	Bronze whaler, Thresher sharks, Dusky whalers	6.1	2	1	1	Fishing and therefore discarding occurred on the shelf and shelf break across most of jurisdiction (>1000nm) but more concentrated in a few areas e.g. off Kangaroo Island, SW Tas and southern NSW. Fishing occurred annually (5 y average <100 d per year). Discarding was likely to attract large predators such as sharks. Intensity considered minor as discard volume is low. Consequence negligible – no changes observed nor likely to be detectable. Confidence low – no data on behavioural impacts of predators.
	Stock enhancement	0									
	Provisioning	0									
	Organic waste disposal	0									Prohibited under MARPOL - not reported by observers
Addition of non-	Debris	0									Prohibited under MARPOL - not reported by observers
	Chemical pollution	0									Prohibited under MARPOL - not reported by observers

biological material	Exhaust	1	6	3	Behaviour/ movement	Australian bonito, Frigate mackerel	6.1	1	1	2	Fishing occurred on the shelf and shelf break across most of jurisdiction (>1000nm) but more concentrated in a few areas e.g. off Kangaroo Island, SW Tas and southern NSW. Fishing occurred less than daily. Exhaust emission is mostly gas that enters the atmosphere directly, or just below the surface. Dissolving exhaust particulates in the water are diluted very quickly, and the ability to detection considered extremely unlikely. Exhaust emission was considered to pose greatest risk for the behaviour/movement of oceanic/neritic species such as bonito and frigate mackerel which are likely to be shallower. Intensity negligible. Consequence negligible i.e. any consequence on small pelagics unlikely to be detectable. Confidence considered high -logical consideration.
	Gear loss	1	2	2	Behaviour/ movement	Australian bonito	6.1	1	1	2	No major gear lost (net): minor gear loss consisted of small lengths of sisal rope and net-sonde wire and a net monitor and possibility of torn nets from pinning up. Aggregation around lost material on the surface may cause change in behaviour by aggregating species. Major gear loss (of whole nets) could affect behaviour /movement of epi-pelagic species, minor gear loss too low to impact. Intensity: negligible. Consequence considered Negligible. Confidence: high -observer reports 100% coverage.
	Navigation/ steaming	1	6	3	Behaviour/ movement	Silver warehou	6.1	2	1	2	Navigation/ steaming occurred on the shelf and shelf break across area but concentrated in a few locations e.g. off Kangaroo Island and occurred annually (5 yr average <100 d per year). Navigation/ steaming most likely to disrupt behaviour/ movement of pelagic species such a silver warehou from noise or echo sounding. Intensity: minor-occurs while fishing and steaming. Consequence: Negligible-unlikely to be differentiated from natural variability in schooling behaviour. Confidence: high because schooling behaviour well-monitored during fishing operations.

	Activity/ presence on water	1	6	4	Behaviour/ movement	Silver warehou	6.1	2	1	2	Fishing occurred on the shelf and shelf break across most of jurisdiction (>1000nm) but more concentrated in a few areas e.g. off Kangaroo Island, SW Tas and southern NSW. Fishing occurred annually (5 y average <100 d per year). Activity/presence on water of fishing vessels was expected to pose greatest potential risk for the Behaviour/movement of silver warehou which move up into the water column to form schools. Intensity was scored as negligible because although the hazard was considered over a large range/scale, vessel presence considered to only impact a small < 1 nm area. Consequence was also considered negligible with any consequence of vessel presence impacts unlikely to be detectable. Confidence in high -logical consideration of localised vessel presence/activity impacts unlikely to affect behaviour/movement of highly mobile midwater species.
Disturb physical processes	Bait collection	0									
	Fishing	1	6	3	Behaviour/ movement	Silver warehou	6.1	2	1	2	Fishing occurred on the shelf and shelf break across most of jurisdiction (>1000nm) but more concentrated in a few areas e.g. off Kangaroo Island, SW Tas and southern NSW. Fishing occurred annually (5 y average <100 d per year). Disturbance of water column may disrupt the behaviour/movement of silver warehou which move up into the water column to feed and spawn. Intensity was scored as negligible because although the hazard was considered over a large range/scale, fishing considered to only impact physical processes over a small < 1 nm area. Consequence was also considered negligible with any consequence of water column disturbance unlikely to be detectable. Confidence high -logical consideration of localised disruption of water column unlikely to impact and have consequences for the behaviour/movement of benthopelagic teleosts.

	Boat launching	0									
	Anchoring/ mooring	0									
	Navigation/steaming	1	6	3	Behaviour/ movement	Australian bonito, Frigate mackerel	6.1	1	1	2	Fishing occurred on the shelf and shelf break across most of jurisdiction (>1000nm) but more concentrated in a few areas e.g. off Kangaroo Island, SW Tas and southern NSW. Fishing occurred annually (5 y average <100 d per year). Wake formation of Navigation/steaming of fishing vessels was expected to pose greatest potential risk for the behaviour/movement of oceanic neritic species (shallower). Intensity was scored as negligible because although the hazard was considered over a large range/scale, Navigation/ steaming considered to only impact a small < 1 nm area. Consequence negligible -any impact of Navigation/ steaming unlikely to be detectable. Confidence high -logical consideration of wake formation from navigation/ steaming unlikely to impact highly mobile epipelagic fishes.
External Impacts	Other fisheries	1	6	6	Population size	Silver warehou	1.2	3	3	2	Byproduct species are targeted daily in external fisheries e.g. silver warehou and blue grenadier in the SESSF. Intensity considered moderate because byproduct species in this fishery are also the key commercial or bycatch of other commonwealth and state fisheries. Consequence considered Moderate (full exploitation rate but long term recruitment dynamics not adversely damaged) because byproduct species are already fully exploited in other fisheries e.g. blue grenadier. Confidence: high – SEF quota species have detailed stock assessments.
	Aquaculture	0									
	Coastal development	1	6	5	Behaviour/movement	Australian sardine (east)	6.1	3	1	1	Coastal development occurred throughout range of the fishery although concentrated in localised areas but beyond the areas where most effort is currently focused. Runoff may affect primary productivity via water quality.

											Considered to pose greatest risk by influencing behaviour/ movement of sardines via alteration to prey distribution and abundance or physical repulsion and avoidance. Intensity considered moderate. Consequence considered negligible – impact on movement of sardine unlikely to be detectable against natural variability of environment. Confidence low because of a lack of data
	Other extractive activities	1	4	6	Behaviour/movement	Silver warehou	6.1	2	2	1	Oil and gas wells and pipelines occur in restricted areas (e.g. Bass Strait exclusion zone ~100 nm) but generally not overlapping with the main effort in the fishery or core distribution of species. Pelagic species usually school and are highly mobile and therefore behaviour/movement most likely to be affected by noise associated with extractive or associated shipping activities. Intensity: negligible as impacted area of activity is relatively very small and fish would avoid an area if a spill occurred or were affected by noise of operations. Consequence: negligible unlikely to detect impact. Confidence low- no data.
	Other non-extractive activities	1	6	6	Behaviour/movement	Australian bonito	6.1	1	1	1	Shipping activity occurred daily across the full range of the fishery, and outside areas of current effort. Noise and vessel strike pose greatest potential risks are to the behaviour/movement of epipelagic species. Intensity: negligible because although the hazard was considered over a large range/scale, the shipping track is narrow - impact a < 1 nm wide strong avoidance ability of silver warehou was expected at the scale of 1 nm. Consequence: negligible with any consequence of shipping impacts unlikely to be detectable. Confidence: high -logical considerations of overlap pf shipping and impacts on silver warehous.

	Other anthropogenic activities	1	4	5	Behaviour/movement	Frigate mackerel, Australian bonito	6.1	1	1	1	Marine tourism activities (not including large cruise ships) (e.g. whale watching, game fishing) occur almost daily but generally inshore of current fishery and effort. Tourism activities centred around population centres and largely within state waters. Greatest potential risks are to the behaviour/movement of oceanic pelagic species perhaps by noise. Intensity: negligible. Consequence: negligible with any consequence of tourism impacts unlikely to be detectable. Confidence: low-no data on tourism activities.

Table 2.22 L1.3 – Protected Species Component

DIRECT IMPACT OF FISHING	FISHING ACTIVITY	PRESENCE (1) ABSENCE (0)	SPATIAL SCALE OF HAZARD (1-6)	TEMPORAL SCALE OF HAZARD (1-6)	SUB-COMPONENT	UNIT OF ANALYSIS	OPERATIONAL OBJECTIVE (FROM S2.1)	INTENSITY SCORE (1-6)	CONSEQUENCE SCORE(1-6)	CONFIDENCE SCORE (1-2)	RATIONALE
Capture	Bait collection	0									
	Fishing	1	6	3	Population size	Australian fur seal	1.4	3	2	2	Fishing occurred on the shelf and shelf break across most of jurisdiction (>1000nm) but more concentrated in a few areas e.g. off Kangaroo Island, SW Tas and southern NSW. Fishing occurred annually (5 y average <100 d per year). Interactions with or sightings of furseals occurred on the large majority resulting in highest mortality rate and non-fatal interactions of protected species. Intensity moderate; fur seals are central placed foragers and their distribution relatively restricted by colony placement therefore effort distribution overlaps distribution. Consequence: minor- unlikely to have had more than minimal impact on stock- 46 mortalities p.a. from population est 120,000 and unlikely to detect difference against background population variability. Confidence high; 100% observer coverage.
	Incidental behaviour	0									

Direct impact without capture	Bait collection	0									
	Fishing	1	6	3	Behaviour / movement	Australian fur seal, NZ furseal	6.1	3	2	2	Fishing occurred on the shelf and shelf break across most of jurisdiction (>1000nm) but more concentrated in a few areas e.g. off Kangaroo Island, SW Tas and southern NSW. Fishing occurred annually (5 y average <100 d per year). Interactions with or sightings of furseals occurred on the large majority. Fishing represent greatest risk to Australian furseals behaviour and movement as they attracted to all fishing activities to net feed. Intensity moderate; fur seals are central placed foragers and their distribution relatively restricted by colony placement therefore effort distribution overlaps distribution. Consequence: minor- unlikely to have had more than minimal impact on stock. Confidence high; 100% observer coverage.
	Incidental behaviour	0									
	Gear loss	1	2	2	Behaviour / movement	Australian fur seal, NZ furseal	6.1	1	1	2	Fishing occurred on the shelf and shelf break across most of jurisdiction (>1000nm) but more concentrated in a few areas e.g. off Kangaroo Island, SW Tas and southern NSW. Fishing occurred annually (5 y average <100 d per year) but no nets were lost and only two small lengths of sisal rope or wire and a net monitor reported. Major gear loss may modify furseal behaviour by attracting them to lost catches or entangle them however minor losses not likely to impact. Intensity negligible -no net losses reported to occur during assessment period. Consequence considered negligible - no detectable change in behaviour/ movement were detected. High confidence 100% observer coverage and reporting.
	Anchoring/ mooring	0									

	Navigation/ steaming	1	6	3	Behaviour / movement	Common dolphins	6.1	2	2	2	Fishing occurred on the shelf and shelf break across most of jurisdiction (>1000nm) but more concentrated in a few areas e.g. off Kangaroo Island, SW Tas and southern NSW. Fishing occurred annually (5 y average <100 d per year). Navigation / steaming producing bow waves modifies dolphin behaviour as they ride bow waves and may strike the vessel. Intensity considered minor -occurred rarely or in restricted locations. Consequence was considered Minor - normal behaviour/ movement would return to normal on the scale of hours. Confidence: high-100% observer coverage
Addition/ movement of biological material	Translocation of species	0									
	On board processing	0									
	Discarding catch	1	6	3	Interactions with fishery	Shy/White-capped albatross	7.1	2	2	1	Fishing occurred on the shelf and shelf break across most of jurisdiction (>1000nm) but more concentrated in a few areas e.g. off Kangaroo Island, SW Tas and southern NSW. Fishing occurred annually (5 y average <100 d per year) therefore discarded catch would occur similarly although not while fishing. Discarded catch attracts birds causing interactions. Intensity was scored minor - discards <1% of total annual SPF catch and discarding is not allowed while gear is in the water when risk of birds striking the warps is high. Consequence minor - time to return to original behaviour/ movement on the scale of hours once the vessel moved on. The confidence score is high -observer data 100% coverage
	Stock enhancement	0									
	Provisioning	0									

	Organic waste disposal	0									Prohibited under MARPOL not reported by observers
Addition of non-biological material	Debris	0									Prohibited under MARPOL not reported by observers
	Chemical pollution	0									Prohibited under MARPOL not reported by observers
	Exhaust	1	6	3	Population size	Shy/White-capped Albatross	1.4	1	1	2	Fishing occurred on the shelf and shelf break throughout jurisdiction (>1000nm) but more concentrated in a few areas e.g. off Kangaroo Island, SW Tas and southern NSW. Fishing occurred annually (5 y average <100 d per year). Exhaust emission into the atmosphere was considered to pose greatest risk for the albatrosses (highest mortality and most abundant observed) -exposure to fumes could result in mortality. Intensity was scored as negligible because although the hazard was considered over a large range/scale, exhaust considered to only impact a small < 1 nm area and would disperse quickly and birds were expected to readily avoid fumes. Consequence was considered Negligible i.e. any consequence on seabirds unlikely to be detectable. Confidence high - localised exhaust effects not reported by observer coverage.

	Gear loss	1	2	2	Population size	Australian fur seal, NZ furseal	1.4	1	1	2	Fishing occurred on the shelf and shelf break across most of jurisdiction (>1000nm) but more concentrated in a few areas e.g. off Kangaroo Island, SW Tas and southern NSW. Fishing occurred annually (5 y average <100 d per year) but no major gear loss reported (net monitor only). Major gear loss could cause fur seal entanglement and mortality. Intensity negligible - no nets were lost and impact of small lengths of rope unlikely to impact. Consequence negligible-undetectable. High confidence 100% observer coverage and reporting.
	Navigation/ steaming	1	6	3	Population size	Shy/White-capped Albatross	1.4	2	1	1	Fishing occurred on the shelf and shelf break across most of jurisdiction (>1000nm) but more concentrated in a few areas e.g. off Kangaroo Island, SW Tas and southern NSW. Fishing occurred annually (5 y average <100 d per year). Navigation and steaming could encourage albatrosses (highest mortality and most abundant observed) to follow the vessels in the expectation of obtaining food and fatally strike the ship infrastructure. Intensity minor as Navigation/steaming is a large component of the small pelagic species fishing operations, however presence of one vessel not considered great impact and not all non-fatal strikes might be observed and recorded. Consequence negligible - no detectable change on population size. Confidence was recorded as low -100% observer coverage-no reports of mortality but not all may be observed.
	Activity/ presence on water	1	6	3	Behaviour / Movement	Shy/White-capped Albatross	6.1	2	1	1	Fishing occurred on the shelf and shelf break across most of jurisdiction (>1000nm) but more concentrated in a few areas e.g. off Kangaroo Island, SW Tas and southern NSW. Fishing occurred annually (5 y average <100 d per year). The presence of vessel on the water would have the greatest effect on seabird behaviour by attracting birds to the vessel in the expectation of obtaining food and shy albatross has highest rate of mortality. Intensity was scored as minor because presence of one vessel considered to only impact a small < 1 nm area. Consequence negligible - any impacts of vessel presence

											unlikely to be detectable for highly mobile birds- expected to return to normal Behaviour/ movement on the scale of hours. Confidence in the consequence score was low-no data on behavioural consequences.
Disturb physical processes	Bait collection	0									
	Fishing	1	6	3	Behaviour/ movement	Southern Bluefin tuna	6.1	1	1	2	Fishing occurred on the shelf and shelf break across most of jurisdiction (>1000nm) but more concentrated in a few areas e.g. off Kangaroo Island, SW Tas and southern NSW. Fishing occurred annually (5 y average <100 d per year). Disturbance of water column was expected to pose greatest potential risk for the Behaviour/movement of SBT resulting in momentary disruption to feeding and/or movement if prey were disrupted. Intensity was scored as minor because although the hazard was considered over a large range/scale, fishing considered to only impact physical processes over immediate vicinity of vessel and gear. Consequence was also considered Negligible with any consequence of water column disturbance undetectable against background variability of water column processes. Confidence high - logical consideration of the high mobility of species.
	Boat launching	0									
	Anchoring/ mooring	0									
	Navigation/steaming	1	6	3	Population size	Common dolphin	1.4	2	2	2	Fishing occurred on the shelf and shelf break across most of jurisdiction (>1000nm) but more concentrated in a few areas e.g. off Kangaroo Island, SW Tas and southern NSW. Fishing occurred annually (5 y average <100 d per year). Disturbance of physical processes via navigation and steaming (bow-wave riding) was expected to pose greatest potential risk for Common dolphins which may result in fatal impact with the vessel. Intensity was scored

											as minor because although the hazard was considered over a large range/scale, the activity was considered to only impact immediate vicinity of vessel but bow-wave riding by dolphins observed with no impact. Consequence was considered minor -not all interactions might be observed. Confidence high because observers occasionally report bow-wave riding of dolphins with no impact.
External Impacts (specify the particular example within each activity area)	Other fisheries	1	6	6	Population size	Wandering Albatross, White-capped/Shy albatross, Buller's, Black-browed	1.4	3	4	2	Commercial fisheries impacting on albatross extend across southern Australian waters and beyond daily. Pose greatest risk to the population size sub-component of over-wintering non-breeding and juveniles Wandering Albatross- most seriously threatened from longline fishing. These species were observed on majority of fishing trips in the SPF and are sighted regularly in other Australian fisheries. Intensity moderate-fisheries occur broadly. Consequence major - global long-term declines have occurred and ongoing in Wandering and Buller's although possibly steady in other species. Confidence was recorded as high because of extensive observational data on albatross long-line fishery interactions (BirdLife International (2016) IUCN Red List for birds. Downloaded from http://www.birdlife.org on 31/07/2016).
	Aquaculture	0									
	Coastal development	1	6	5	Population size	Fairy tern	1.4	3	4	1	Coastal development occurred around the range of the fishery but inshore of the fishery effort. Fairy terns breed throughout the fishery but declining 23% pa and are listed vulnerable. Impacts on the Fairy terns from habitat degradation and inappropriate water management, interaction with human disturbance and predation reduce breeding success. Intensity considered major – occurred broadly across spatial area. Consequence major-recruitment rate has declined and continues to effect population. Confidence low – patchy data and trends still uncertain (BirdLife International (2016) Species factsheet: Sternula nereis. Downloaded from http://www.birdlife.org on 31/07/2016)

	Other extractive activities	1	4	6	Behaviour/movement	Bottle nose dolphins	6.1	2	2	1	Oil and gas activities occur daily particularly in Bass Strait. Seismic and other noise from these sites may cause disturbance in dolphins' behaviour and movement. Intensity: minor-occurs in restricted areas and species are highly mobile. Consequence: minor -possible avoidance of area but unlikely to detect against variability in distribution. Confidence low-no data.
	Other non-extractive activities	1	6	6	Population size	Wandering Albatross, White-capped/Shy albatross, Buller's, Black-browed	1.4	2	2	1	Shipping activity occurs daily across the full range of the fishery. Greatest potential risks are to the population of albatrosses due to fatal strikes. Seabirds may be attracted to ships expecting food and hit infrastructure. Intensity: minor because although the hazard occurs over a large range/scale, shipping tracks are narrow. Consequence minor- fatal impacts could potentially contribute to decline in populations but undetectable against natural population variability. Confidence: low - no data and shipping strikes unlikely to be reported.
	Other anthropogenic activities	1	4	5	Behaviour/movement	Bottle nose dolphins	6.1	2	2	1	Tourism occurred daily across the full range of the fishery, but usually outside areas of current fishery effort. Greatest potential risks are to the Behaviour/movement of dolphin species resulting in disruption to feeding and/ or migration. Intensity: minor because although the hazard is dispersed over a large range, its occurrence is patchy- around population centres. Consequence: minor - tourism impacts unlikely to be detectable for dolphins against background variability in movement. Confidence: low – no data

Table 2.23 L1.4 - Habitat Component

DIRECT IMPACT OF FISHING	FISHING ACTIVITY	PRESENCE (1) / ABSENCE (0)	SPATIAL SCALE OF HAZARD (1-6)	TEMPORAL SCALE OF HAZARD (1-6)	SUB-COMPONENT	UNIT OF ANALYSIS	OPERATIONAL OBJECTIVE (FROM S2.1)	INTENSITY SCORE (1-6)	CONSEQUENCE SCORE(1-6)	CONFIDENCE SCORE (1-2)	RATIONALE
Capture	Bait collection	0									
	Fishing	1	6	3	Habitat structure and Function	Southern coastal pelagic Province	5.1	3	1	1	Fishing occurred on the shelf and shelf break across most of jurisdiction (>1000nm) but more concentrated in a few areas e.g. off Kangaroo Island, SW Tas and southern NSW. Fishing occurred annually (5 y average <100 d per year). Mid water trawling for small pelagic species is mainly likely to affect habitat structure and function as a result of local disruption to pelagic processes. Intensity: moderate but relatively localised. Consequence: Negligible, as water column expected to resume state rapidly. Confidence: low because of insufficient knowledge of pelagic habitat processes.
	Incidental behaviour	0									
	Bait collection	0									

Direct impact without capture	Fishing	1	6	2	Habitat structure and Function	Outer-shelf, Cobble, outcrop, crinoids	5.1	1	1	1	Fishing occurred on the shelf and shelf break across most of jurisdiction (>1000nm) but more concentrated in a few areas e.g. off Kangaroo Island, SW Tas and southern NSW. Fishing occurred annually (5 yr average <100 d per year). Trawl nets or ground rope reported to contact bottom briefly on 3 occasions, 1 pin-up. Subsequent degree of disturbance, damage or mortality of substratum and associated faunal assemblages, dependent on size of net (footprint), contact force, extent of area dragged before net lifted, but unknown. Intensity: minor, the impact of non-capture damage or mortality was reported 3 times. Consequence: over the entire scale of the effort is likely to be negligible. Confidence: high due to 100% observer coverage and recorded contact.
	Incidental behaviour	0									
	Gear loss	1	2	2	Habitat structure and Function	Outer-shelf, Cobble, outcrop, crinoids	5.1	1	1	2	No major gear lost (net): minor gear loss consisted of small lengths of sisal rope and net-sonde wire and a net monitor and possibility of torn nets from pinning up. Lost gear may be irretrievable in deeper waters, may impact benthos in process of balling up and retrieval, or snag on higher relief reefs, potentially damaging habitat in the vicinity, eventually becoming habitat. Intensity: negligible. Consequence: negligible. Confidence: high, 100% observer coverage.
	Anchoring/ mooring	0									
	Navigation/steaming	1	6	3	Water quality	Southern coastal pelagic Province	2.1	1	1	2	Fishing occurred on the shelf and shelf break across most of jurisdiction (>1000nm) but more concentrated in a few areas e.g. off Kangaroo Island, SW Tas and southern NSW. Fishing and therefore Navigation/ steaming occurred annually (5 yr average

											<100 d per year). The pelagic water quality of the Southern Coastal Pelagic habitat may change with increased turbulence and changes in water mixing that could occur from movement of vessels through water. Intensity and Consequence: negligible due to remote likelihood of detection at any spatial or temporal scale, and interactions that may be occurring are not detectable against natural variation. Confidence scored high because of logical constraints.
Addition/ move-ment of biological material	Translocation of species	0									
	On board processing	0									
	Discarding catch	1	6	3	Substrate quality	fine sediments, subcrop, large sponges, outer-shelf	3.1	1	1	1	Discarding occurred on the shelf and shelf break across most of jurisdiction (>1000nm) but more concentrated in a few areas e.g. off Kangaroo Island, SW Tas and southern NSW annually (5 y average <100 d per year). Discarding byproduct species known to occur during fishing trips but <1% of total catch. Discards largely consumed by scavenging species but some may reach the benthos. Localized accumulation unlikely. Intensity considered negligible. Consequence: negligible. Confidence low: because of a lack of insufficient knowledge on microbial processes.
	Stock enhancement	0									
	Provisioning	0									
	Organic waste disposal	0									Prohibited under MARPOL not reported by observers
Addition of non-	Debris	0									Prohibited under MARPOL not reported by observers

biological material	Chemical pollution	0									Prohibited under MARPOL not reported by observers
	Exhaust	1	6	3	Air quality	Southern coastal pelagic province.	2.1	1	1	2	Exhaust from running engines may impact the air quality of the species within Southern Coastal Pelagic habitat (e.g. birds). Intensity: negligible. Consequence: negligible due to rapid dispersal of pollutants in winds, and likely to be physically undetectable over very short time frames. Confidence in assessment: high because effect of exhaust was considered to be very localised, and logical consideration.
	Gear loss	1	2	2	Habitat structure and Function	Pelagic: Southern coastal pelagic Province, Benthic: sedimentary rock, outcrop, mixed faunal community, outer-shelf	5.1	1	1	2	Lost gear known to ball up if not retrieved, may drift to bottom or snag on higher relief reefs, potentially damaging habitat in the vicinity, eventually becoming habitat. Intensity: negligible not reported. Consequence: negligible. Confidence: high, 100% observer coverage and recording
	Navigation/ steaming	1	6	3	Water quality	Southern coastal pelagic Province	1.1	1	1	2	Navigation/ steaming may occur daily during fishing season. Addition of non-biological material will occur during the normal course of steaming throughout the fishing operations. Changes to the pelagic water quality of the Southern Coastal Pelagic habitat likely to be undetectable over these scales due to rapid dispersal of presence water. Intensity and Consequence: negligible due to remote likelihood of detection at any spatial or temporal scale, and interactions that may be occurring are not detectable against natural variation. Confidence scored high because of logical constraints.

	Activity/ presence on water	1	6	3	Habitat structure and Function	Southern coastal pelagic Province	5.1	1	1	2	Activity/presence on water occurs over a small spatial scale, daily during fishing season. Activity/presence on water of midwater fishing vessels was expected to pose greatest potential risk for the Southern coastal pelagic habitat structure and function. Intensity and Consequence: negligible, remote likelihood of impact at any spatial or temporal scale. Confidence in consequence score: high because it was considered highly unlikely that vessel presence/activity would lead to community level changes in its own right (logical constraints).
Disturb physical processes	Bait collection	0									
	Fishing	1	6	3	Substrate quality	fine sediments, unrippled, mixed faunal community, outer shelf	3.1	2	2	1	Fishing activity concentrates along on the narrow band of the outer continental shelf edge and upper slope, of SE Bass Strait and Eastern Tasmania. This zone is characterised by gently sloping plains of muddy and sandy sediments grading into narrow mud terraces and escarpments. Soft ground is interspersed with hard patches (± a veneer of fine sediments) which provide attachment points for mixed faunal communities. Suspension and filter feeding animals dominate these communities. Disturbance of physical processes via mid-water trawling will occur if nets contact benthos. Sediments will be resuspended, potentially smothering filter feeding animals. Shallow infaunal bioturbators will be dislodged, settling elsewhere. Recovery capacity of sessile species removed by the net is unknown for many groups. Intensity: minor because net contact with bottom not a usual part of deployment. Consequence: minor with current level of effort, however this would need review if effort increases. Disturbance of water column unlikely to be detectable for pelagic communities. Confidence: low for benthos, inadequate documentation of frequency of this occurrence.

	Boat launching	0									
	Anchoring/ mooring	0									
	Navigation/ steaming	1	6	3	Habitat structure and function	Southern coastal pelagic Province	5.1	1	1	2	Navigation/ steaming may occur daily during fishing season. Disturbance of physical processes will occur during the normal course of steaming throughout the fishing zone. Turbulence and disturbance of pelagic water quality is unlikely to affect normal water column processes for long. Any disruption to these processes can therefore be expected to alter habitat function only briefly for macroscopic fauna. Intensity and Consequence: negligible due to remote likelihood of detection at any spatial or temporal scale, and interactions that may be occurring are not detectable against natural variation. Confidence scored high because of logical constraints.
External Impacts	Other fisheries	1	6	6	Habitat structure and function	Southern coastal pelagic Province	5.1	3	4	1	Fishery covers a small spatial area in which other fisheries occur, using different targeting methods and gears. Fishing activity of these fisheries occurs over a large spatial range, over which there can be daily fishing activity. Other fisheries most likely to affect benthic habitats include those using bottom gears i.e. SET Danish seine, and otter trawl, GHAT gillnet, auto longline, (and to a lesser degree) demersal longlines, dropline, trap. Intensity: moderate, the impact was considered to be potentially severe at local scales but moderate at broader spatial scale. Consequence: major to severe, because the cumulative effects of fishing are likely to have measurable changes to structure, function, extent, and quality and regeneration capacity of vulnerable habitats. Loss of habitat results in short and long term loss of species, as habitats play a keystone role in ecosystem stability. Confidence: low because of insufficient knowledge of habitat dynamics, and ecosystem connectivity

	Aquaculture	0									
	Coastal development	1	6	5	Habitat structure and function	fine sediments, unrippled, mixed faunal community, outer shelf	5.1	3	3	1	Coastal development occurred around the range of the fishery but inshore of the fishery effort. Frequent, local impacts at small spatial scales are likely to have most obvious impact on the habitat composition, structure and function, including for pelagic types, water quality and for benthic types, substratum state. Intensity: moderate at broader spatial scale, or severe but localized within the areas affected. Consequence: moderate, greatest impacts likely to be inshore including waters less than 25m, extending in some cases further out onto the inner shelf Southern Coastal Pelagic and benthic habitats. Confidence: low because of a lack of data.
	Other extractive activities	1	4	6	Habitat structure and function	Southern coastal pelagic Province	5.1	2	2	1	Oil and gas industry occur in the area (e.g. Bass Strait). There may be pollution from the petrochemical industry in both shallow and deep water and associated stimuli. Intensity: minor as direct and indirect impact(s) on community likely to be low, but linkages need to be better understood. Consequence: Cumulative impacts may exist, but considered minor as commercial fishing restricted within these zones. Confidence: low, due to limited information available.
	Other non-extractive activities	1	6	6	Habitat structure and function	Southern coastal pelagic Province	5.1	2	1	1	Shipping activity occurs daily across the full range of the fishery. Most shipping considered to occur in the Southern Coastal Pelagic environment and impact bio- and geo-chemical cycles of pelagic waters by disturbing mixed depth layer, and addition of non-biological materials. Intensity: minor because natural levels of mixing and re-mixing considered high in Eastern Coastal Pelagic and benthic impacts localised over scale of fishery area. Consequence: negligible - Interactions which affect bio- & geochemical cycling unlikely to be detectable against natural variation. Confidence: low because of a lack of information on

											shipping-animal interactions plus insufficient knowledge on effects of ships on bio- and geo-chemical cycling
	Other anthropogenic activities	1	4	5	Habitat structure and function	Southern coastal pelagic Province	5.1	2	2	1	Habitats may be disturbed by charter boats associated with general recreational activities, and tourism (e.g. whale watching, fishing tours, anchoring, recreational diving etc). Intensity: Assumed to have minor direct and indirect impacts on pelagic habitat, and un measured on benthos. Consequence: Until there is better information, difficult to score therefore low confidence.

Table 2.24 L1.5 - Community Component

DIRECT IMPACT OF FISHING	FISHING ACTIVITY	PRESENCE (1) ABSENCE (0)	SPATIAL SCALE OF HAZARD (1-6)	TEMPORAL SCALE OF HAZARD (1-6)	SUB-COMPONENT	UNIT OF ANALYSIS	OPERATIONAL OBJECTIVE (FROM S2.1)	INTENSITY SCORE (1-6)	CONSEQUENCE SCORE (1-6)	CONFIDENCE SCORE (1-2)	RATIONALE
Direct impact with capture	Bait collection	0									
	Fishing	1	6	3	Functional group composition	Southern Pelagic Province - Coastal, Eastern Pelagic Province- Coastal	2.1	2	2	2	Fishing occurred on the continental shelf and shelf break throughout the whole jurisdiction but more concentrated in a few areas e.g. Kangaroo Island, southwest Tas, and southern NSW. Fishing occurred annually (5 y average <100 d per year). Mid water trawling for small pelagic species most likely to affect functional group composition, i.e. removal of the small pelagic species functional group from the Southern Coastal Pelagic community. Intensity: minor occurs in a few restricted locations. Consequence: minor i.e. it was considered that fishing at current levels below the RBC has minimal impact on ecosystem function. Confidence: high because of detailed knowledge of trophic interactions and modelling studies.
	Incidental behaviour	0									
Direct impact	Fishing	1	6	3	Functional group composition	Southern Pelagic Province -	2.1	2	1	1	Fishing occurred on the continental shelf and shelf break throughout the whole jurisdiction but slightly concentrated in a few areas e.g. Kangaroo

without capture						Coastal, Eastern Pelagic Province-Coastal					Island, SW Tas, and southern NSW. Fishing occurred annually (5 y average <100 d per year). Escapement mortality from trawls most likely to affect functional group composition by removing small pelagic functional group from the Southern Coastal Pelagic community. Intensity: minor – current rates of removal are well under TAC therefore potential escapement minimal. Consequence: negligible -unlikely to detect against natural variation. Confidence: low because of insufficient knowledge on escapement.
	Incidental behaviour	0									
	Gear loss	1	2	2	Functional group composition	Southern Province outer shelf, South East transition outer shelf	2.1	1	1	2	No major gear lost (net): minor gear loss consisted of small lengths of sisal rope and net-sonde wire and a net monitor and possibility of torn nets from pinning up. Major gear loss (of whole nets) most likely to affect population size of small pelagic species from lost catch affecting functional group composition, minor gear loss unlikely to impact. Intensity negligible -no reports of major gear and rare minor gear loss. Consequence negligible. Confidence was scored as high 100% observer coverage and all gear losses reported.
	Anchoring/ mooring	0									
	Navigation/ steaming	1	6	3	Species composition	Southern Pelagic Province - Coastal, Eastern Pelagic	1.1	2	1	2	Navigation/ steaming occurred on the continental shelf and shelf break throughout the whole jurisdiction but more concentrated in a few areas e.g. Kangaroo Island, southwest Tas, southern NSW, annually (5 yr average <100 d per year). Mortality from vessel strike could potentially affect whales and other cetacean abundance. Intensity: minor. Consequence:

						Province-Coastal					negligible- mortality would not be detectable against natural variation and not reported in fishery. Confidence high: 100% observer coverage.
	Translocation of species	0									
	On board processing	0									
Addition/ movement of biological material	Discarding catch	1	6	3	Functional group composition	Southern Pelagic Province - Coastal, Eastern Pelagic Province-Coastal	1.1	2	1	2	Discarding occurred on the continental shelf and shelf break throughout the whole jurisdiction but more concentrated in a few areas e.g. Kangaroo Island, southwest Tas, southern NSW, annually (5 y average <100 d per year). Majority of discard species were key commercial species but also include sardine, squid. Most likely to affect functional group composition of communities, i.e. removal of the small pelagic species functional group. Intensity: minor occurs in a few restricted locations. Consequence: negligible i.e. it was considered that fishing at current levels below the RBC has minimal impact on ecosystem function. Confidence: high because of detailed knowledge of trophic interactions and modelling studies.
	Stock enhancement	0									
	Provisioning	0									
	Organic waste disposal	0									Prohibited under MARPOL not reported by observers
Addition of non-biological material	Debris	0									Prohibited under MARPOL not reported by observers
	Chemical pollution	0									Prohibited under MARPOL not reported by observers

	Exhaust	1	6	3	Species composition	Southern Pelagic Province - Coastal, Eastern Pelagic Province-Coastal	3.1	1	1	2	Fishing occurred on the shelf and shelf break across whole jurisdiction but concentrated in a few locations e.g. off Kangaroo I, southern NSW and SW Tas. Fishing occurred annually (5 yr average <100 d per year). Exhaust emission is mostly gas that enters the atmosphere directly, or just below the surface therefore affecting the survival of species in close proximity. Dissolving exhaust particulates in the water are diluted very quickly, and the ability to detection considered extremely unlikely. Intensity- negligible-detection unlikely. Consequence: negligible as unlikely to be detectable against natural variation. Confidence: high-logical considerations
	Gear loss	1	2	2	Functional group composition	Southern Province outer shelf, South East transition outer shelf	2.1	1	1	2	No major gear lost (net): minor gear loss consisted of small lengths of sisal rope and net-sonde wire and a net monitor and possibility of torn nets from pinning up. Gear loss was considered to have greatest community level impact by creating new benthic habitat or potential risk of entanglement, minor gear loss unlikely to have impact. Intensity: negligible – i.e. the likelihood of impact was considered remote. Consequence: negligible. Confidence in the consequence score: high -100% observer coverage and recorded gear loss.
	Navigation/ steaming	1	6	3	Functional group composition	Southern Pelagic Province - Coastal, Eastern Pelagic Province-Coastal	1.1	1	1	2	Noise and echo-sounding from fishing occurred on the shelf and shelf break across whole jurisdiction but concentrated in a few locations e.g. off Kangaroo I, southern NSW and SW Tas, annually (5 y average <100 d per year). The functional group composition of the communities may be affected by avoidance of the disturbance. Intensity: minor. Consequence: negligible since unlikely to be detectable - any consequence on species unlikely to be detectable against natural

											variability. Confidence: high- logical consideration.
	Activity/ presence on water	1	6	4	Species composition	Southern Pelagic Province - Coastal, Eastern Pelagic Province-Coastal	1.1	1	1	2	Activity /presence occurred on the continental shelf and shelf break throughout the whole jurisdiction but more concentrated in a few areas e.g. Kangaroo Island, southwest Tas, southern NSW, annually (5 y average <100 d per year). May effect the functional group composition by changing behaviour and distribution of cetaceans, scavengers, marine mammals. Intensity: negligible - remote likelihood of detection at any spatial or temporal scale. Consequence: negligible as interactions may be occurring which affect the internal dynamics of communities leading to change in species composition but not detectable against natural variation. Confidence: high because of logical consideration.
Disturb physical processes	Bait collection	0									
	Fishing	1	6	3	Distribution of the community	Southern Pelagic Province - Coastal, Eastern Pelagic Province-Coastal	3.1	1	1	2	Fishing occurred on the continental shelf and shelf break throughout the whole jurisdiction but more concentrated in a few areas e.g. Kangaroo Island, southwest Tas, southern NSW, annually (5 y average <100 d per year). Disturbance of water column from mid-water trawling was expected to impact the distribution of the community. Intensity: negligible. Consequence: negligible with any consequence of water column disturbance unlikely to be detectable for pelagic communities. Confidence: high logical consideration.
	Boat launching	0									

	Anchoring/ mooring	0									
	Navigation/st eaming	1	6	3	Bio- and geo-chemical cycles	Eastern Pelagic Province-Coastal	5.1	1	1	2	Navigation /steaming occurred on the continental shelf and shelf break throughout the whole jurisdiction but more concentrated in a few areas e.g. Kangaroo Island, southwest Tas, southern NSW, annually (5 y average <100 d per year). Possible Impact on bio- and geo-chemical cycles of pelagic waters by disturbing mixed depth layer. Intensity: negligible - navigation/steaming is a large component of the small pelagic species mid water trawling operations, but localised impact within immediate vicinity of the vessel. Consequence: negligible because impact considered likely undetectable against natural levels of mixing and re-mixing. Confidence: high-logical consideration.
External Impacts	Other fisheries e.g. South East Fishery – otter trawl; GHAT – auto-longline	1	6	6	Functional group composition	Southern Pelagic Province - Coastal, Eastern Pelagic Province-Coastal	2.1	3	3	2	Other fisheries including recreational, capture a range of species across the full area of the fishery. Other fisheries most likely to affect functional group composition. Intensity: moderate – i.e. the impact was considered to be potentially severe at local scales but moderate at broader spatial scale. Consequence: moderate-historical evidence to show some species are in serious decline but without a detrimental loss to overall ecosystem function. Confidence: high-ecosystem models exist that investigate effects of fishing.
	Aquaculture	0									
	Coastal development	1	6	5	Species composition	Southern Pelagic Province - Coastal, Eastern	1.1	3	2	1	Coastal development occurs across the range of the fishery but beyond the boundaries of current effort. Frequent, local impacts at small spatial scales should have most obvious impact on the species composition of the areas affected, the

						Pelagic Province-Coastal					impacts should be local and their consequences only minor to the communities. Intensity: moderate - moderate at broader spatial scale, or severe but local. Consequence: minor - Consequence: minor- greatest impacts likely to be inshore including waters less than 25m, and unlikely to extend to entire coastal pelagic communities. Confidence: low because of a lack of data.
	Other extractive activities	1	4	6	Distribution of the community	Eastern Pelagic Province-Coastal	3.1	2	1	1	Oil and gas activities occur daily particularly in Bass Strait. Seismic and other noise from these sites may cause disturbance in behaviour and movement of species and here may be pollution from the petrochemical industry in both shallow and deep water resulting in change in distribution in local areas. Intensity: minor-occurs in restricted areas and species are highly mobile. Consequence: negligible -possible avoidance of area but unlikely to detect against variability in distribution. Confidence low-no data.
	Other non-extractive activities	1	6	6	Bio- and geo-chemical cycles	Southern Pelagic Province - Coastal, Eastern Pelagic Province-Coastal	5.1	2	1	1	Shipping may occur in the area of fishing effort (predominantly eastern sub-area and may occur daily. Most shipping considered to occur in the Southern Coastal Pelagic community and impact bio- and geo-chemical cycles of pelagic waters by disturbing mixed depth layer. Intensity: minor because natural levels of mixing and re-mixing considered high in Southern Coastal Pelagic and community level impact considered rarely detectable. Consequence: negligible - Interactions which affect bio- & geochemical cycling unlikely to be detectable against natural variation. Confidence in consequence score: low because of a lack of information on shipping-animal interactions plus insufficient knowledge on effects of ships on bio- and geo-chemical cycling.

Summary of SICA results

Table 2.25 Level 1 (SICA) Document L1.6. Summary table of consequence scores for all activity/component combinations. Those that scored >3 (highlighted in green) and high confidence (in bold).

DIRECT IMPACT OF FISHING	FISHING ACTIVITY	KEY COMM-ERCIAL	BYCATCH BYPRODUCT	PROTECTED	HABITAT	COMMUNITY
Capture	Bait collection	0	0	0	0	0
	Fishing	2	2	2	1	2
	Incidental behaviour	0	0	0	0	0
Direct impact without capture	Bait collection	0	0	0	0	0
	Fishing	1	2	2	1	1
	Incidental behaviour	0	0	0	0	0
	Gear loss	1	1	1	1	1
	Anchoring/ mooring	0	0	0	0	0
	Navigation/ steaming	1	1	2	1	1
Addition/ movement of biological material	Translocation of species	0	0	0	0	0
	On board processing	0	0	0	0	0
	Discarding catch	1	1	2	1	1
	Stock enhancement	0	0	0	0	0
	Provisioning	0	0	0	0	0
	Organic waste disposal	0	0	0	0	0
Addition of non-biological material	Debris	0	0	0	0	0
	Chemical pollution	0	0	0	0	0
	Exhaust	1	1	1	1	1
	Gear loss	1	1	1	1	1
	Navigation/ steaming	1	1	1	1	1
	Activity/ presence on water	1	1	1	1	1
Disturb physical processes	Bait collection	0	0	0	0	0
	Fishing	1	1	1	2	1
	Boat launching	0	0	0	0	0
	Anchoring/ mooring	0	0	0	0	0
	Navigation/steaming	1	1	2	1	1
External	Other fisheries	**2**	**3**	**4**	4	**3**
	Aquaculture	0	0	0	0	0
	Coastal development	2	1	4	**3**	2
	Other extractive activities	1	2	2	2	1
	Other non-extractive activities	1	1	2	1	1
	Other anthropogenic activities	1	1	2	2	1

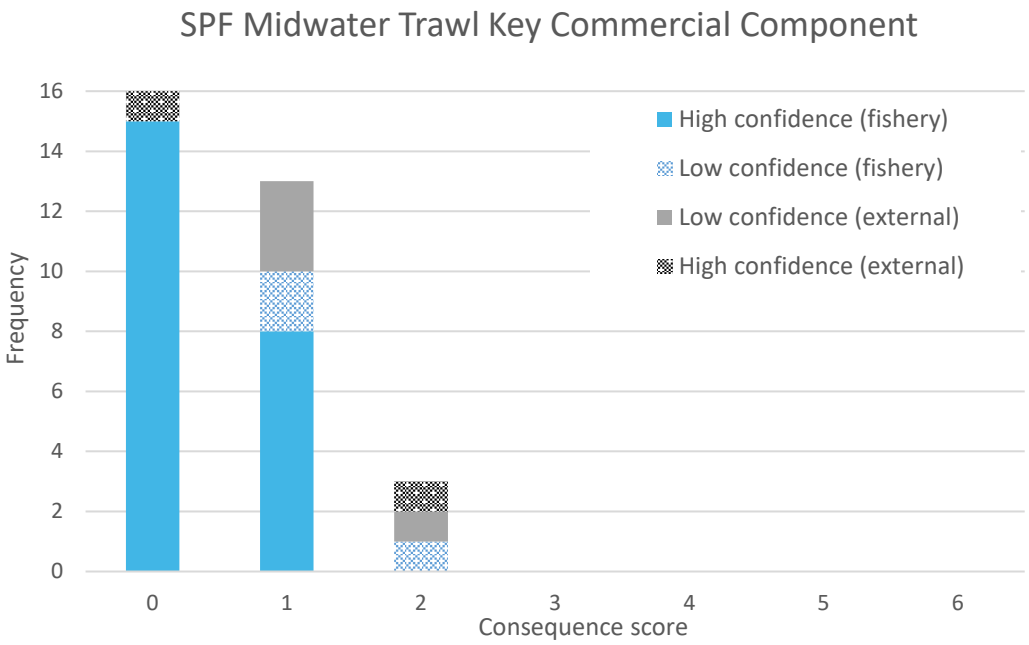


Figure 2.1 Key commercial species: Frequency of consequence score differentiated between high and low confidence.

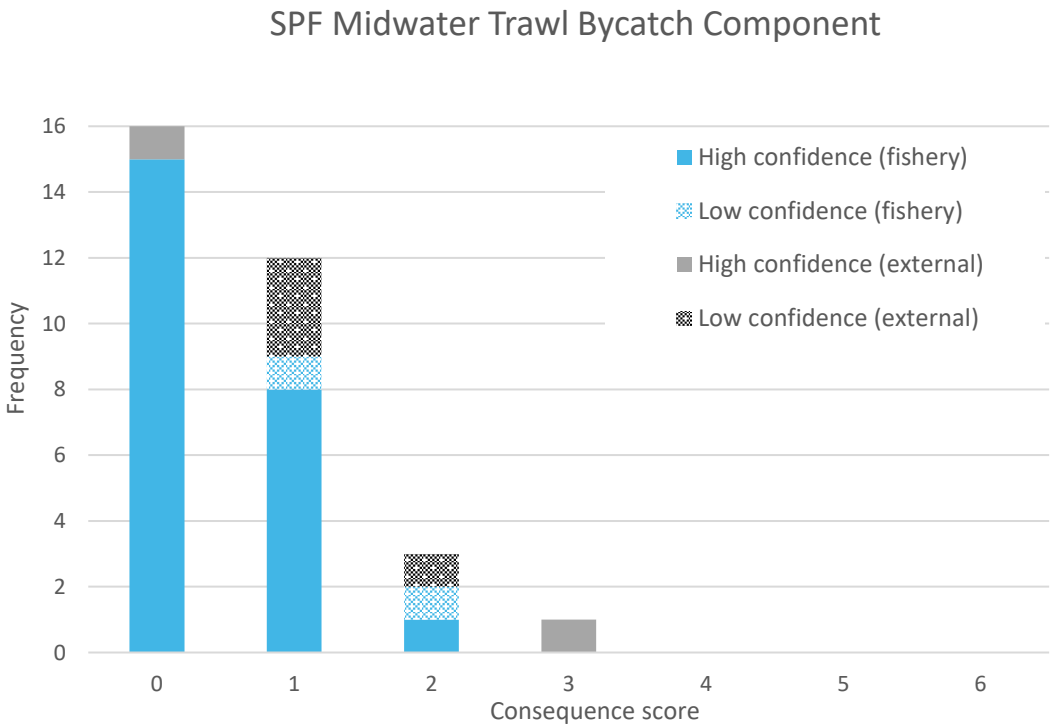


Figure 2.2 Byproduct and bycatch species: Frequency of consequence score differentiated between high and low confidence

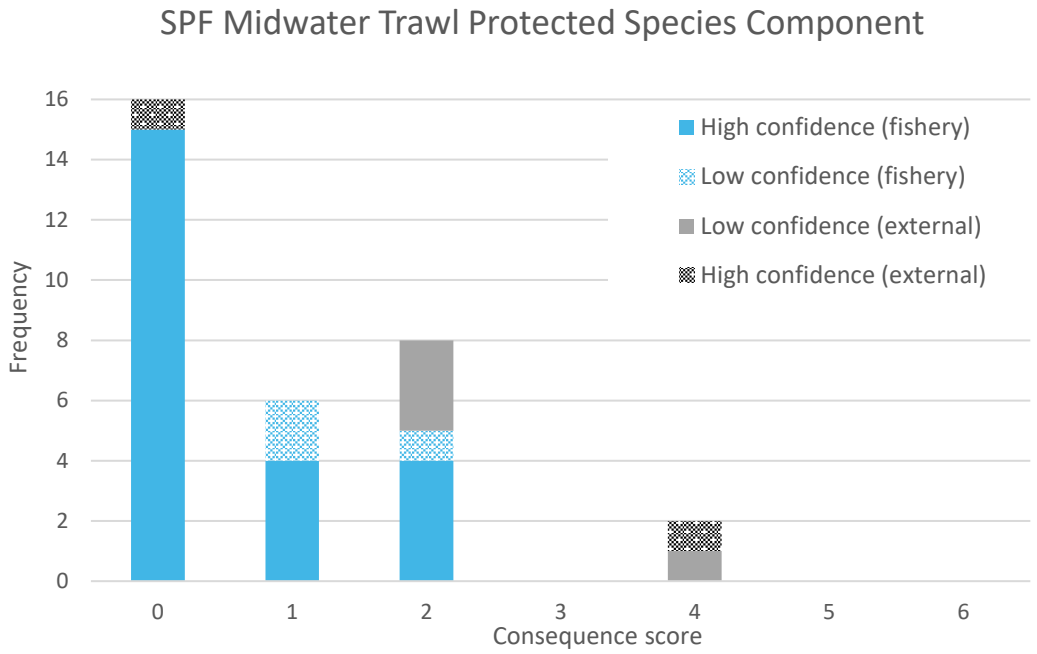


Figure 2.3 Protected species: Frequency of consequence score differentiated between high and low confidence

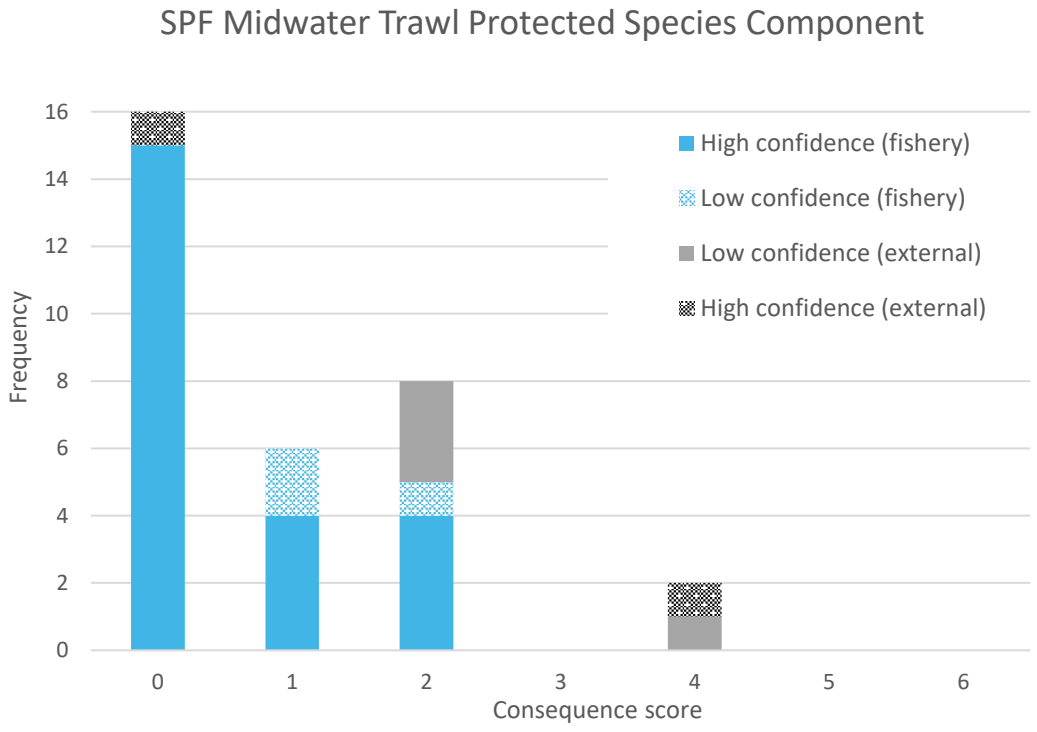


Figure 2.4 Habitats: Frequency of consequence score differentiated between high and low confidence

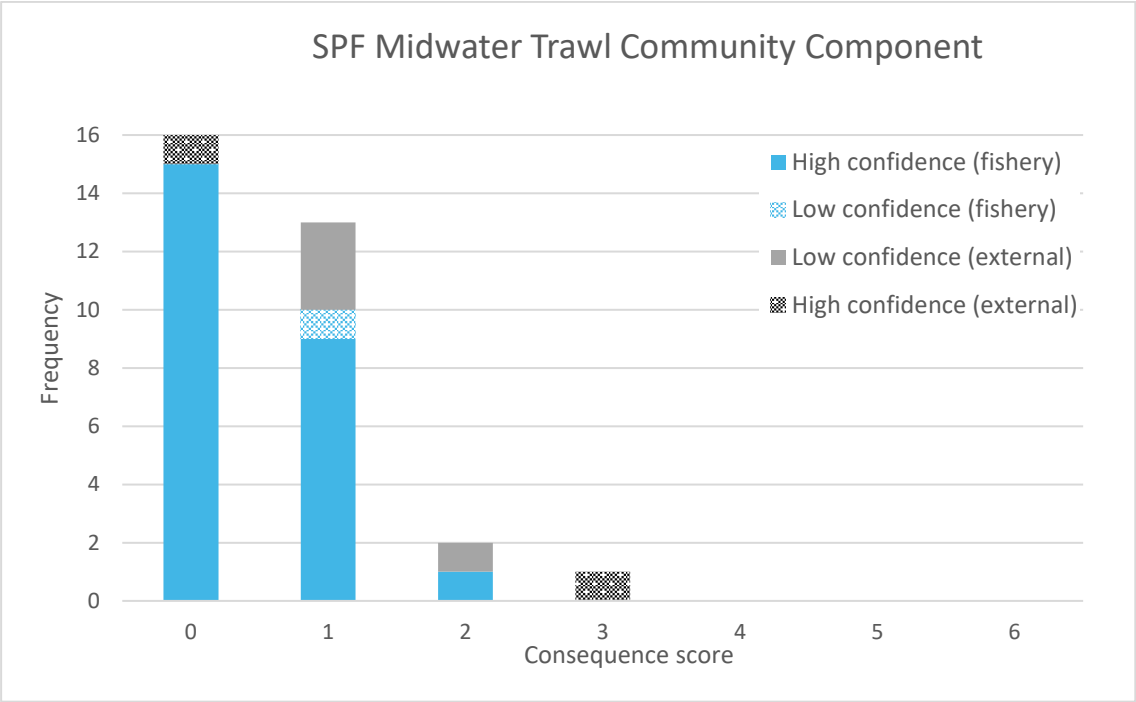


Figure 2.5 Communities: Frequency of consequence score differentiated between high and low confidence

2.3.12 Evaluation/discussion of Level 1

This section provides a brief discussion of the results of the Level 1 analysis. Full details and rationale for the scores are provided in the SICA tables earlier in this section.

Of the 32 possible activities (hazards), 16 were identified as occurring in the SPF midwater trawl sub-fishery, 12 internal and 4 external. A total of 80 scenarios were scored -16 activities for each of the five components. None of the internal scenarios, and only two external scenarios, were identified as having an impact of moderate or above (see **Level 1 (SICA) Document L1.6**).

The significant external activities to the components relevant to the SPF midwater trawl sub-fishery were external fishing in all five components and coastal development in habitats and protected species components.

This analysis did not yield any surprises; the lack of fishing for the majority of the assessment period and the low level of fishing since means that the impact all activities was minor. The capture volume of the key commercial species were all below the TAC set for each stock. Capture of conservation-dependent species of other fisheries were of low proportions and probably don't present concern. However the capture of the byproduct species Silver warehou perhaps should be considered in stock assessments in their primary fishery e.g. SESSF. No risks were identified for protected species but continued fishing pressure over a full assessment period may raise the risk level.

2.3.13 **Components to be examined at Level 2**

As a result of the SICA analysis, there were no components that are to be examined at Level 2 are those with any consequence scores of 3 or above.

2.4 Level 2 Productivity and Susceptibility Analysis (PSA)

When the risk of an activity at Level 1 (SICA) on a component is moderate or higher and no planned management interventions that would remove this risk are identified, an assessment is required at Level 2. The PSA approach is a method of assessment which allows all units within any of the ecological components to be effectively and comprehensively screened for risk. The units of analysis are the complete set of species habitats or communities identified at the scoping stage. The PSA results in sections 2.4.2 and 2.4.3 of this report measure risk from direct impacts of fishing only. In all assessments to date, this has been the hazard with the greatest risks identified at Level 1. Future iterations of the methodology will include PSAs modified to measure the risk due to other activities, such as gear loss.

The PSA approach is based on the assumption that the risk to an ecological component will depend on two characteristics of the component units: (1) the extent of the impact due to the fishing activity, which will be determined by the susceptibility of the unit to the fishing activities (Susceptibility) and (2) the productivity of the unit (Productivity), which will determine the rate at which the unit can recover after potential depletion or damage by the fishing. It is important to note that the PSA analysis essentially measures potential for risk, hereafter noted as 'risk'. A measure of absolute risk requires some direct measure of abundance or mortality rate for the unit in question, and this information is generally lacking at Level 2.

The PSA approach examines attributes of each unit that contribute to or reflect its productivity or susceptibility to provide a relative measure of risk to the unit. The following section describes how this approach is applied to the different components in the analysis. Full details of the methods are described in Hobday *et al*. (2007).

Species

The following Table outlines the seven attributes that are averaged to measure productivity, and the four aspects that are multiplied to measure susceptibility for all the species components.

Table 2.26 Attributes for productivity and susceptibility measures of species

	ATTRIBUTE
Productivity	Average age at maturity
	Average size at maturity
	Average maximum age
	Average maximum size
	Fecundity
	Reproductive strategy
	Trophic level
Susceptibility	Availability considers overlap of fishing effort with a species distribution

	ATTRIBUTE
	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)
	Selectivity considers the potential of the gear to capture or retain species
	Post capture mortality considers the condition and subsequent survival of a species that is captured and released (or discarded)

The productivity attributes for each species are based on data from the literature or from data sources such as FishBase. The four aspects of susceptibility are calculated in the following way:

Availability considers overlap of effort with species distribution. For species without distribution maps, availability is scored based on broad geographic distribution (global, southern hemisphere, Australian endemic). Where more detailed distribution maps are available (e.g. from BIOREG data or DEH protected species maps), availability is scored as the overlap between fishing effort and the portion of the species range that lies within the broader geographical spread of the fishery. Overrides can occur where direct data from independent observer programs are available.

Encounterability is the likelihood that a species will encounter fishing gear deployed within its range. Encounterability is scored using habitat information from FishBase, modified by bathymetric information. Higher risk corresponds to the gear being deployed at the core depth range of the species. Overrides are based on mitigation measures and fishery independent observer data.

For species that do encounter gear, **selectivity** is a measure of the likelihood that the species will be caught by the gear. Factors affecting selectivity will be gear and species dependent, but body size in relation to gear size is an important attribute for this aspect. Overrides can be based on body shape, swimming speed and independent observer data.

For species that are caught by the gear, **post capture mortality** measures the survival probability of the species. Obviously, for species that are retained, survival will be zero. Species that are discarded may or may not survive. This aspect is mainly scored using independent filed observations or expert knowledge.

Overall susceptibility scores for species are a product of the four aspects outlined above. This means that susceptibility scores will be substantially reduced if any one of the four aspects is considered to be low risk. However the default assumption in the absence of verifiable supporting data is that all aspects are high risk.

Habitats

Similar to species, PSA methods for habitats are based around a set of attributes that measure productivity and susceptibility. Productivity attributes include speed of

regeneration of fauna, and likelihood of natural disturbance. The susceptibility attributes for habitats are described in the following Table.

Table 2.27 Habitat attributes

ASPECT	ATTRIBUTE	CONCEPT	RATIONALE
Susceptibility			
Availability	General depth range (Biome)	Spatial overlap of sub fishery with habitat defined at biomic scale	Habitat occurs within the management area
Encounterability	Depth zone and feature type	Habitat encountered at the depth and location at which fishing activity occurs	Fishing takes place where habitat occurs
	Ruggedness (fractal dimension of substratum and seabed slope)	Relief, rugosity, hardness and seabed slope influence accessibility to different sub-fisheries	Rugged substratum is less accessible to mobile gears. Steeply sloping seabed is less accessible to mobile gears
	Level of disturbance	Gear footprint and intensity of encounters	Degree of impact is determined by the frequency and intensity of encounters (including size, weight and mobility of individual gears)
Selectivity	Removability/ mortality of fauna/ flora	Removal/ mortality of structure forming epifauna/ flora (including bioturbating infauna)	Erect, large, rugose, inflexible, delicate epifauna and flora, and large or delicate and shallow burrowing infauna (at depths impacted by mobile gears) are preferentially removed or damaged.
	Areal extent	How much of each habitat is present	Effective degree of impact greater in rarer habitats: rarer habitats may maintain rarer species.
	Removability of substratum	Certain size classes can be removed	Intermediate sized clasts (~6 cm to 3 m) that form attachment sites for sessile fauna can be permanently removed
	Substratum hardness	Composition of substrata	Harder substratum is intrinsically more resistant
	Seabed slope	Mobility of substrata once dislodged; generally higher levels of structural fauna	Gravity or latent energy transfer assists movement of habitat structures, e.g. turbidity flows, larger clasts. Greater density of filter feeding animals found where currents move up and down slopes.
Productivity			
Productivity	Regeneration of fauna	Accumulation/ recovery of fauna	Fauna have different intrinsic growth and reproductive rates which are also variable in different conditions of temperature, nutrients, productivity.
	Natural disturbance	Level of natural disturbance affects intrinsic ability to recover	Frequently disturbed communities adapted to recover from disturbance

Communities

PSA methods for communities are relatively new and have only been undertaken for SESSF otter trawl sub-fishery (Hobday *et al.* 2011).

During the Level 2 assessment, each unit of analysis within each ecological component (species or habitat) is scored for risk based on attributes for productivity and susceptibility, and the results are plotted as shown in Figure 13.

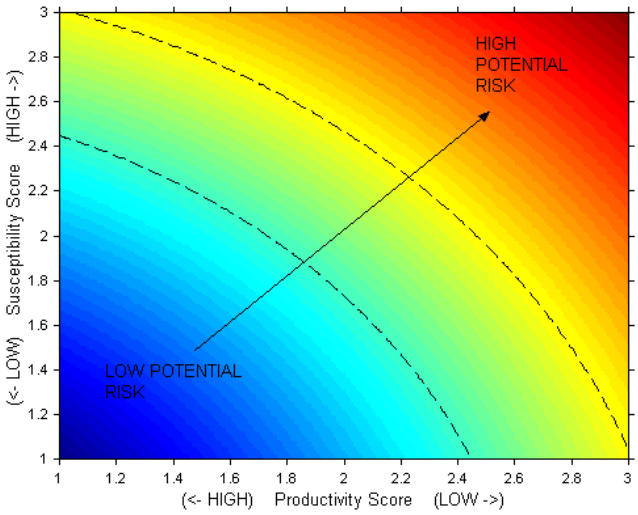


Figure 2.6 The axes on which risk to the ecological units is plotted. The x-axis includes attributes that influence the productivity of a unit, or its ability to recover after impact from fishing. The y-axis includes attributes that influence the susceptibility of the unit to impacts from fishing. The combination of susceptibility and productivity determines the relative risk to a unit, i.e. units with high susceptibility and low productivity are at highest risk, while units with low susceptibility and high productivity are at lowest risk. The contour lines divide regions of equal risk and group units of similar risk levels.

There are seven Steps for the PSA undertaken for each component brought forward from Level 1 analysis.

Step 1: Identify the units excluded from analysis and document the reason for exclusion

Step 2: Score units for productivity

Step 3: Score units for susceptibility

Step 4: Plot individual units of analysis onto a PSA Plot

Step 5: Ranking of overall risk to each unit

Step 6: Evaluation of the PSA analysis

Step 7: Decision rules to move from Level 2 to Level 3

2.4.1 Units excluded from analysis and document the reason for exclusion (Step 1)

Species lists for PSA analysis are derived from recent observer data where possible or, for fisheries with no observer programs, from logbook and scientific data. In some logbook data, there may only be family level identifications. Where possible these are resolved to species level by cross-checking with alternative data sources and discussion with experts. In cases where this is not possible (mainly invertebrates) the analysis may be based on family average data.

Table 2.28 Units excluded from PSA lists

ERA_SPECIES_ID	ERA_SUB_FISHERY_ID	TAXA_NAME	SCIENTIFIC_NAME	CAAB_CODE	FAMILY_NAME	COMMON_NAME	EXPLANATION FOR WHY TAXA EXCLUDED

2.4.2 Level 2 PSA (Steps 2 and 3)

Summary of Species PSA results

The results in the Tables below provide details of the PSA assessments for each species, separated by role in the fishery, and by taxa where appropriate. These assessments are limited to direct impacts from fishing, and the operational objective is to avoid over-exploitation due to fishing, either as over-fishing or becoming over-fished. The risk scores and categories (high, medium or low) reflect potential rather than actual risk using the Level 2 (PSA) method. For species assessed at Level 2, no account is taken of the level of catch, the size of the population, or the likely exploitation rate. To assess actual risk for any species requires a Level 3 assessment which does account for these factors. However, recent fishing effort distributions are considered when calculating the availability attribute for the Level 2 analysis, whereas the entire jurisdictional range of the fishery is considered at Level 1.

The PSA analyses do not fully take account of management actions already in place in the fishery that may mitigate for high risk species. Some management actions or strategies, however, can be accounted for in the analysis where they exist. These 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). Management strategies that are not reflected in the PSA scores include limits to fishing effort, use of catch limits (such as TACs), and some other controls such as seasonal closures.

It should be noted that the PSA method is likely to generate more false positives for high risk (species assessed to be high risk when they are actually low risk) than false negatives (species assessed to be low risk when they are actually high risk). This is due to the precautionary approach to uncertainty adopted in the PSA method, whereby attributes are set at high risk levels in the absence of information. It also arises from the nature of the PSA method assessing potential rather than actual risk, as discussed above. Thus some species will be assessed at high risk because they have low productivity and are exposed to the fishery, even though they are rarely if ever caught and are relatively abundant.

In the PSA Tables below, the "Comments" column is used to provide information on one or more of the following aspects of the analysis for each species: use of overrides to alter susceptibility scores (for example based on use of observer data, or taking account of specific management measures or mitigation); data or information sources or limitations; and information that supports the overall scores. The use of over-rides is explained more fully in Hobday *et al.* (2007).

The PSA Tables also report on "missing information" (the number of attributes with missing data that therefore score at the highest risk level by default). There are seven attributes used to score productivity and four aspects (availability, encounterability, selectivity and post capture mortality) used to score susceptibility (though encounterability is the average of two attributes). An attribute or aspect is scored as missing if there are no data available to score it, and it has defaulted to high risk for this reason. For some species, attributes may be scored on information from related species or other supplementary information, and even though this information is indirect and less reliable than if species specific information was available, this is not scored as a missing attribute.

There are differences between analyses for protected species and the other species components. In particular, key commercial, by-product and by-catch species are included on the basis that they are known to be caught by the fishery (in some cases only very rarely). However protected species are included in the analysis on the basis that they occur in the area of the fishery, whether or not there has ever been an interaction with the fishery recorded. For this reason there may be a higher proportion of false positives for high vulnerability for species, unless there is a robust observer program that can verify that species do not interact with the gear.

Observer data and observer expert knowledge are important sources of information in the PSA analyses, particularly for the bycatch and protected species components. Observer data has been collected by the agencies that co-manage the fishery. There are no stated objectives of the program and objectives have varied between trips. Objectives for a revised program are still under consideration under the developing Harvest Strategy Framework. Additional information is given in the scoping section.

A summary of the species considered at Level 2 is presented below, sorted by component, by taxa within components, and then by the overall risk score [high (>3.18), medium (2.64-3.18), low<2.64)], together with categorisation of risk (refer to section 2.4.8)

Table 2.29 Key commercial species Small Pelagic Fishery midwater trawl

ERA SPECIES ID	SCIENTIFIC NAME	COMMON NAME	AVERAGE LOGBOOK CATCH (KG) (2001-04)	MISSING > 3 ATTRIBUTES (Y/N)	NUMBER OF MISSING PRODUCTIVITY ATTRIBUTES (OUT	MISSING SUSCEPTIBILITY ATTRIBUTES (OUT OF 5)	PRODUCTIVITY (ADDITIVE) 1- LOW RISK, 3 - HIGH RISK	SUSCEPTIBILITY (MULT) 1- LOW RISK, 3 - HIGH RISK	2D RISK VALUE (P&S) 1.41- LOW RISK, 4.24 - HIGH RISK	SUSCEPTIBILITY OVERRIDE USED?	2D P&S RISK CATEGORY	HIGH/MED RISK CATEGORY (REFER 2.4.8)	COMMENTS

Table 2.30 Byproduct species Small Pelagic Fishery midwater trawl

ERA SPECIES ID	SCIENTIFIC NAME	COMMON NAME	AVERAGE LOGBOOK CATCH (KG) (2001-04)	MISSING > 3 ATTRIBUTES (Y/N)	NUMBER OF MISSING PRODUCTIVITY ATTRIBUTES (OUT OF 5)	MISSING SUSCEPTIBILITY ATTRIBUTES (OUT OF 5)	PRODUCTIVITY (ADDITIVE) 1- LOW RISK, 3 - HIGH RISK	SUSCEPTIBILITY (MULT) 1- LOW RISK, 3 - HIGH RISK	2D RISK VALUE (P&S) 1.41- LOW RISK, 4.24 - HIGH RISK	SUSCEPTIBILITY OVERRIDE USED?	2D P&S RISK CATEGORY	HIGH/MED RISK CATEGORY (REFER 2.4.8)	COMMENTS

Table 2.31 Bycatch species Small Pelagic Fishery midwater trawl

ERA SPECIES ID	SCIENTIFIC NAME	COMMON NAME	AVERAGE LOGBOOK CATCH (KG) (2001-04)	MISSING > 3 ATTRIBUTES (Y/N)	NUMBER OF MISSING PRODUCTIVITY ATTRIBUTES (OUT OF 7)	MISSING SUSCEPTIBILITY ATTRIBUTES (OUT OF 5)	PRODUCTIVITY (ADDITIVE) 1- LOW RISK, 3 - HIGH RISK	SUSCEPTIBILITY (MULT) 1- LOW RISK, 3 - HIGH RISK	2D RISK VALUE (P&S) 1.41- LOW RISK, 4.24 - HIGH RISK	SUSCEPTIBILITY OVERRIDE USED?	2D P&S RISK CATEGORY	HIGH/MED RISK CATEGORY (REFER 2.4.8)	COMMENTS

Table 2.32 Protected species Small Pelagic Fishery midwater trawl

ERA SPECIES ID	SCIENTIFIC NAME	COMMON NAME	AVERAGE LOGBOOK CATCH (KG) (2001-04)	MISSING > 3 ATTRIBUTES (Y/N)	NUMBER OF MISSING PRODUCTIVITY ATTRIBUTES (OUT OF 7)	MISSING SUSCEPTIBILITY ATTRIBUTES (OUT OF 5)	PRODUCTIVITY (ADDITIVE) 1- LOW RISK, 3 - HIGH RISK	SUSCEPTIBILITY (MULT) 1- LOW RISK, 3 - HIGH RISK	2D RISK VALUE (P&S) 1.41- LOW RISK, 4.24 - HIGH RISK	SUSCEPTIBILITY OVERRIDE USED?	2D P&S RISK CATEGORY	HIGH/MED RISK CATEGORY (REFER 2.4.8)	COMMENTS

2.4.3 Summary of Habitat PSA results

Habitats were eliminated at the end of Level 1

2.4.4 **Summary of Community PSA results**

Communities were eliminated at end of Level 1.

Glossary

Assemblage	A subset of the species in the community that can be easily recognized and studied. For example, the set of sharks and rays in a community is the Chondrichthyan assemblage.
Attribute	A general term for a set of properties relating to the productivity or susceptibility of a particular unit of analysis.
Bycatch species	A non-target species captured in a fishery, usually of low value and often discarded (see also Byproduct).
Byproduct species	A non-target species captured in a fishery, but it may have value to the fisher and be retained for sale.
Community	A complete set of interacting species.
Component	A major area of relevance to fisheries with regard to ecological risk assessment (e.g. key commercial species, bycatch and byproduct species, threatened and endangered species, habitats, and communities).
Component model	A conceptual description of the impacts of fishing activities (hazards) on components and sub-components, linked through the processes and resources that determine the level of a component.
Consequence	The effect of an activity on achieving the operational objective for a sub-component.
Core objective	The overall aim of management for a component.
End point	A term used in risk assessment to denote the object of the assessment; equivalent to component or sub-component in ERAEF
Ecosystem	The spatially explicit association of abiotic and biotic elements within which there is a flow of resources, such as nutrients, biomass or energy (Crooks, 2002).
External factor	Factors other than fishing that affect achievement of operational objectives for components and sub-components.
Fishery method	A technique or set of equipment used to harvest fish in a fishery (e.g. long-lining, purse-seining, trawling).
Fishery	A related set of fish harvesting activities regulated by an authority (e.g. South-East Trawl Fishery).
Habitat	The place where fauna or flora complete all or a portion of their life cycle.
Hazard identification	The identification of activities (hazards) that may impact the components of interest.
Indicator	Used to monitor the effect of an activity on a sub-component. An indicator is something that can be measured, such as biomass or abundance.
Key commercial species	A species or group of species whose capture is the goal of a fishery, sub-fishery, or fishing operation.
Likelihood	The chance that a sub-component will be affected by an activity.

Operational objective	A measurable objective for a component or sub-component (typically expressed as “the level of X does not fall outside acceptable bounds”)
Precautionary approach	The approach whereby, if there is uncertainty about the outcome of an action, the benefit of the doubt should be given to the biological entity (such as species, habitat or community).
PSA	Productivity-Susceptibility Analysis. Used at Level 2 in the ERAEF methodology.
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.
SICA	Scale, Impact, Consequence Analysis. Used at Level 1 in the ERAEF methodology.
Sub-component	A more detailed aspect of a component. For example, within the key commercial species component, the sub-components include the population size, geographic range, and the age/size/sex structure.
Sub-fishery	A subdivision of the fishery on the basis of the gear or areal extent of the fishery. Ecological risk is assessed separately for each sub-fishery within a fishery.
Sustainability	Ability to be maintained indefinitely
Target species	A species or group of species whose capture is the goal of a fishery, sub-fishery, or fishing operation. Has been replaced by key commercial in relation to the components.
Trophic position	Location of an individual organism or species within a foodweb.
Unit of analysis	The entities for which attributes are scored in the Level 2 analysis. For example, the units of analysis for the Key commercial Species component are individual “species”, while for Habitats, they are “biotypes”, and for Communities the units are “assemblages”.

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