Australia's National
Science Agency

Ecological Risk Assessment for the Effects of Fishing

Report for the Small Pelagic Fishery: Purse Seine sub-fishery, 2017 - 2021

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Notes to this document

This fishery ERA Report document contains figures and tables with numbers that correspond to the full methodology document for the ERAEF method:

> Hobday, A. J., A. Smith, H. Webb, R. Daley, S. Wayte, C. Bulman, J. Dowdney, A. Williams, M. Sporcic, J. Dambacher, M. Fuller, T. Walker (2007). Ecological Risk Assessment for the Effects of Fishing: Methodology. Report R04/1072 for the Australian Fisheries Management Authority, Canberra

Thus, table and figure numbers within the fishery ERA Report document are not sequential as not all are relevant to the fishery ERA Report results.

Additional details on the rationale and the background to the methods development are contained in the ERAEF Final Report:

> Smith, A., A. Hobday, H. Webb, R. Daley, S. Wayte, C. Bulman, J. Dowdney, A. Williams, M. Sporcic, J. Dambacher, M. Fuller, D. Furlani, T. Walker. (2007). Ecological Risk Assessment for the Effects of Fishing: Final Report R04/1072 for the Australian Fisheries Management Authority, Canberra.

This document also reflects some changes in methods that are detailed in AFMA's ERA guide (2017):

> Australian Fisheries Management Authority (2017). Guide to AFMA's Ecological Risk Management. 130 p. (Commonwealth of Australia, Canberra).

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Executive Summary

The "Ecological Risk Assessment for Effect of Fishing" ERAEF was developed jointly by CSIRO Oceans and Atmosphere (now CSIRO Environment) and the Australian Fisheries Management Authority (Hobday et al., 2007, 2011a). This assessment of the ecological impacts of the Small Pelagic Fishery - Purse Seine sub-fishery was undertaken using the ERAEF method version 9.2, with some additional modifications currently in the final stages of development with AFMA. This revised ERAEF provides a hierarchical framework for a comprehensive assessment of the ecological risks arising from fishing, with impacts assessed against five revised ecological components: key commercial and secondary commercial species; byproduct and bycatch species; protected species; habitats; and (ecological) communities (see ERM Guide, AFMA, 2017).

The 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 (including PSA – Productivity Susceptibility Analysis and SAFE – Sustainability Assessment for Fishing Effects); 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 represents 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 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 specific fishery. Level 1 screens out activities that are judged to have low impact, and potentially screens out components with all low impact scores. Level 2 is a screening or prioritization process for individual species, habitats and communities at risk from direct impacts of fishing, using either PSA or bSAFE. 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 assess absolute levels of risk.

This SPF Purse Seine sub-fishery ERAEF assessment is based on analyses of data (2017- 2021) conducted in 2023. It should be noted that significant changes have occurred in this sub-fishery since the last (2006) ERAEF assessment. These consist of new management arrangements developed e.g., Bycatch Action Plans to reduce protected species interactions; spatial closures to protect species; reduction in fishing effort; electronic logbooks. In addition, there have been changes in (i) ERAEF methodology (ii) ERAEF species classification and (iii) availability of new information.

This 2017-2021 assessment of the Small Pelagic Fishery - Purse Seine sub-fishery consists of the following:

- Scoping
- Level 1 results for all components

Fishery Description

Gear Purse Seine
Area Southern Qld to WA (encompassing eastern and western sub-areas)
Depth range surface to ~20 m
Fleet size 2-4 vessels fishing
Effort 46 - 201 shots p.a.
Landings 88.5 t - 219.4 t p.a. of 3 key commercial species (Australian Sardine; Blue Mackerel; Jack Mackerel)
Discard rate fishery-wide estimate unavailable
Key commercial species Australian Sardine; Blue Mackerel; Jack Mackerel
Management Input and output controls

Observer program Observer coverage rate: Less than 10% p.a. over assessment period. Observer Program replaced by E-Monitoring on 1 July 2015: 100% electronic monitoring coverage for vessels operating >30 days/year.

Ecological Units Assessed

A total of 155 species across all ecological components were assessed in this ERAEF compared to 232 species in 2006 (Table 0.1). The following components were not assessed in this report: commercial bait species.

Table 0.1: Ecological units assessed in 2023 (data from 2017 to 2021) and earlier assessments.

Ecological units assessed	2006	2023
Key/secondary commercial species	5	1
Commercial species/Bait	NA	NA
Byproduct species	9	6
Bycatch species	3	148
Protected species	215	NA
Benthic habitats	258	84
Pelagic habitats	6	10
Demersal communities	4	47
Pelagic communities	4	21

The substantial increase in the number of bycatch species between assessments is due to the expansion of higher taxonomic group codes identified from AFMA Observer data, to species that may occur in the fishery under each group. In this case, the increase in the number of possible species warrants further examination as most are demersal, and hence the likelihood of these species interacting with a Purse Seine should be confirmed.

No protected species were identified in this assessment as none were recorded to have interacted with the fishing gear over this assessment period. This contrasts with the previous assessment, as it included all protected species that occur in the fishery area. The decrease in benthic habitats between assessments is not directly comparable, due to changes in methodology since the last assessment.

Level 1 Results and Summary

All ecological components were eliminated at Level 1 (i.e., no components with risk scores of 3 – moderate – or above) (Table 0.2). Approximately 93% of the Australian Sardine (*Sardinops sagax*) was harvested by Purse Seine over the 2017-21 period. This was followed by approximately 3% of Blue Mackerel (*Scomber australasicus*). Very little catch of bycatch species was recorded for this sub-fishery. The 148 bycatch species assessed were mostly expanded from higher taxonomic group codes. Also, no protected species were recorded for this sub-fishery. As a result, this ecological component was not assessed.

All hazards (internal fishing activities) were considered as 'low risk' and eliminated at Level 1 (i.e., no components with risk scores of 3 – moderate – or above) across each of the ecological components assessed. The highest risk scores (2 (minor); with high confidence) were recorded as a result of direct impact without capture from fishing for key commercial species and the addition/movement of biological material from discarding catch for bycatch species. All of the assessed direct and indirect impacts to this fishery were either low or negligible based on the scale and nature of the fishery as well as available Observer data.

The 2019 stock assessment for the Australian Sardine estimated the spawning biomass of 42,724 t (95% CI: 15,487 - 69,962 t) and has also been classified as *not overfished* or *not subject to overfishing* (see Table 0.3 and references within). Given there are no additional key commercial species in this fishery (that are not formally assessed), a Level 1 analysis was not required for this hazard i.e., fishing by capture.

The direct ecological impact on habitats and communities from harvesting key commercial and

Table 0.2: Outcomes of assessments for ecological components conducted in 2023. *: there are no recorded protected species in this sub-fishery.

Ecological Component	2023
Key/secondary commercial species	Level 1
Byproduct and bycatch species	Level 1
Protected species	Not required*
Habitats	Level 1
Communities	Level 1

byproduct/bycatch species was low. In particular, fishing for these species represented a 'low risk' (negligible; risk score = 1) to pelagic habitats and communities (minor; risk score =2) largely due to the small footprint of gear used in the fishery and effort along the Eastern Coastal Pelagic Province (0-200 m).

Hazards assessed as moderately affected by external impacts consisted of other fisheries in the region also capturing the same key commercial or byproduct/bycatch species. The Habitats and Communities ecological components were also assessed to be moderately impacted by other fisheries. All remaining external hazards were assessed at low risk (i.e., risk score = 1 or 2) across each of the ecological components.

The external hazard, coastal development assessed as low risk (risk score = 2) to key commercial and byproduct species, habitats and communities due to localised pollution and sediment run-off from coastal developments. Sediments can increase turbidity and the reduction in light penetration can negatively affect nursery habitats that depend on them. Confidence is low because impacts of coastal development are still poorly understood and there is a lack of data on water quality issues and recovery times of species and habitats and communities.

Overall, all of the assessed direct and indirect impacts of fishery activities in the this sub-fishery were low based on scale of the fishery as well as on available Observer data.

No level 1 SICA for protected species was conducted, as none were recorded to have interacted with Purse Seine gear over this assessment period. This contrasts the previous (2006) assessment which used all protected species that occur in the fishery. The previous assessment identified 29 high risk species comprising dolphins, whales and seals. However, it was noted that marine mammals are able to freely move in and out of the net as it is top-opening. While there were no recorded protected species interactions with Purse Seine gear over this assessment period, an increase in Observer coverage and/or e-monitoring may help confirm this and therefore the likely presence of potential false negatives. Globally, interactions with cetaceans from Purse Seine fishing have been documented. Although cetaceans are known to occur in the area of this sub-fishery, there were no recorded interactions with cetaceans during this assessment period.

Level 2 Results and Summary

A Level 2 assessment was not conducted for this report.

Table 0.3: Stock assessments including status detail (where available) of key commercial species in the Small Pelagic Fishery Purse Seine sub-fishery. NOF: not overfished, NSTOF: not subject to overfishing. ABARES: Australian Bureau of Agricultural and Resource Economics and Sciences, ABARES: ^: Based on ABARES classification.

Common Name	Scientific Name	ERA Classification	Biomass^/Fishing Mortality^	References	Year Last Assessed
Australian Sardine	*Sardinops sagax*	Key Commercial	NSTOF / NOF	Ward et al. (2021). See also Grammer et al. (2022)	2019
Blue Mackerel East	*Scomber australasicus*	Byproduct	NSTOF / NOF	Ward et al. (2021). See also Grammer et al. (2022)	2019
Blue Mackerel West	*Scomber australasicus*	Byproduct	NSTOF / NOF	Ward and Rogers (2007). SPFRAG made recommendations in 2017	2007
Jack Mackerel East	*Trachurus declivis*	Byproduct	NSTOF / NOF	Ward et al. (2020). See also Grammer et al. (2022)	2019
Jack Mackerel West	*Trachurus declivis*	Byproduct	NSTOF / NOF	Ward et al. (2018). See also Grammer et al. (2022)	2016, 2017
Redbait East	*Emmelichthys nitidus*	Byproduct	NSTOF / NOF	Grammer et al. (2022). See also Grammer et al. (2022)	2020
Redbait West	*Emmelichthys nitidus*	Byproduct	NSTOF / NOF	Ward et al. (2019). See also Grammer et al. (2022)	2017

1 Overview - Ecological Risk Assessment for the Effects of Fishing (ERAEF) Framework

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.

1.2 Conceptual Model

The approach makes use of a general conceptual model of how fishing impacts 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 components are evaluated, corresponding to five areas of focus in evaluating the 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 (target, 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 the achievement of management objectives.

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]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).

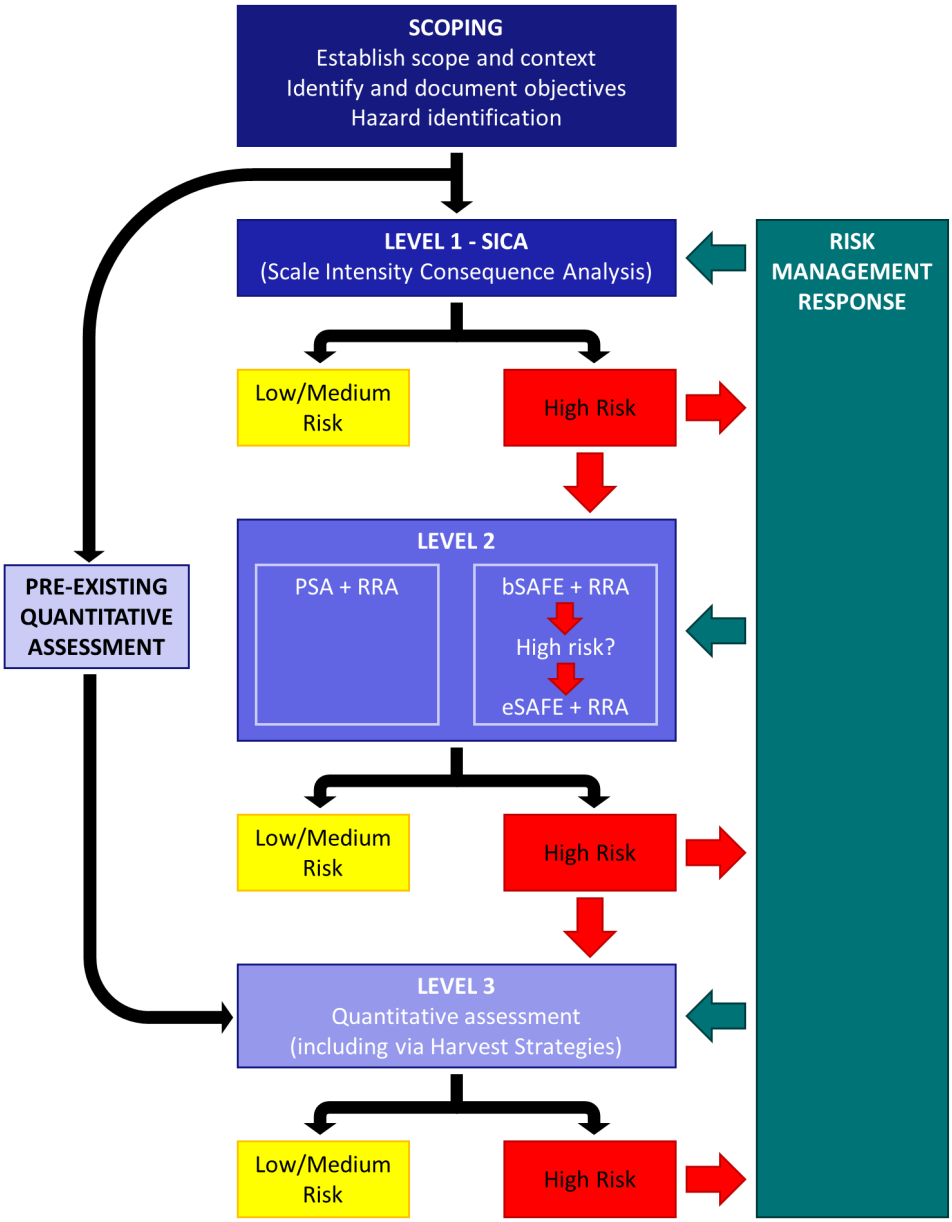


Figure 1.1: Structure of the 3 level hierarchical ERAEF methodology. SICA – Scale Intensity Consequence Analysis; PSA – Productivity Susceptibility Analysis; SAFE – Sustainability Assessment for Fishing Effects; RRA – Residual Risk Analysis. T1 – Tier 1. eSAFE may be used for species classified as high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

1.3 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.

1.4 Scoping

In the first instance, scoping is based on a 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.

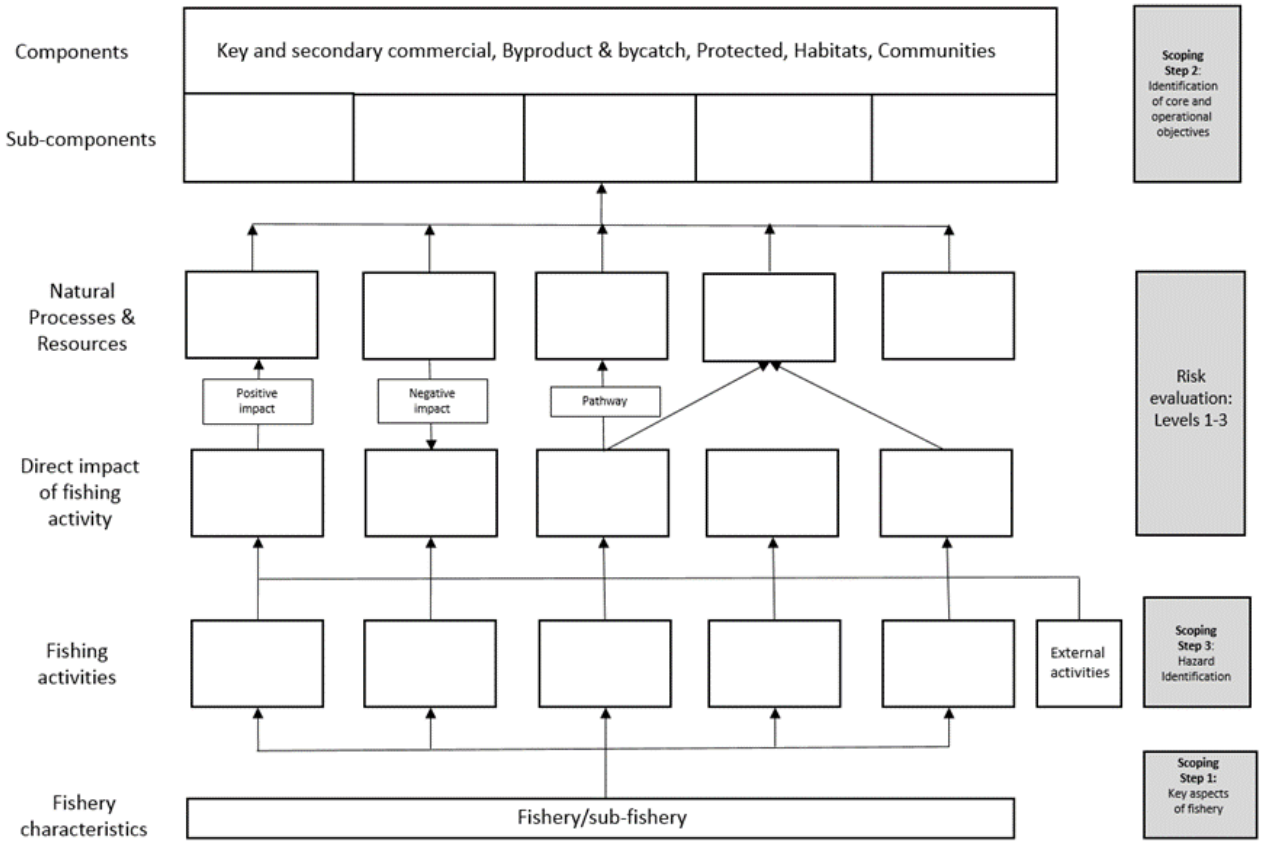


Figure 1.2: Generic conceptual model used in ERAEF.

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 2.2.4; 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, 2017 Ecological Risk Management (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 (e.g., Tables 5A-C in Hobday et al., 2007).
3. **Selection of activities** (hazards) (Section 2.2.5; 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/or consultation with the stakeholders are 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.

1.5 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 the 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 results 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.

1.6 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 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, 2017).

Level 2 was originally designed to rely on a single risk assessment methodology, the Productivity-Susceptibility Analysis (PSA) (see Chapter 4.9 of AFMA ERM Guide, AFMA, 2017). However, a more quantitative method called the Sustainability Assessment for Fishing Effects (SAFE) (see Chapter 4.10 of AFMA ERM Guide, AFMA, 2017) 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 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 take more immediate management action to reduce the risk. The types of considerations required in making that choice (i.e.: moving up the ERAEF assessment hierarchy or taking direct management action) are outlined in Chapter 5.5 of the AFMA ERM Guide (AFMA, 2017).

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.

1.6.1 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, 2017). Stakeholders can provide input and

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

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, the 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.

1.6.2 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 (AFMA, 2018) to assist in making accurate judgements 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 that 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 facilitate 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 publicly available documents.

1.6.3 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 et al., 2007b, 2011; Zhou & Griffiths, 2008):

- is a more quantitative approach (analogous to stock assessment) that can provide absolute measures of risk by estimating fishing mortality rates relative to fishing mortality rate reference points (based on life history parameters);
- requires fewer productivity data than the PSA;
- can account for cumulative risk and
- potentially outperforms PSA in several areas, including the 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 (e.g., 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
- 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:

- $\mathbf{F_{MSY}}$ – 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 the target species MSY.
- $\mathbf{F_{LIM}}$ – instantaneous fishing mortality rate that corresponds to the limit biomass B_{LIM} where B_{LIM} is assumed to be half of the biomass that supports a maximum sustainable fishing mortality ($0.5B_{MSM}$)
- $\mathbf{F_{CRASH}}$ – 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) is 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 may narrow uncertainties around the risk (but is more time and resource intensive than bSAFE).

Assumptions and issues to be aware of:

- 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 suggests 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).

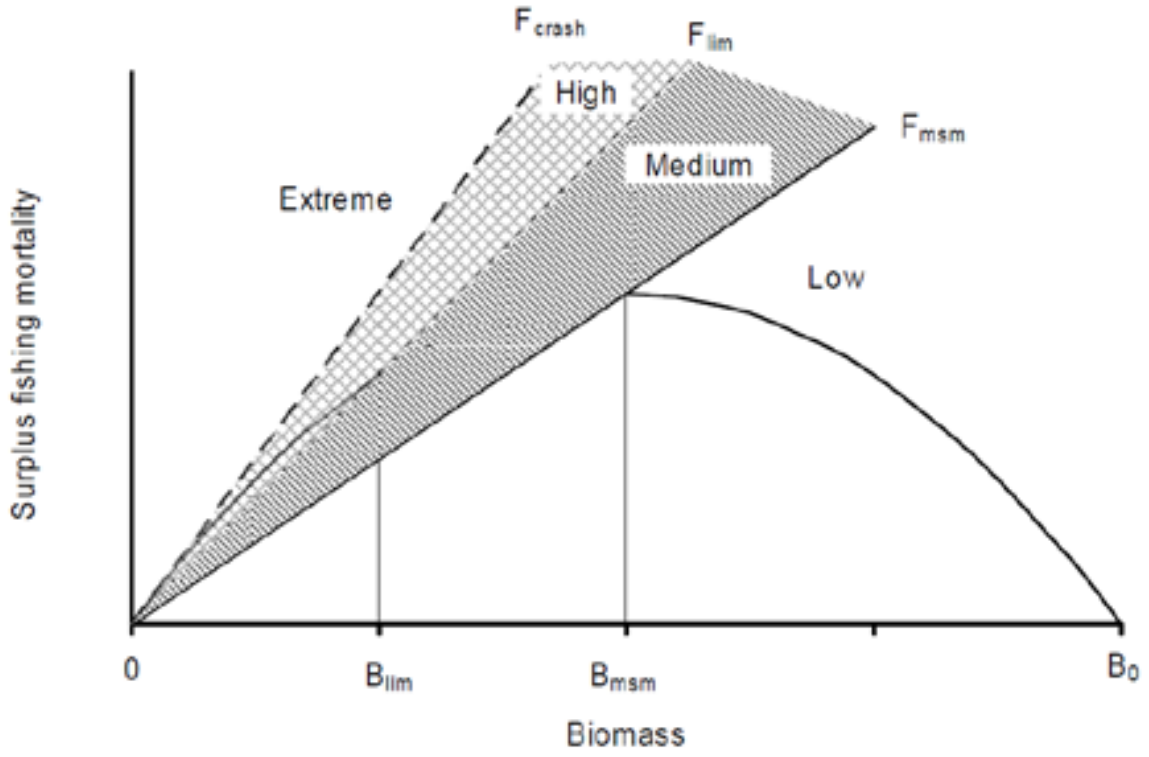


Figure 1.3: Stock productivity, biological reference points and ecological risk assessment for managing bycatch species.

- 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 (i.e.: 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 a 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 habitats, while risk would be under-estimated for species that prefer fished habitats (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.

1.7 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 analysis. 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 considered unlikely.

1.8 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 the Department of Climate Change, Energy, the Environment and Water.

1.9 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 Fishery Management Strategy (FMS).

For byproduct and bycatch species, in the periods between scheduled five-year ERA reviews[5], AFMA will develop and monitor a set of fishery indicators and triggers, on an annual basis, in order 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 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.

[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.

- 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 Chapter 6 in AFMA ERM Guide, AFMA, 2017). 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 Scoping and Stakeholder Engagement

The focus of analysis is the fishery as identified by the responsible management authority (AFMA). The assessment area is defined by the fishery management jurisdiction within the Australian Fisheries Zone (AFZ). The fishery may also be divided into sub-fisheries based on 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 are 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 the Small Pelagic Fishery - Purse Seine sub-fishery. A full description of the ERAEF method is provided in the methodology document (Hobday et al., 2011b; Hobday et al., 2007).

2.1 Stakeholder Engagement

Table 2.1: Summary Document SD1. Summary of stakeholder involvement for Small Pelagic Fishery - Purse Seine 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	MSTeams video meeting	3 Nov. 2022	Yvette Lamont (AFMA)	Project discussed, methods for Scoping analysis. Training provided on Scoping template files
Scoping	Phone calls and emails	21 Dec. 2022	Yvette Lamont (AFMA); Steve Hall (AFMA)	Scoping information provided to CSIRO
Scoping	Email	23 Dec. 2022	Miriana Sporcic (CSIRO)	Review of Scoping files provided to AFMA
Scoping; data	Email	3 Feb. 2023	Steve Hall (AFMA)	Revised Scoping files provided to CSIRO
Scoping	Email	6 Feb. 2023	Miriana Sporcic (CSIRO)	Review of Scoping files provided to AFMA
Scoping	Email	13 Feb. 2023	Yvette Lamont (AFMA)	Revised Scoping files provided to CSIRO
Scoping	Phone calls and emails	22 Feb. 2023	Yvette Lamont (AFMA)	Additional revised Scoping information provided to CSIRO
Data	Email	23 Feb. 2023	Yvette Lamont (AFMA)	Logbook data provided to CSIRO
Data	Phone calls and emails	3 Mar. 2023	Yvette Lamont (AFMA)	Observer data provided to CSIRO
Data	Phone calls and emails	15 Mar. 2023	Yvette Lamont (AFMA)	Revised data provided to CSIRO
Level 1 (SICA)	Phone calls and emails	18 May 2023	CSIRO	Draft Level 1 completed
Level 1	Email	16 Jun. 2023	Steve Hall (AFMA); Ryan Murphy (AFMA)	Draft report submitted to AFMA
Draft report	Email	7 Nov. 2023	Steve Hall (AFMA), Yvette Lamont (AFMA)	Review of draft report submitted to CSIRO

Table 2.1: *(continued)*

Fishery ERA Report stage	Type of stakeholder interaction	Date of stakeholder interaction	Composition of stakeholder group (names or roles)	Summary of outcome
Draft final report	Email	28 Nov. 2023	Steve Hall (AFMA); Yvette Lamont (AFMA); Ryan Murphy (AFMA)	Draft final report submitted to AFMA

2.2 Scoping

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

- Step 1. Document 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 came from a range of documents such as the Fishery's Management Plan, Assessment Reports, Bycatch Action Plans, and any other relevant background documents.

The following sections comprise the **Scoping Document S1 General Fishery Characteristics**.

Fishery Assessed: Small Pelagic Fishery - Purse Seine sub-fishery

Date of revised ERAEF assessment: November 2023

Assessor: AFMA and authors of this report (CSIRO)

2.2.1.1 General Fishery Characteristics

Fishery Name

Small Pelagic Fishery - Purse Seine sub-fishery

Sub-fisheries

The two sub-fisheries permitted in the Small Pelagic Fishery (SPF) are:

- Small Pelagic Fishery – Purse Seine
- Small Pelagic Fishery – Midwater trawl

Sub fisheries assessed

This ERA will assess the Small Pelagic Fishery – Purse Seine sub-fishery.

Start date/history

In 1936, CSIRO surveys located large schools of small pelagic fishes along the western edge of the Great Australian Bight (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 the development and expansion of the fishery into other fishing methods and consequently key commercial species and i.e., midwater trawling and Redbait.

Most historical fishing effort before 2015, occurred off the east coast of Tasmania. Purse Seine effort peaked at 1,093 search-hours in 2005–06. Search effort declined to 45 hours in 2013–14, increasing to 208 search-hours in 2018–19 (Noriega et al., 2022). There were 141 search-hours in 2020–21. Trawl effort in the SPF increased in 2015–16 with the operation of a factory freezer trawler. This vessel left the fishery in late 2016, resulting in a 40% decrease in effort (number of shots). A different midwater trawler entered the fishery in 2017, increasing effort levels between 2016–17 and 2018–19. Purse Seine effort has varied between the 2017–21 fishing seasons as detailed in Section 2.2.1.1.2.

2.2.1.1.1 Geographic Extent of Fishery

The SPF extends from the Queensland/ New South Wales border, typically outside 3 nm, around southern Australia to a line at latitude 31°00' South in Western Australia (Figure 2.1). The fishery is divided into two sub-areas, east and west of latitude 146°30' due to evidence of separate stocks both east and west of Tasmania (AFMA, 2022c). Since the sardine sub-area (off eastern Australia) is the only area of the SPF where SPF vessels harvest Australian Sardine, the sardine sub-area is assessed and managed as a single management unit (AFMA, 2022c).

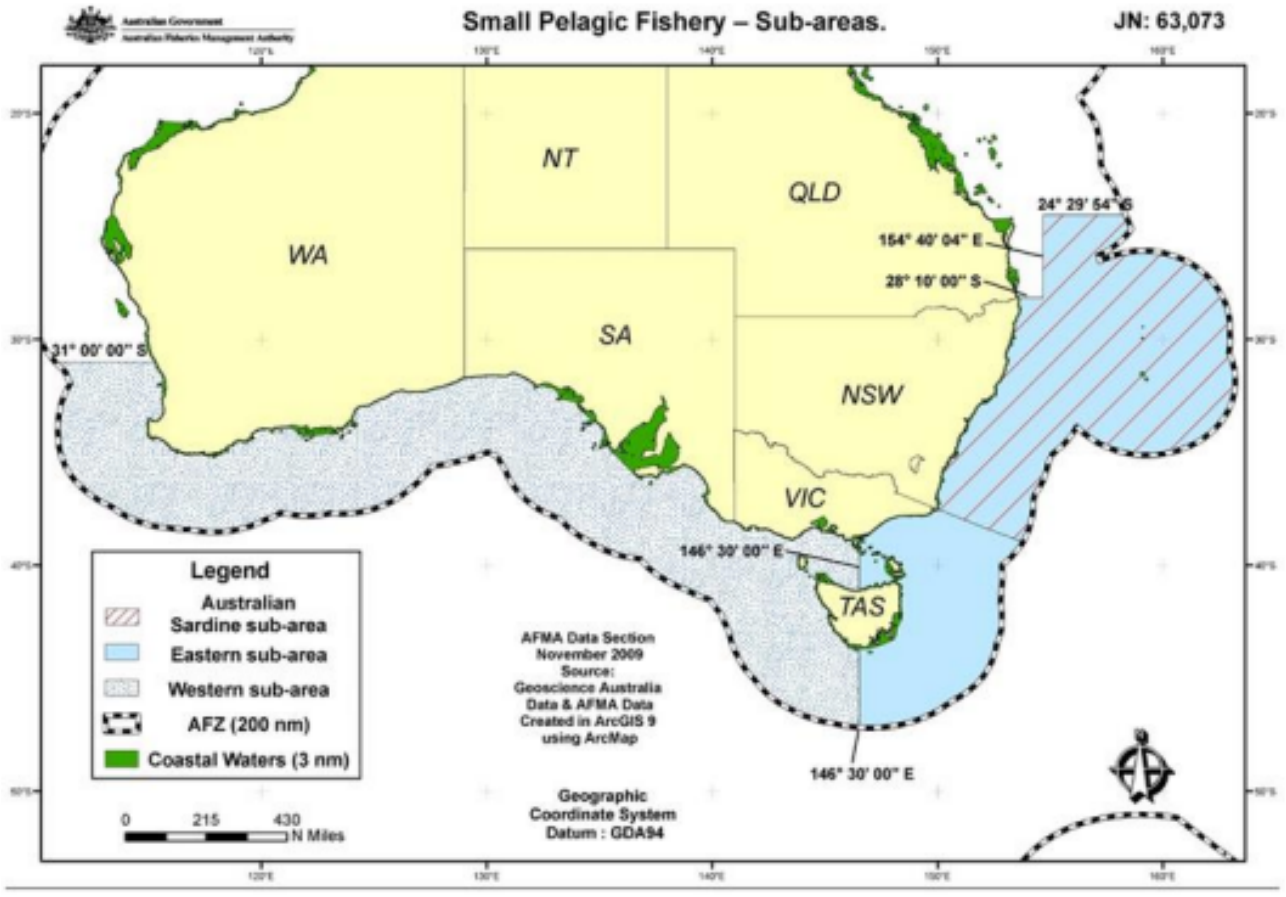


Figure 2.1: Management sub-areas of the small pelagic fishery. Source: AFMA

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 Figure 2.1 in Section 2.2.1.1.1).

Further management of catches is implemented through regional catch limits (as set out in the AFMA-approved Vessel Management Plan (VMP), which is required for any vessel operating in the SPF

midwater trawl sub-fishery) to enable a spread of data collection throughout the fishery and to minimize the risk of localised depletion.

Spatial management grids and closed areas have been developed for managing catch and protected species interactions within the SPF and are provided below (Figure 2.2).

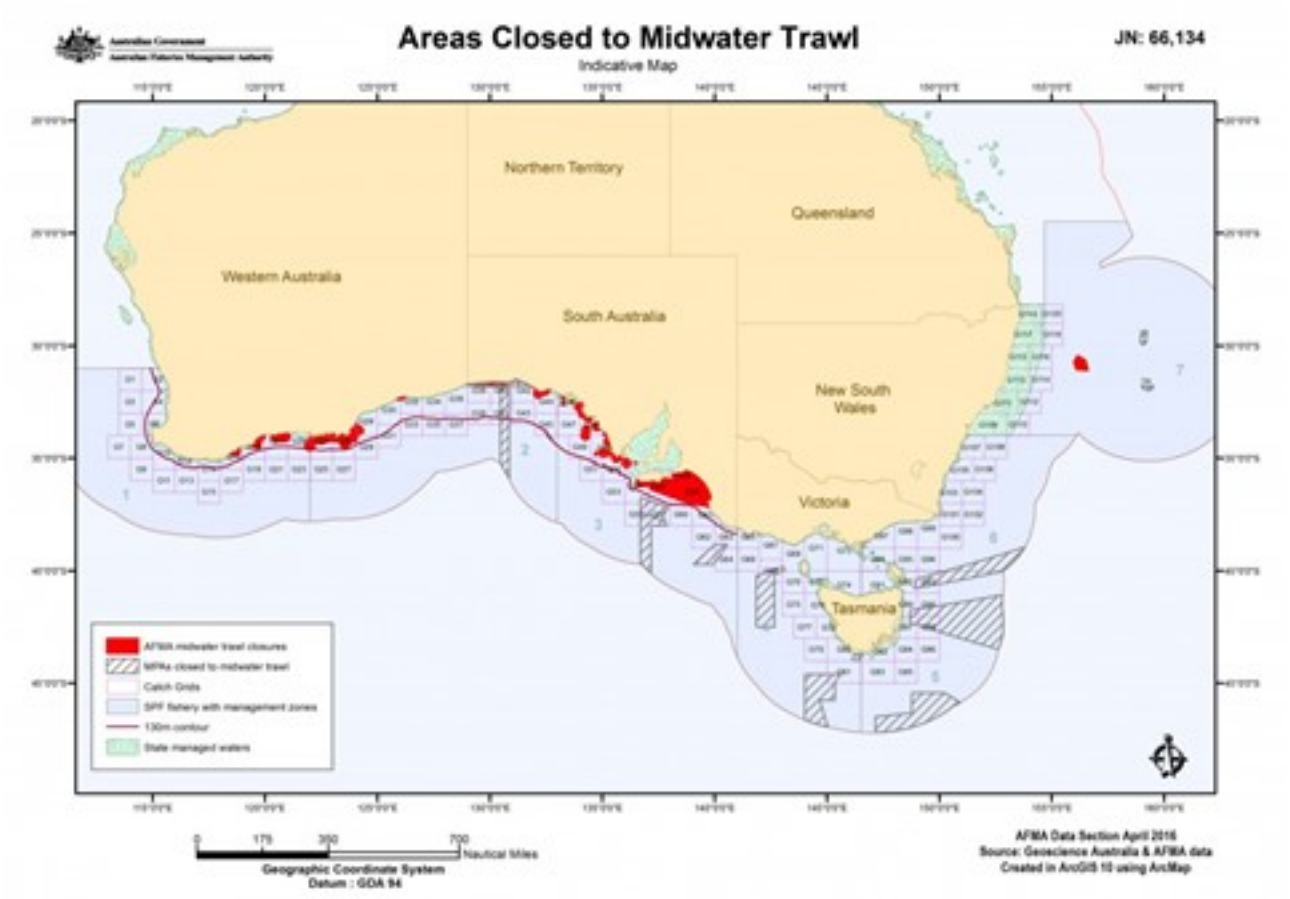


Figure 2.2: Sub zones, catch grids and areas closed to mid-water trawl within management sub-areas of the Small Pelagic Fishery. Source: AFMA

Fishing season

The fishing season for all sectors of the SPF runs from 1 May to 30 April each year.

Key/secondary commercial and byproduct species and stock status

ABARES has classified all stocks as sustainable (Noriega et al., 2022. See also Table 0.3). A daily egg production method (DEPM) Survey of Australian Sardine was conducted in 2019-20, with an estimated biomass of 42,724 t (95% CI: 15,487 – 69,962 t, Ward et al., 2021). Several studies have found evidence of stock structuring of Australian Sardine across temperate and sub-tropical Australia (Dixon et al., 1993; Izzo et al., 2012; Yardin et al., 1998) however, the boundaries were not defined conclusively. Using an integrated assessment that included genetic, morphological, otolith, growth, reproductive and fishery data, found evidence for at least four isolated stocks (Izzo et al., 2017). The Status of Australian Fish Stocks Reports (https://www.fish.gov.au/) recognises four Australian stocks: South-western (Western Australia), Southern (South Australia), South-eastern (Victoria, Tasmania and southern NSW), and eastern Australia (southern Queensland to central NSW). Since the Sardine subarea (off eastern Australia) is the only area of the SPF where SPF vessels take Australian Sardine, the sardine sub-area is assessed and managed as a single management unit.

The stock structure of Blue Mackerel is currently uncertain. Genetic analysis indicates the presence of population subdivisions between southern Queensland, Western Australia and New Zealand. In addition, genetic differences were detected between Western Australia (WA) and Queensland, and between WA and

New Zealand, but not between Queensland and New Zealand (Schmarr et al., 2012). Blue Mackerel within the SPF is assessed and managed as separate stocks in the eastern and western sub-areas as no finer scale genetic analyses have been performed to further delineate stock structure. A DEPM survey for Blue Mackerel east was conducted in 2019-20 (Ward et al., 2021). It has been recommended to collect large, spawning fish between now and the next scheduled DEPM survey (2024) to inform estimates of spawning fraction and other parameters used to calculate spawning biomass.

The 2018/19 DEPM biomass estimates of Jack Mackerel off eastern Australia are consistent with those from earlier studies (Ward et al., 2015b, 2020). It is proposed that a DEPM for Jack Mackerel East will take place in 2023-24. The estimated spawning biomass for Jack Mackerel in the west of at least 31,000 t (Ward et al., 2018). While the Purse Seine sector mainly targets the Australian Sardine and Blue Mackerel, Jack Mackerel may also be caught. However, there was no recorded Purse Seine caught Jack Mackerel within this assessment period (Table 2.5).

Stock assessments based on DEPM for Redbait in the south-eastern region were made in 2005 and 2006 (Neira et al., 2008; Neira & Lyle, 2011) and most recently in 2020-21 (Grammer et al., 2022). The most recent spawning biomass estimates in the south-western region Redbait was 66,767 t (95% CI: 28,797-190,392 t, Ward et al., 2019). There has been no recorded Purse Seine caught Redbait during this assessment period.

Key commercial species (in the Purse Seine sector):

- Australian Sardine (*Sardinoprs sagax*)

Byproduct species (in the Purse Seine sector) that have stock assessments:

- Blue Mackerel East (*Scomber australasicus*)
- Jack Mackerel (*Trachurus declivis*)

Other TAC species mostly caught by mid-water trawl in the SPF:

- Blue Mackerel West (*Scomber australasicus*)
- Jack Mackerel East (*Trachurus declivis*)
- Jack Mackerel West (*Trachurus declivis*)
- Redbait East (*Emmelichthys nitidus*)
- Redbait West (*Emmelichthys nitidus*)

All species recent catches have been below the Recommended Biological Catch (RBC), historical catches have been low and are not likely to have reduced biomass below the limit Reference point (LRP) (Noriega et al., 2022). Australian Sardine (*Sardinops sagax*) is predominately taken by Purse-Seine vessels in the sardine sub-area.

Bait collection and usage

Bait is not used in the SPF.

Current entitlements

There are currently 35 entities holding quota SFRs in the fishery. See also Table 2.2, and Table 2.3.

Table 2.2: Entitlements over the last seven quota years. ^^ SFR: Statutory Fishing Rights. °All concessions and SFRs can be used for purse seine, midwater trawl, jigging or minor line methods. °°° Inactive SFRs have the potential to be used for either fishing method. Purse Seine: PS. Source: AFMA

Quota year	No. of SFR^^ concession holders°	No. of active Purse Seine vessels	No. of inactive conces-sions°°°	No. of inactive nominate Purse Seine Vessels	Comment
2015-16	32	2	29	1	One PS vessel nominated but did not fish

Table 2.2: *(continued)*

Quota year	No. of SFR^^ concession holders°	No. of active Purse Seine vessels	No. of inactive conces-sions°°°	No. of inactive nominate Purse Seine Vessels	Comment
2016-17	34	1	32	2	One PS vessel nominated but did not fish
2017-18	30	2	28	3	Three PS vessel nominated but did not fish. Two active PS vessels fished under the same concession holder
2018-19	30	3	27	2	One PS vessel nominated but did not fish. Two active PS vessels fished under the same concession holder
2019-20	31	3	28	1	One PS vessel nominated but did not fish. Two active PS vessels fished under the same concession holder
2020-21	34	4	29	0	Two active PS vessels fished under the same concession holder
2021-22	35	4	28	1	One PS vessel nominated but did not fish. Two active PS vessels fished under the same concession holder

Table 2.3: Number of active Purse Seine vessels over the SPF from 2015-16 to 2021-22 fishing season period.

Year	No. Active Vessels (Purse Seine)
2015-16	2
2016-17	1
2017-18	2
2018-19	3
2019-20	3
2020-21	4
2021-22	4

Current and recent TACs, quota trends by method

The Total Allowable Catch (TAC) for SPF quota species has been relatively stable over recent fishing seasons. The TACs for the last six seasons for SPF quota species are shown in Table 2.4. In 2021-2022 season four Purse Seine vessels were active.

Table 2.4: Agreed Total Allowable Catch (TAC (t)) for quota species in the SPF fishing seasons (1 May – 30 April) 2016-17 to 2021-22. TACs apply to all fishing methods in the SPF. Research quota included in these TACs. Undercatch and Overcatch not included.

Species	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22
Australian Sardine	9550	9550	9510	9050	9190	7980
Blue Mackerel East	12090	12090	12090	11970	11970	11440
Blue Mackerel West	3230	3230	3230	3240	3210	3210
Jack Mackerel East	18880	18880	18890	18730	18580	18630
Jack Mackerel West	920	920	4190	4200	4170	4180
Redbait East	3410	3410	3420	3150	3420	3440
Redbait West	820	820	820	6680	6640	6680

2.2.1.1.2 Current and recent fishery effort trends by method

The annual catch (t) by trawl and Purse Seine from 2004-05 to 2021-21 fishing seasons are shown in Figure 2.3. Approximately 93% of the total retained catch comprises the Australian Sardine over the 2017-21 period (Table 2.5).

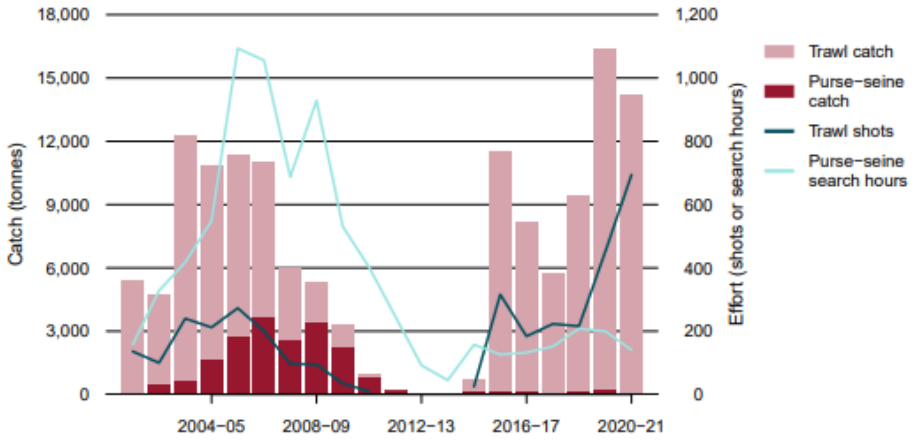


Figure 2.3: Small Pelagic Fishery total catch (t) and fishing effort (shots or search hours) over the 2001/02-2021/22 fishing seasons. Source: Noriega et al. (2022).

Current and recent fishery catch trends by method

Approximately 93% of the total retained catch comprises the Australian Sardine over the 2017-21 period (Table 2.5). See also Section 2.2.1.1.2.

Table 2.5: Total annual (calendar year) catch (retained weight; kg) of Australian Sardine, Blue Mackerel, Jack Mackerel and Redbait caught by Purse Seine in the SPF for the period 2017-2021 inclusive. Source: AFMA Logbook data.

Year	Australian Sardine	Blue Mackerel	Jack Mackerel	Redbait	Total
2017	96915	0	0	0	96915
2018	134525	473	0	0	134998
2019	217009	2415	0	0	219424
2020	88174	355	0	0	88529
2021	111765	48618	0	0	160383
Total:	648388	51861	0	0	700249

Current and recent value of fishery ($)

The current and recent value for this sub-fishery is confidential and withheld in this report based on the Fisheries Management Policy 12 (Noriega et al., 2022).

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 & Mazur, 2015). Estimates of take from the recreational and Indigenous sectors are made from a national survey but are not as reliable as those for the 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) and Western Australia as the South Coast Purse Seine Managed Fishery (SCPSMF). The eastern stock of Australian Sardine is co-managed by the Australian, New South Wales, Victorian and Tasmanian governments (Moore & Mazur, 2015).

2.2.1.2 Gear

Fishing methods and gear

The top of the net of a Purse Seine is floated at the ocean's surface and the bottom of the net has weights attached that pull the walls of the net downwards. The bottom of the net has a wire threaded through it which is pulled and tightens the net like a purse trapping the fish inside. The net is then pulled in toward the vessel and the catch is either pumped or lifted out with small nets or the whole net is brought aboard. The size of Purse Seine nets can be varied, depending on what species is being targeted (AFMA, 2023) (Figure 2.4).

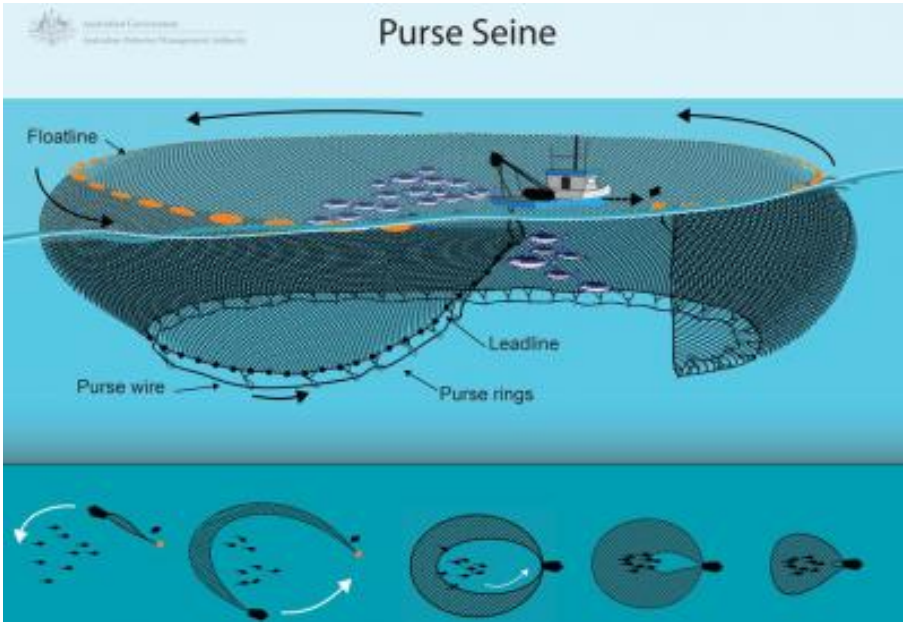


Figure 2.4: Purse Seine. Source: AFMA, http://www.afma.gov.au/fisheries-management/methods-and-gear/purse-seine

Fishing gear restrictions

SPF operators are only permitted to fish using the gear/methods specified on their vessel statutory fishing right (SFR) and/or fishing permit.

Purse Seine nets may be set around a floating object such as ocean debris. These objects are called Fish Aggregating Devices (FADs) and large numbers of fish are often attracted to these. This means that if a Purse Seine net is set around a FAD, many other marine species may be caught. The use of FADs for Purse Seine

fishing is not allowed in Australia (AFMA, 2023).

Selectivity of fishing methods

The Purse Seine method of fishing is very selective as it usually targets only one species at a time. This means that there is very little impact from Purse Seine fishing on other marine species.

Spatial gear zone set

Purse seine nets are set near the ocean surface and do not touch the sea floor, so their impact on the marine environment is considered minimal.

Depth range gear set

Purse Seines can reach more than 2000 m (6,500 ft) in length and 200 m (650 ft) in depth, varying in size according to the vessel, mesh size, and target species. Source: FAO (2023).

How gear is set

A Purse Seine is a large wall of netting deployed around an entire school of fish. The Seine has floats along the top line with a lead line threaded through rings along the bottom. Once a school of fish is located (either by visual cues such as congregations of seabirds or dolphins, or through using sonar), a skiff encircles the school with the net. The lead line is then pulled in, "pursing" the net closed on the bottom, preventing fish from escaping by swimming downward. The catch is harvested by hauling the net ('net rolling') and stacking it on the back deck of the vessel until all slack is removed and the fish are crowded in the 'bunt' and a brailer (small net) can be used to scoop out the fish. Source: FAO (2023).

Area of gear impact per set or shot

This varies considerably as a function of tow duration, tow speed, and net width, Purse Seine nets usually only impact the actual water column and rarely contact the seabed.

Capacity of gear

A requirement of the Purse Seine code of conduct is that when nets are manufactured for use in the fishery, fishers will utilise net-building techniques which minimise the possibility of harm to captured marine mammals and other Threatened, Endangered, or Protected Species (PS). Source: AFMA (2008).

Effort per annum all vessels

There has been an increase of 155 shots since the start of this assessment period (from 46 to 201). An additional vessel has contributed to this increase (Table 2.6).

Table 2.6: Total annual (calendar year) effort (total vessels and no. of operations) in the SPF Purse Seine sub-fishery for 2017-2021 period. Source: AFMA.

Year	No. of vessels	No. of operations
2017	2	46
2018	3	89
2019	3	86
2020	3	41
2021	4	201

Lost gear and ghost fishing

Whole or parts of nets are occasionally lost, however no quantitative data is available. Gear retrieval depends on circumstances however ghost fishing is not considered to be a significant issue with this gear.

2.2.1.3 Issues

Key/secondary commercial species issues and Interactions

Stock assessments are in place for each of the commercial species under quota in the SPF. The status of species relevant to the SPF, an overview of stock status and fishing mortality is available in the ABARES Fishery Status Report 2022 (Noriega et al., 2022).

The Status of Australian Fish Stocks Reports (https://www.fish.gov.au/) recognises four Australian stocks: South-western (Western Australia), Southern (South Australia), South-eastern (Victoria, Tasmania and southern NSW), and eastern Australia (southern Queensland to central NSW). Since the Sardine sub-area (off eastern Australia) is the only area of the SPF where SPF vessels harvest Australian Sardine, the sardine sub-area is assessed and managed as a single management unit. The SPF sardine sub-area includes both the entire eastern stock and the northern part of the south-eastern stock (i.e., southern NSW). This means that the management unit does not align directly with the biological stocks. The most recent stock assessment of Australian Sardine East was conducted in 2019-20 the DEPM resulted in a biomass estimate of 42,575 t (Ward et al., 2021; see also Grammer et al., 2022).

Byproduct and bycatch issues and interactions

Byproduct species are defined as species that do not make a significant contribution to the overall catch but are sometimes landed for sale. Bycatch species are defined as species that are caught as part of fishing activities but are rarely landed.

The stock structure of Blue Mackerel is uncertain. Genetic analysis of samples from southern Queensland, Western Australia and New Zealand indicates population subdivisions. Genetic differences were detected between Western Australia and Queensland, and between Western Australia and New Zealand, but not between Queensland and New Zealand (Schmarr et al., 2012). The most recent stock assessment of Blue Mackerel East was conducted in 2019-20 the DEPM resulted in a biomass estimate of 80,000 t. There have been some difficulties in catching large, adult-spawning Blue Mackerel on the east coast which needs resolving prior to the next DEPM (AFMA, 2022a). The Small Pelagic Fishery Resource Assessment Group (SPFRAG) identified the need to update the understanding of key species biology, and this is a current research priority for the SPF.

The Ecological Risk Assessment (ERA) is the primary assessment tool to assess the impact on these species. Such assessments were previously conducted in 2007 based on a Productivity Susceptibility Analysis (PSA, Daley et al., 2007) and in 2009 based on a base Sustainability Assessment for Fishing Effects (bSAFE, Zhou et al., 2007a) and none were found to be at high risk.

In 2021–22, the retained catch in the SPF for species other than key commercial species assessed accounted for approximately 0.5% of the total catch (Noriega et al., 2022). These species (both caught with Purse Seine vessels) were:

- Yellowtail Scad (*Trachurus novaezelandiae*)
- Maray (*Etrumeus teres*)

Protected species issues and interaction

AFMA Management developed, in consultation with industry, interim management measures that strengthen the implementation of the SPF Dolphin Strategy and minimise the risk of continued dolphin interactions in the SPF.

Operators are required to report all interactions with protected species in their logbooks and AFMA reports quarterly to the Department of Environment and Energy.

There have been no recorded Purse Seine gear interactions with Protected species since the first SPF Bycatch and Discarding Workplan commenced in 2009, with very low levels of recorded interactions before 2009. Source: AFMA (2022a)

An Ecological Risk Assessment was undertaken in 2007 in the Purse Seine sub-fishery which identified 108 potentially high risk protected species following a PSA (Daley et al., 2007). These species were considered at

high risk because of a lack of observer information regarding the nature of interactions with the Purse Seine sector of the SPF. A subsequent residual risk analysis within an ERM framework identified 29 species remained at high risk (AFMA, 2010). These species are listed below (Table 2.7). The ERA assessment acknowledges that the impact on PS species when using Purse Seine gear is generally considered to be low as in most cases most marine mammals can move freely into and out of the Purse Seine net as it is top-opening.

The Ecological Risk Management Report (AFMA, 2010) identified that Purse Seine fishing in the SPF represents a minimal risk to Protected species and other bycatch species because:

- species targeted in the SPF generally school in single species groups;
- Purse Seine operators assess schools prior to deploying nets and if species such as marine; mammals or sharks are detected, the net is not deployed;
- Purse Seine nets rarely entangle fish or other species, and Protected species can usually be readily released by lowering of part of the net and
- the method allows continuous access to the water/air interface for marine mammals and allows reptiles to breathe, if a protected species is encircled in the net. (https://www.afma.gov.au/sites/default/files/uploads/2014/11/Bycatch-and-Discard-Work-Plan-SPF-2016.pdf)

Table 2.7: High risk scores folowing the residual risk analysis of the previous ERA undertaken in 2006. Source: AFMA (AFMA, 2010).

Common name	Scientific name
Andrew's Beaked Whale	*Mesoplodon bowdoini*
Australian Fur Seal	*Arctocephalus pusillus doriferus*
Blainville's Beaked Whale	*Mesoplodon densirostris*
Bottlenose Dolphin	*Tursiops truncatus*
Cuvier's Beaked Whale	*Ziphius cavirostris*
Dwarf Sperm Whale	*Kogia sima*
Elephant Seal	*Mirounga leonina*
False Killer Whale	*Pseudorca crassidens*
Fraser's Dolphin	*Lagenodelphis hosei*
Ginkgo Beaked Whale	*Mesoplodon ginkgodens*
Gray's Beaked Whale	*Mesoplodon grayi*
Hector's Beaked Whale	*Mesoplodon hectori*
Hourglass Dolphin	*Lagenorhynchus cruciger*
Humpback Whale	*Megaptera novaeangliae*
Indo-Pacific Bottlenose Dolphin	*Tursiops aduncus*
Australian Humpback Dolphin	*Sousa sahulensis*
Killer Whale	*Orcinus orca*
Leopard Seal	*Hydrurga leptonyx*
Long-finned Pilot Whale	*Globicephala melas*
Minke Whale	*Balaenoptera acutorostrata*
Pygmy Killer Whale	*Feresa attenuata*
Risso's Dolphin	*Grampus griseus*
Rough-toothed Dolphin	*Steno bredanensis*
Short-finned Pilot Whale	*Globicephala macrorhynchus*
Southern Bottlenose Whale	*Hyperoodon planifrons*
Southern Right Whale Dolphin	*Lissodelphis peronii*
Strap-toothed Beaked Whale	*Mesoplodon layardii*
Striped Dolphin	*Stenella coeruleoalba*

Table 2.7: *(continued)*

Common name	Scientific name
True's Beaked Whale	*Mesoplodon mirus*

Habitat issues and interactions

Habitat loss and deterioration is recognised as one of the main threats to biodiversity conservation. Seafloor habitats provide some of the most productive environments of entire ocean systems and international consensus shows that protecting seafloor habitats is an essential part of ecologically sustainable use of marine resources (Nellemann et al., 2008), however Purse Seine gear rarely contacts the seabed.

Community issues and interactions

Removing one species or size range of the population, in addition, to changes to the community structure from which it is removed, will also change food web dynamics and energy transfer in the system.

Over the past decade, it has become evident that climate change is affecting water temperatures and probably salinities and other water properties. This effect on species could cause changes in distribution and increasingly species are being more regularly sighted beyond previous known distributions. Some species might not be able to disperse or extend their range so readily and populations may decline due to their inability to adapt to new environmental conditions. While ecosystem models account to some extent for cumulative pressures, how they interact may not be linear and is currently the focus of research. Irrespectively, whole of ecosystem-based advice is being sought and accepted by fishery management.

Discarding

Discarding individual species generally occurs when the return in the catch is not adequate to cover costs of further handling, or when retention is not allowed by management arrangements. Discards may also include juvenile or damaged target and non-target species, which are often discarded back into the sea during fishing operations.

Species that have been discarded in the 2017-21 period are recorded in the AFMA Commonwealth Logbook database. A total of three species were discarded over this assessment period (Table 2.8).

The AFMA Observer Program also records species retained and discarded (in kg) in the SPF. Annual percentage coverage rates are listed in Table 2.12. Corresponding targets were unavailable.

2.2.1.4 Management: planned and implemented

Table 2.8: Annual discards (kg) for the period 2018-2021 inclusive. Source: AFMA Commonwealth Logbook database.

Year	Species Group	Common name	Scientific name	Life status	Discard (kg)
2018	Clupeidae	Australian Sardine	*Sardinops sagax*	Unknown	500
2019	Clupeidae	Australian Sardine	*Sardinops sagax*	Unknown	62
2019	Clupeidae	Maray	*Etrumeus teres*	Unknown	348
2021	Scombridae	Blue Mackerel	*Scomber australasicus*	Unknown	10

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:

- implementing efficient and cost-effective fisheries management on behalf of the Commonwealth; and
- 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), particularly, 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
- maximizing the net economic returns to the Australian community from the management of Australian fisheries; and
- ensuring accountability to the fishing industry and to the Australian community in AFMA's management of fisheries resources; and
- 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:

- ensuring, through proper conservation and management measures, that the living resources of the AFZ are not endangered by over-exploitation; and
- achieving the optimum utilization of the living resources of the AFZ; and
- 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
- to the extent that Australia has obligations under international law; or under the Compliance Agreement or any other international agreement; in relation to fishing activities by Australian flagged vessels 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

Management includes legislative objectives regarding bycatch to avoid and minimise fishing related impacts on bycatch species, including protected species, in a manner consistent with the principles of ecologically sustainable development. The SPF is managed under the SPF Management Plan 2009 established under the Fisheries Management Act 1991. For details see:

https://www.legislation.gov.au/Details/F2014C01077

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 and
- directions not to engage in fishing.

In addition, the revised Small Pelagic Fishery Harvest Strategy (HS) 2022 describes arrangements for harvesting target species and some byproduct species in line with the Commonwealth Fisheries Harvest Strategy Policy and Guidelines 2007 (AFMA, 2022b). The objective of the HS is the sustainable and profitable utilization of the SPF 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).

Input controls

A vessel must have a vessel Statutory Fishing Right (SFR) allowing it to trawl. This SFR will entitle a vessel to use Purse Seine gear in a specific area of water. Operators are required to hold Commonwealth trawl

entitlement SFRs for small pelagic fish in other Commonwealth trawl fisheries.

A network of closures is implemented for fishing in the SPF that offers protection to a broad range of species, including bycatch and protected species. The closures are enforced under the Fisheries Management (Southern and Eastern Scalefish and Shark Fishery (SESSF) and Small Pelagic Fishery (SPF) Closures) Direction 2021. SPF operations are also required to adhere to spatial closures implemented under the South-East Commonwealth Marine Reserve Network (AFMA, 2022a).

The Temperate East Marine Park Network covers 383352 km^2 and includes eight marine parks. The network includes important offshore reef habitats at Elizabeth and Middleton Reefs, Lord Howe Island and Norfolk Island. Several significant seamount ridges run parallel to the coast in this region. Zoning and maps of the Temperate East Marine Park Network detailing each of the eight marine parks are provided (Figure 2.5).

Australia's South-east Commonwealth Marine Parks Network stretches from the far south coast of New South Wales, around Tasmania and Victoria and west to Kangaroo Island off South Australia. The reserves cover an area of 388464 km^2 with a depth between 40 - 4600 m. The network includes 14 Commonwealth Marine Reserves, ranging in size from 537 to 162000 km^2. Zones and maps of the SE Marine Park Network detailing each of the 14 marine parks are provided in Figure 2.6.

Further information is available from the Department of Climate Change, Energy, the Environment and Water (DCCEEW) http://www.environment.gov.au/topics/marine/marine-reserves/south-east or Australian Marine Parks https://parksaustralia.gov.au/marine/parks/.

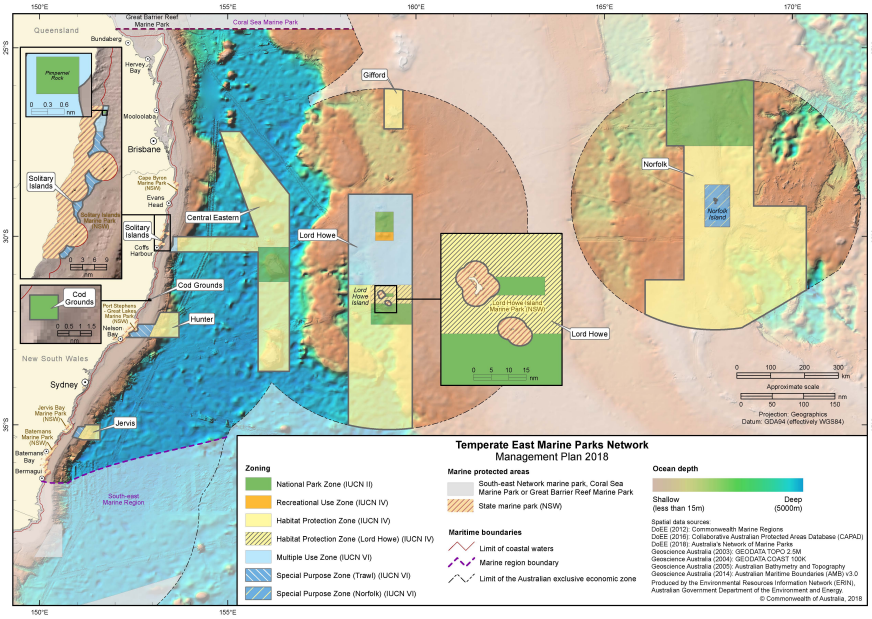


Figure 2.5: Temperate East Marine Parks Network map and zoning. Source: Australian Marine Parks, 2022.

Output controls

All major key commercial species in the SPF are managed under total allowable catch (TAC). Quota is issued in the form of 'quota' SFRs and an operator must hold both the appropriate vessel SFR and Quota SFR.

The Purse Seine Code of Practice (the Code of Practice) applies to all commercial fishers taking fish by use of Purse Seine nets in the SPF (AFMA, 2008). The Code of Practice outlines ways in which Purse Seine fishers in the SPF will minimise their impacts on the environment. These include:

- ensuring nets are manufactured using techniques that minimise the possibility of harm to marine mammals;
- ensuring the presence of protected species is considered prior to and during Purse Seine operations; and
- return any captured protected individual alive, with priority given the safety of crew.

Source: AFMA (2008)

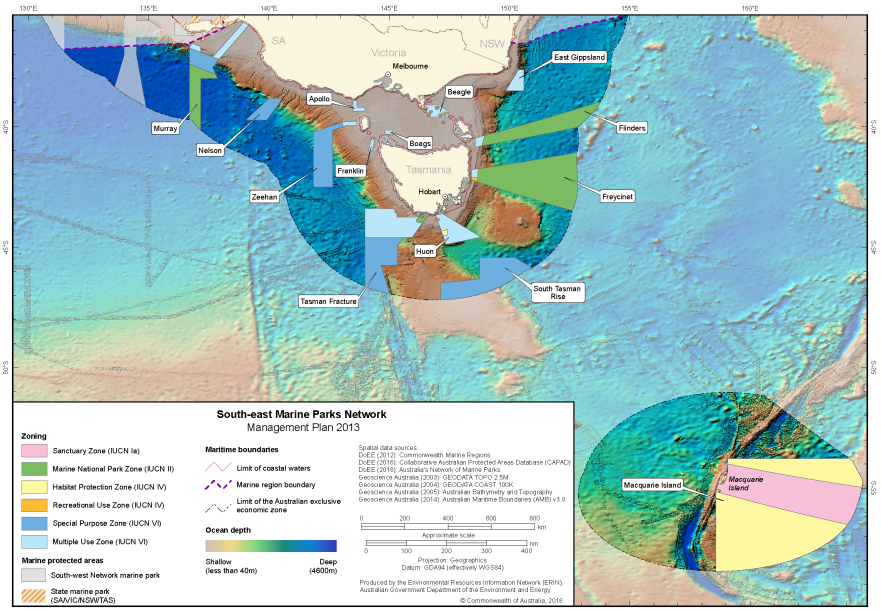


Figure 2.6: South East Marine Parks Network map and zoning. Source: Australian Marine Parks, 2022.

Table 2.9: Quota species permitted to be taken in the Small Pelagic Fishery (SPF). Total Allowable Catch: TAC.

Common name	Scientific name	Restrictions
Australian Sardine	*Sardinops sagax*	annual TAC set
Blue Mackerel East	*Scomber australasicus*	annual TAC set
Blue Mackerel West	*Scomber australasicus*	annual TAC set
Jack Mackerel East	*Trachurus declivis*	annual TAC set
Jack Mackerel West	*Trachurus declivis*	annual TAC set
Redbait East	*Emmelichthys nitidus*	annual TAC set
Redbait West	*Emmelichthys nitidus*	annual TAC set

Technical measures

Section 28 of the Management Plan imposes a general 'carrying, transhipping or processing condition' on all fishing concessions in the fishery unless AFMA grants a fishing permit allowing one to carry, tranship or process fish. Processing conditions are provided below (Table 2.10). If a person holds a quota SFR to fish in the SPF, they are authorised to carry and process fish in the fishery. If any bycatch is processed, then restrictions apply under the Fisheries Management Regulations 2019. Source: AFMA (2022c)

Table 2.10: AFMA Management Arrangements Booklet: carrying, transhipping or processing condition AFMA (AFMA, 2022c).

Species	Must not be removed from the carcass before the fish is received by an authorised fish receiver
Tuna other than Northern Bluefin Tuna of Billfish	Caudal keel
Billfish other than Broadbill Swordfish (Xiphias gladius)	Caudal keel; dorsal, pectoral, or anal fin
Sharks of the class Chondrichthyes other than: Angel Sharks (family Squantinidae) Rays, Skates Spurdogs (genus Squalus)	Caudal lobe; dorsal, pectoral, or caudal fin

Table 2.10: *(continued)*

Species	Must not be removed from the carcass before the fish is received by an authorised fish receiver
Angel Sharks (family Squantinidae) and Dogfish (family Squalidae)	Dorsal or caudal fin
Skates and Rays	The skin, a fillet
Banjo Shark (Trygonorrhina spp.)	The skin, a fillet, pectoral fin, tail
Elephant Fish (families Callorhinchidae, Chimaeridae, and Rhinochimaeridae)	Second dorsal fin, tail

Regulations

The Fisheries Management Regulations (FMRs) 1992 prescribes detail on the management arrangements implemented in Commonwealth fisheries. These have since been superseded by the current FMRs https://www.legislation.gov.au/Details/F2021C01167. Specifically, the current FMRs cover bans on vessels over 130 m, administration of and standard conditions for fishing concessions including VMS operation, carrying observers, processing fish, marine environment impacts, payments and fees, registers and administration, allocation of statutory fishing rights (SFRs)and 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 Climate Change, Energy, the Environment and Water. A Memorandum of Understanding between AFMA and the Department for the Reporting of Fisheries Interactions with Protected Species (Reporting MOU) streamlines those reporting requirements. AFMA reports its protected species interactions to the Department quarterly.

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). 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).

Initiatives, strategies and incentives

The Small Pelagic Fishery Management Arrangements Booklet 2022-23 documents all regulations (AFMA, 2022c). The SPF Bycatch and Discard Workplan 2022-25 documents mandatory measures to minimize the risk of interactions with seabirds, seals and dolphins. An AFMA-approved VMP is required for any vessel operating in the SPF midwater trawl sub-fishery but not the Purse Seine sub-fishery (AFMA, 2022a).

The Management Arrangements and VMPs are reviewed annually to allow for improvement. Bycatch and Discarding Workplans are reviewed every six 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

Monitoring

The following observer-level targets apply to monitor operations in the SPF:

- Purse Seine vessels: observer coverage target of at least 10 % of effort. For new vessels entering the fishery or existing vessels moving into significantly new areas, observer coverage for at least the first five trips is required.

Assessment

A summary of the tiered framework from the current SPF Harvest Strategy (HS) (AFMA, 2022b) is provided below.

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 Harvest Strategy apply to fish stocks throughout their range and to mortality resulting from all types of fishing. There is also the capacity to establish finer-scale spatial management within zones based on new information about the stock structure or practicalities of stock assessment. The current HS applies to:

- Australian Sardine (*Sardinops sagax*) in Commonwealth waters adjacent to NSW;
- Blue Mackerel (*Scomber australasicus*);
- Jack Mackerels (*Trachurus declivis*, and *T. murphyi*) and
- Redbait (*Emmelichthys nitidus*).

A tiered HS framework is applied to the SPF to accommodate different information levels for different stocks, potential growth of the fishery, the consequent collection of additional information to support more complex stock assessments and responds to the reduction in information levels as assessments become dated. Underpinning the tiered approach is the need to balance risk with certainty by establishing exploitation rates that are initially very conservative, but increase (while remaining conservative) as additional information (eg, quantitative measures of spawning biomass) becomes available. The framework includes three tier levels with different information needs and harvest control rules (HCRs):

- Tier 1, based on a quantitative stock assessment and an annual fishery assessment incorporating a DEPM estimate, provides the greatest certainty in RBC setting and allows for the highest potential harvest rate.
- Tier 2 provides a medium level of assessment based on an annual fishery assessment and a previous DEPM assessment. It also allows for a lower potential harvest rate than Tier 1.
- Tier 3 is the lowest level of assessment, applies when the requirements of other Tier levels are not met, and has a lower potential harvest rate than Tier 1 or Tier 2. A review of available catch and effort data should be undertaken annually.

The framework allows the level of investment in research and assessment to be varied to match commercial interest in exploiting the resource while generating the information required to manage each stock. Assessment costs increase as the fishery moves towards a Tier 1 assessment, although an increase in the level of assessment may not necessarily result in a commensurate increase in the RBC. Rather, the RBC will be dictated by the status of the stock. Assuming a stock is at the same biomass, additional certainty associated with the data and assessment requirements of higher Tiers allow for higher harvest rates and higher catches.

The HS recognises that:

- Tiers apply to individual species by zone in the fishery, i.e., the Eastern Zone and the Western Zone;
- SPF quota species have different biological characteristics and accordingly exploitation rates are species–specific at every Tier;
- The reliability of estimates of spawning biomass declines over time as uncertainty around how stock status might have changed in the elapsed period increases.
- Information on the stock status is determined for each zone.
- Exploitation rates should reflect levels of knowledge about stock status.

Table 2.11: Summary of SPF Harvest Strategy including assessments and harvest control rules (HCRs). Daily Egg Production Method: DEPM. Source: Noriega et al. (2022).

Stock	Tier 1 exploitation rate (%)	Maximum time (seasons) at rate	Tier 2 exploitation rate (%)	Maximum time (seasons) at rate	Tier 3 (with DEPM, indefinite time period) exploitation rate (%)
Redbait West	10	5	5	10	2.5
Redbait East	10	5	5	10	2.5

Table 2.11: ***(continued)***

Stock	Tier 1 exploitation rate (%)	Maximum time (seasons) at rate	Tier 2 exploitation rate (%)	Maximum time (seasons) at rate	Tier 3 (with DEPM, indefinite time period) exploitation rate (%)
Jack Mackerel West	12	5	6	10	3
Jack Mackerel East	12	5	6	10	3
Blue Mackerel West	15	5	7.5	5	3.75
Blue Mackerel East	15	5	7.5	5	3.75
Australian Sardine East	20	5	10	5	5

Other initiatives or agreements

State, national, or international conventions or agreements that impact the management of the fishery/sub-fishery are 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) and Western Australia as the South Coast Purse Seine Managed Fishery (SCPSMF). The eastern stock of Australian Sardine is co-managed by the Australian, New South Wales, Victorian and Tasmanian governments (Moore & Mazur, 2015).

In addition, there are national and international initiatives in place that impact the management of the fishery. These include:

Declaration of the Harvest Operations of the Small Pelagic Fishery as an approved wildlife trade operation, February 2018. http://www.environment.gov.au/biodiversity/wildlife-trade/trading/commercial/operations

2.2.1.5 Data

Logbook data

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 CSIRO.

Electronic logbooks (e-logs) are an electronic alternative to submitting traditional paper logbooks. E-logs allow data to be received by AFMA in near real-time, closer to actual fishing events. From 1 May 2018, it will be compulsory for all trawl vessels that have fished more than 50 days in the current or previous fishing season to have transitioned to e-logs.

Observer data

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 vessels operating inside, and periodically outside, the Australian Fishing Zone" (http://www.afma.gov.au/fisheries-services/observer-services/: accessed 19 December 2022).

AFMA observers are highly experienced in fishery observer work in Australia. They:

- collect data on independent vessel 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 and
- monitor compliance of the vessel 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. Annual percentage coverage rates were less than 10% p.a. (Table 2.12).

Table 2.12: Percentage of observer coverage in the SPF Purse Seine sector by fishing season. Source: AFMA

Fishing season	Number of boat days	Number of observed days	Observer coverage (%)
2016-17	59	0	0
2017-18	87	3	3.45
2018-19	86	0	0
2019-20	41	2	4.88
2020-21	118	7	5.93
2021-22	50	4	8

Other data

Consultants are engaged to collate detailed biological data including DEPM surveys on the four key commercial species which are assessed annually (Ward & Earl, 2014; Ward et al., 2015a, 2015b).

Legislative instruments and directions

Fisheries Management Act 1991

https://www.legislation.gov.au/Details/C2017C00363

Fisheries Management Regulations 2019

https://www.legislation.gov.au/Series/F2019L00383

Commonwealth fisheries harvest strategy policy 2018

https://www.agriculture.gov.au/sites/default/files/sitecollectiondocuments/fisheries/domestic/hsp.pdf

Small Pelagic Fishery Management Plan 2009

https://www.legislation.gov.au/Details/F2014C01077

Small Pelagic Fishery Dolphin Strategy 2017 https://www.afma.gov.au/sites/default/files/2023-02/Small-Pelagic-Fishery-Dolphin-Mitigation-Strategy-FINAL.pdf

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 and secondary commercial; byproduct/discards and protected species components). [Scoping document S2A Species]
- **Habitat Component**: habitat types. [Scoping document S2B1 and S2B2 Habitats]
- **Community Component**: community types. [Scoping document S2C1 and S2C2 Communities]

Ecological Units Assessed

Key commercial and secondary species 1 (C1), 0 (C2), Not assessed (CB)
Byproduct and bycatch species 6 (BP), 148 (BC)
Protected species 0
Habitats 94 (84 benthic, 10 pelagic)
Communities 68 (47 demersal, 21 pelagic)

Scoping Document S2A. Species

Each species identified during the scoping is added to the ERAEF database used to run the Level 1 and/or Level 2 analyses. 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.cmar.csiro.au/caab/

Key/Secondary Commercial Species

- *Key commercial species* – defined in the Harvest Strategy Policy (HSP) Guidelines as a species that is, or has been, specifically targeted and is, or has been, a significant component of a fishery.
- *Secondary commercial species* – commercial species that, while not specifically targeted, are commonly caught and generally retained, and comprise a significant component of a fishery's catch and economic return. These can include quota species in some fisheries.
- *Commercial bait species*

Commercial bait species were not assessed in this report.

Table 2.13: Key commercial species (C1) and/or secondary commercial species (C2) list for the Small Pelagic Fishery - Purse Seine sub-fishery. LOG: refers to AFMA Logbook data. OBS: refers to AFMA Observer data.

ERA Species ID	Role in Fishery	Taxa	Family Name	CAAB Code	Scientific Name	Common Name	Source(s)
825	C1	Teleost	Clupeidae	37085002	*Sardinops sagax*	Australian Sardine	LOG, OBS

Byproduct Species

List the byproduct species of the sub-fishery. Byproduct species refers to any species that are retained for sale but comprise a minor component of the fishery catch and economic return. Byproduct are considered to be commercial species under the CPFB 2000. This list is obtained by reviewing all available fishery literature, including logbooks, observer reports and discussions with stakeholders.

Table 2.14: Byproduct species list for the Small Pelagic Fishery - Purse Seine sub-fishery. LOG: refers to AFMA Logbook data. OBS: refers to AFMA Observer data.

ERA Species ID	Role in Fishery	Taxa	Family Name	CAAB Code	Scientific Name	Common Name	Source(s)
6700	BP	Teleost	Clupeidae	37085001	*Etrumeus teres*	Maray	LOG
831	BP	Teleost	Engraulidae	37086001	*Engraulis australis*	Australian Anchovy	LOG, OBS

Table 2.14: *(continued)*

ERA Species ID	Role in Fishery	Taxa	Family Name	CAAB Code	Scientific Name	Common Name	Source(s)
1088	BP	Teleost	Carangidae	37337002	*Trachurus declivis*	Common Jack Mackerel	LOG
540	BP	Teleost	Carangidae	37337003	*Trachurus novaezelandiae*	Yellowtail Scad	LOG
1132	BP	Teleost	Carangidae	37337015	*Selaroides leptolepis*	Yellowstripe Scad	LOG, OBS
210	BP	Teleost	Scombridae	37441001	*Scomber australasicus*	Blue Mackerel	LOG, OBS

Bycatch (Discard) Species

Bycatch species are species that are not retained (i.e., are discarded, and includes catch that does not reach the deck of the vessel but which nonetheless is killed (or affected) as a result of the interaction with the fishing gear) and as such make no contribution to the value of the fishery. The term bycatch does not include discards of commercial species. Here, 'bycatch species' refers to general bycatch species only (i.e., species of fish, sharks, invertebrates, etc., that are never retained for sale), it excludes protected species, which are a separate category.

Table 2.15: Bycatch species list for the Small Pelagic Fishery - Purse Seine sub-fishery. OBS: refers to AFMA Observer data. LOG: refers to AFMA Logbook data.

ERA Species ID	Role in Fishery	Taxa	Family Name	CAAB Code	Scientific Name	Common Name	Source(s)
535	BC	Chondrichthyan	Carcharhinidae	37018001	*Carcharhinus brachyurus*	Bronze Whaler	OBS
647	BC	Chondrichthyan	Carcharhinidae	37018014	*Carcharhinus tilstoni*	Australian Blacktip Shark	OBS
552	BC	Chondrichthyan	Sphyrnidae	37019004	*Sphyrna zygaena*	Smooth Hammerhead	OBS
709	BC	Chondrichthyan	Trygonorrhinidae	37027009	*Aptychotrema rostrata*	Eastern Shovelnose Ray	OBS
764	BC	Chondrichthyan	Dasyatidae	37035001	*Bathytoshia brevicaudata*	Short-Tail Stingray	Expanded from 37035000

Table 2.15: *(continued)*

ERA Species ID	Role in Fishery	Taxa	Family Name	CAAB Code	Scientific Name	Common Name	Source(s)
767	BC	Chondrichthyan	Dasyatidae	37035002	*Bathytoshia lata*	Brown Stingray / Black Stingray	Expanded from 37035000
769	BC	Chondrichthyan	Dasyatidae	37035004	*Neotrygon australiae*	Bluespotted Maskray	Expanded from 37035000
9285	BC	Chondrichthyan	Dasyatidae	37035008	*Hemitrygon fluviorum*	Estuary Stingray	Expanded from 37035000
816	BC	Chondrichthyan	Dasyatidae	37035010	*Pteroplatytrygon violacea*	Pelagic Stingray	Expanded from 37035000
510	BC	Chondrichthyan	Dasyatidae	37035011	*Pastinachus ater*	Cowtail Stingray	Expanded from 37035000
8460	BC	Chondrichthyan	Dasyatidae	37035022	*Maculabatis toshi*	Brown Whipray	Expanded from 37035000
8461	BC	Chondrichthyan	Dasyatidae	37035024	*Pateobatis fai*	Pink Whipray	Expanded from 37035000
1808	BC	Invertebrate	Luidiidae	25105001	*Luidia australiae*	A Seastar	Expanded from 25102000
1299	BC	Invertebrate	Astropectinidae	25111017	*Bollonaster pectinatus*	A Seastar	Expanded from 25102000
9477	BC	Invertebrate	Goniasteridae	25122001	*Pentagonaster duebeni*	Vermilion Seastar; Biscuit Sea Star	Expanded from 25102000
9478	BC	Invertebrate	Goniasteridae	25122013	*Mediaster praestans*	A Sea Star	Expanded from 25102000
9479	BC	Invertebrate	Goniasteridae	25122015	*Calliaster spinosus*	A Sea Star	Expanded from 25102000
9480	BC	Invertebrate	Goniasteridae	25122021	*Mediaster boardmani*	A Sea Star	Expanded from 25102000
9481	BC	Invertebrate	Goniasteridae	25122081	*Lithosoma penichra*	A Sea Star	Expanded from 25102000
9482	BC	Invertebrate	Goniasteridae	25125014	*Fromia polypora*	Many Spotted Sea Star	Expanded from 25102000
9483	BC	Invertebrate	Ophidiasteridae	25125037	*Ophidiaster confertus*	Orange Sea Star	Expanded from 25102000
9484	BC	Invertebrate	Ophidiasteridae	25125043	*Pseudophidiaster rhysus*	A Sea Star	Expanded from 25102000
9485	BC	Invertebrate	Oreasteridae	25127017	*Anthenea sidneyensis*	A Sea Star	Expanded from 25102000
1300	BC	Invertebrate	Oreasteridae	25127039	*Nectria ocellata*	A Seastar	Expanded from 25102000
6308	BC	Invertebrate	Asterodiscididae	25128001	*Asterodiscides truncatus*	Firebrick Seastar	Expanded from 25102000
9486	BC	Invertebrate	Asterinidae	25140010	*Indianastra inopinata*	A Sea Star	Expanded from 25102000
9487	BC	Invertebrate	Asterinidae	25140025	*Paranepanthia grandis*	A Sea Star	Expanded from 25102000

Table 2.15: *(continued)*

ERA Species ID	Role in Fishery	Taxa	Family Name	CAAB Code	Scientific Name	Common Name	Source(s)
9488	BC	Invertebrate	Asterinidae	25140027	*Meridiastra gunnii*	Gunn's Six-Armed Star	Expanded from 25102000
9489	BC	Invertebrate	Asterinidae	25140028	*Meridiastra calcar*	Carpet Sea Star	Expanded from 25102000
9490	BC	Invertebrate	Asterinidae	25140029	*Parvulastra exigua*	Dwarf Cushion Star	Expanded from 25102000
9491	BC	Invertebrate	Asterinidae	25140043	*Meridiastra oriens*	Eastern Six-Armed Sea Star	Expanded from 25102000
9492	BC	Invertebrate	Echinasteridae	25143001	*Henricia obesa*	Obese Henricia	Expanded from 25102000
9493	BC	Invertebrate	Echinasteridae	25143005	*Echinaster colemani*	A Sea Star	Expanded from 25102000
1301	BC	Invertebrate	Echinasteridae	25143015	*Plectaster decanus*	A Seastar	Expanded from 25102000
9494	BC	Invertebrate	Asteropseide	25144002	*Petricia vernicina*	Velvet Sea Star	Expanded from 25102000
9495	BC	Invertebrate	Asteriidae	25154001	*Asterias amurensis*	Northern Pacific Seastar	Expanded from 25102000
9496	BC	Invertebrate	Asteriidae	25154011	*Coscinasterias muricata*	Eleven-Armed Sea Star	Expanded from 25102000
3263	BC	Invertebrate	Portunidae	28911002	*Charybdis natator*	Hairyback Crab	Expanded from 28911000
9497	BC	Invertebrate	Portunidae	28911003	*Ovalipes australensis*	A Swimming Crab	Expanded from 28911000
9498	BC	Invertebrate	Portunidae	28911004	*Nectocarcinus tuberlosus*	A Swimming Crab	Expanded from 28911000
2545	BC	Invertebrate	Portunidae	28911005	*Portunus armatus*	Blue Swimmer Crab	Expanded from 28911000
9513	BC	Invertebrate	Portunidae	28911005	*Portunus pelagicus*	Blue Swimmer Crab	Expanded from 28911000
2554	BC	Invertebrate	Portunidae	28911006	*Portunus sanguinolentus*	Three-Spotted Crab	Expanded from 28911000
7583	BC	Invertebrate	Portunidae	28911010	*Nectocarcinus integrifrons*	Rough Rock Crab	Expanded from 28911000
7771	BC	Invertebrate	Portunidae	28911014	*Podophthalmus vigil*	Sentinel Crab	Expanded from 28911000
3264	BC	Invertebrate	Portunidae	28911015	*Charybdis truncata*	A Swimming Crab	Expanded from 28911000
9499	BC	Invertebrate	Portunidae	28911024	*Thalamita bouvieri*	A Swimming Crab	Expanded from 28911000

Table 2.15: *(continued)*

ERA Species ID	Role in Fishery	Taxa	Family Name	CAAB Code	Scientific Name	Common Name	Source(s)
9500	BC	Invertebrate	Portunidae	28911036	*Lissocarcinus orbicularis*	A Swimming Crab	Expanded from 28911000
9501	BC	Invertebrate	Portunidae	28911051	*Nectocarcinus spinifrons*	A Swimming Crab	Expanded from 28911000
9502	BC	Invertebrate	Portunidae	28911063	*Cycloachelous orbitosinus*	A Swimming Crab	Expanded from 28911000
9503	BC	Invertebrate	Portunidae	28911066	*Monomia curvipenis*	A Swimming Crab	Expanded from 28911000
9504	BC	Invertebrate	Portunidae	28911067	*Portunus pubescens*	A Swimming Crab	Expanded from 28911000
9505	BC	Invertebrate	Portunidae	28911084	*Thalamita admete*	A Swimming Crab	Expanded from 28911000
7933	BC	Teleost	Portunidae	28911008	*Scylla serrata*	Giant Mud Crab	Expanded from 28911000
6326	BC	Teleost	Clupeidae	37085005	*Hyperlophus vittatus*	Sandy Sprat	OBS
6363	BC	Teleost	Platycephalidae	37296036	*Platycephalus longispinis*	Longspine Flathead	OBS
3380	BC	Teleost	Sillaginidae	37330005	*Sillago robusta*	Stout Whiting	OBS
145	BC	Teleost	Sillaginidae	37330014	*Sillago flindersi*	Eastern School Whiting	OBS
167	BC	Teleost	Scorpididae	37361004	*Scorpis aequipinnis*	Sea Sweep	OBS
607	BC	Teleost	Scorpididae	37361009	*Scorpis lineolata*	Silver Sweep	LOG
7821	BC	Teleost	Sphyraenidae	37382001	*Sphyraena pinguis*	Striped Barracuda	Expanded from 37382000
184	BC	Teleost	Sphyraenidae	37382002	*Sphyraena novaehollandiae*	Snook	Expanded from 37382000
7077	BC	Teleost	Sphyraenidae	37382003	*Sphyraena acutipinnis*	Sharpfin Barracuda	Expanded from 37382000
879	BC	Teleost	Sphyraenidae	37382004	*Sphyraena jello*	Pickhandle Barracuda	Expanded from 37382000
2349	BC	Teleost	Sphyraenidae	37382005	*Sphyraena forsteri*	Blackspot Barracuda	Expanded from 37382000
1237	BC	Teleost	Sphyraenidae	37382006	*Sphyraena putnamae*	Military Barracuda	Expanded from 37382000
1238	BC	Teleost	Sphyraenidae	37382007	*Sphyraena obtusata*	Yellowtail Barracuda	Expanded from 37382000
614	BC	Teleost	Sphyraenidae	37382008	*Sphyraena barracuda*	Great Barracuda	Expanded from 37382000
2296	BC	Teleost	Sphyraenidae	37382009	*Sphyraena qenie*	Darkfinned Seapike	Expanded from 37382000

Table 2.15: *(continued)*

ERA Species ID	Role in Fishery	Taxa	Family Name	CAAB Code	Scientific Name	Common Name	Source(s)
8075	BC	Teleost	Sphyraenidae	37382011	*Sphyraena helleri*	Heller's Barracuda	Expanded from 37382000
63	BC	Teleost	Scombridae	37441010	*Euthynnus affinis*	Mackerel Tuna	OBS
211	BC	Teleost	Scombridae	37441020	*Sarda australis*	Australian Bonito	LOG, OBS
1069	BC	Teleost	Centrolophidae	37445006	*Seriolella punctata*	Silver Warehou	OBS
1223	BC	Teleost	Psettodidae	37457001	*Psettodes erumei*	Australian Halibut	Expanded from 37990009
307	BC	Teleost	Bothidae	37460001	*Lophonectes gallus*	Crested Flounder	Expanded from 37990009
1116	BC	Teleost	Bothidae	37460010	*Grammatobothus polyophthalmus*	Threespot Flounder	Expanded from 37990009
1396	BC	Teleost	Bothidae	37460012	*Engyprosopon grandisquama*	Spot-Tail Wide-Eye Flounder	Expanded from 37990009
7256	BC	Teleost	Bothidae	37460013	*Engyprosopon maldivensis*	Olive Wide-Eye Flounder	Expanded from 37990009
7257	BC	Teleost	Bothidae	37460016	*Grammatobothus pennatus*	Pennant Flounder	Expanded from 37990009
9457	BC	Teleost	Bothidae	37460017	*Psettina iijimae*	Leaf Flounder	Expanded from 37990009
8410	BC	Teleost	Bothidae	37460021	*Engyprosopon praeteritus*	Spotless Lefteye Flounder	Expanded from 37990009
2409	BC	Teleost	Bothidae	37460022	*Laeops parviceps*	Smallhead Flounder	Expanded from 37990009
8418	BC	Teleost	Bothidae	37460028	*Arnoglossus armstrongi*	Armstrong's Flounder	Expanded from 37990009
7258	BC	Teleost	Bothidae	37460029	*Arnoglossus bassensis*	Bass Strait Flounder	Expanded from 37990009
1821	BC	Teleost	Bothidae	37460030	*Arnoglossus muelleri*	Mueller's Flounder	Expanded from 37990009
2411	BC	Teleost	Bothidae	37460033	*Psettina gigantea*	Combscale Flounder	Expanded from 37990009
9381	BC	Teleost	Bothidae	37460034	*Arnoglossus japonicus*	Japanese Lefteye Flounder	Expanded from 37990009
9456	BC	Teleost	Bothidae	37460042	*Bothus myriaster*	Indo-Pacific Oval Flounder	Expanded from 37990009

Table 2.15: *(continued)*

ERA Species ID	Role in Fishery	Taxa	Family Name	CAAB Code	Scientific Name	Common Name	Source(s)
7259	BC	Teleost	Bothidae	37460043	*Arnoglossus fisoni*	Fison's Flounder	Expanded from 37990009
7261	BC	Teleost	Bothidae	37460049	*Chascanopsetta lugubris*	Pelican Flounder	Expanded from 37990009
9132	BC	Teleost	Bothidae	37460050	*Engyprosopon bleekeri*	Bleeker's Flounder	Expanded from 37990009
9382	BC	Teleost	Bothidae	37460051	*Laeops kitaharae*	Kitahara's Flounder	Expanded from 37990009
7282	BC	Teleost	Bothidae	37460059	*Arnoglossus micrommatus*	Smalleye Flounder	Expanded from 37990009
7263	BC	Teleost	Bothidae	37460066	*Crossorhombus valderostratus*	Broadbrow Flounder	Expanded from 37990009
7264	BC	Teleost	Bothidae	37460067	*Engyprosopon hureaui*	Hureau's Wide-Eye Flounder	Expanded from 37990009
9380	BC	Teleost	Bothidae	37460068	*Engyprosopon longipterum*	Long Pectoral Fin Flounder	Expanded from 37990009
9455	BC	Teleost	Bothidae	37460071	*Arnoglossus polyspilus*	Many-Spotted Lefteye Flounder	Expanded from 37990009
7266	BC	Teleost	Pleuronectidae	37461019	*Nematops macrochirus*	Longfin Righteye Flounder	Expanded from 37461000
7269	BC	Teleost	Soleidae	37462001	*Aesopia cornuta*	Unicorn Sole	Expanded from 37462000
226	BC	Teleost	Soleidae	37462004	*Zebrias quagga*	Zebra Sole	Expanded from 37462000
9379	BC	Teleost	Soleidae	37462005	*Phyllichthys punctatus*	Spotted Sole	Expanded from 37462000
2368	BC	Teleost	Soleidae	37462006	*Zebrias cancellatus*	Harrowed Sole	Expanded from 37462000
1398	BC	Teleost	Soleidae	37462007	*Brachirus muelleri*	Tufted Sole	Expanded from 37462000
1236	BC	Teleost	Soleidae	37462009	*Pardachirus pavoninus*	Peacock Sole	Expanded from 37462000
26	BC	Teleost	Soleidae	37462010	*Zebrias scalaris*	Manyband Sole	OBS
8974	BC	Teleost	Soleidae	37462015	*Soleichthys heterorhinos*	Tiger Sole	Expanded from 37462000

Table 2.15: *(continued)*

ERA Species ID	Role in Fishery	Taxa	Family Name	CAAB Code	Scientific Name	Common Name	Source(s)
2393	BC	Teleost	Soleidae	37462016	*Aseraggodes melanostictus*	Dappled Sole	Expanded from 37462000
6414	BC	Teleost	Soleidae	37462017	*Brachirus nigra*	Black Sole	Expanded from 37462000
7270	BC	Teleost	Soleidae	37462018	*Synclidopus macleayanus*	Narrowbanded Sole	Expanded from 37462000
7284	BC	Teleost	Soleidae	37462020	*Aseraggodes haackeanus*	Southern Sole	Expanded from 37462000
7271	BC	Teleost	Soleidae	37462029	*Pardachirus hedleyi*	Southern Peacock Sole	Expanded from 37462000
1399	BC	Teleost	Soleidae	37462031	*Phyllichthys sclerolepis*	Hardscale Sole	Expanded from 37462000
7272	BC	Teleost	Soleidae	37462033	*Soleichthys microcephalus*	Smallhead Sole	Expanded from 37462000
7285	BC	Teleost	Soleidae	37462036	*Zebrias penescalaris*	Duskybanded Sole	Expanded from 37462000
7273	BC	Teleost	Soleidae	37462049	*Aseraggodes nigrocirratus*	A Sole	Expanded from 37462000
1146	BC	Teleost	Cynoglossidae	37463001	*Paraplagusia bilineata*	Lemon Tongue Sole	OBS
7287	BC	Teleost	Monacanthidae	37465001	*Acanthaluteres brownii*	Spinytail Leatherjacket	Expanded from 37465903
311	BC	Teleost	Monacanthidae	37465002	*Acanthaluteres vittiger*	Toothbrush Leatherjacket	Expanded from 37465903
231	BC	Teleost	Monacanthidae	37465003	*Eubalichthys mosaicus*	Mosaic Leatherjacket	Expanded from 37465903
232	BC	Teleost	Monacanthidae	37465005	*Meuschenia scaber*	Velvet Leatherjacket	Expanded from 37465903
233	BC	Teleost	Monacanthidae	37465006	*Nelusetta ayraud*	Ocean Jacket	Expanded from 37465903
234	BC	Teleost	Monacanthidae	37465007	*Scobinichthys granulatus*	Rough Leatherjacket	Expanded from 37465903
1178	BC	Teleost	Monacanthidae	37465009	*Monacanthus chinensis*	Fan-Bellied Leatherjacket	Expanded from 37465903
6820	BC	Teleost	Monacanthidae	37465012	*Thamnaconus hypargyreus*	Yellowspotted Leatherjacket	Expanded from 37465903

Table 2.15: *(continued)*

ERA Species ID	Role in Fishery	Taxa	Family Name	CAAB Code	Scientific Name	Common Name	Source(s)
1181	BC	Teleost	Monacanthidae	37465013	*Chaetodermis penicilligerus*	Tasselled Leatherjacket	Expanded from 37465903
1183	BC	Teleost	Monacanthidae	37465022	*Aluterus monoceros*	Grey Leatherjacket	Expanded from 37465903
1182	BC	Teleost	Monacanthidae	37465024	*Paramonacanthus filicauda*	Threadfin Leatherjacket	Expanded from 37465903
6821	BC	Teleost	Monacanthidae	37465025	*Brachaluteres jacksonianus*	Southern Pygmy Leatherjacket	Expanded from 37465903
8911	BC	Teleost	Monacanthidae	37465026	*Thamnaconus tessellatus*	Manyspot Leatherjacket	Expanded from 37465903
6822	BC	Teleost	Monacanthidae	37465035	*Meuschenia flavolineata*	Yellowstriped Leatherjacket	Expanded from 37465903
237	BC	Teleost	Monacanthidae	37465036	*Meuschenia freycineti*	Sixspine Leatherjacket	Expanded from 37465903
6823	BC	Teleost	Monacanthidae	37465038	*Thamnaconus modestoides*	Modest Leatherjacket	Expanded from 37465903
6438	BC	Teleost	Monacanthidae	37465039	*Eubalichthys bucephalus*	Black Reef Leatherjacket	Expanded from 37465903
6824	BC	Teleost	Monacanthidae	37465041	*Cantherhines fronticinctus*	Spectacled Leatherjacket	Expanded from 37465903
4901	BC	Teleost	Monacanthidae	37465045	*Aluterus scriptus*	Scrawled Leatherjacket	Expanded from 37465903
6825	BC	Teleost	Monacanthidae	37465049	*Brachaluteres taylori*	Taylor's Pygmy Leatherjacket	Expanded from 37465903
6826	BC	Teleost	Monacanthidae	37465050	*Cantherhines dumerilii*	Barred Leatherjacket	Expanded from 37465903
4410	BC	Teleost	Monacanthidae	37465051	*Cantherhines pardalis*	Honeycomb Leatherjacket	Expanded from 37465903
8425	BC	Teleost	Monacanthidae	37465052	*Cantheschenia grandisquamis*	Largescale Leatherjacket	Expanded from 37465903
6827	BC	Teleost	Monacanthidae	37465053	*Cantheschenia longipinnis*	Smoothspine Leatherjacket	Expanded from 37465903

Table 2.15: *(continued)*

ERA Species ID	Role in Fishery	Taxa	Family Name	CAAB Code	Scientific Name	Common Name	Source(s)
238	BC	Teleost	Monacanthidae	37465059	*Meuschenia trachylepis*	Yellowfin Leatherjacket	Expanded from 37465903
6828	BC	Teleost	Monacanthidae	37465060	*Meuschenia venusta*	Stars-And-Stripes Leatherjacket	Expanded from 37465903
4662	BC	Teleost	Monacanthidae	37465063	*Paraluteres prionurus*	Blacksaddle Filefish	Expanded from 37465903
3344	BC	Teleost	Monacanthidae	37465065	*Paramonacanthus otisensis*	Dusky Leatherjacket	Expanded from 37465903
4674	BC	Teleost	Monacanthidae	37465066	*Pervagor alternans*	Yelloweye Leatherjacket	Expanded from 37465903
4676	BC	Teleost	Monacanthidae	37465068	*Pervagor janthinosoma*	Gillblotch Leatherjacket	Expanded from 37465903
8426	BC	Teleost	Monacanthidae	37465083	*Pseudalutarius nasicornis*	Rhinoceros Leatherjacket	Expanded from 37465903
6830	BC	Teleost	Monacanthidae	37465085	*Paramonacanthus lowei*	Lowe's Leatherjacket	Expanded from 37465903

Protected Species

A protected species[7] refers to all species listed/covered under the EPBC Act 1999, which include Protected[8] species (listed threatened species i.e. vulnerable, endangered or critically endangered), cetaceans, listed migratory species, and listed marine species.

There are no recorded protected species that have interacted with this fishery within the assessment period.

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

[8]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).

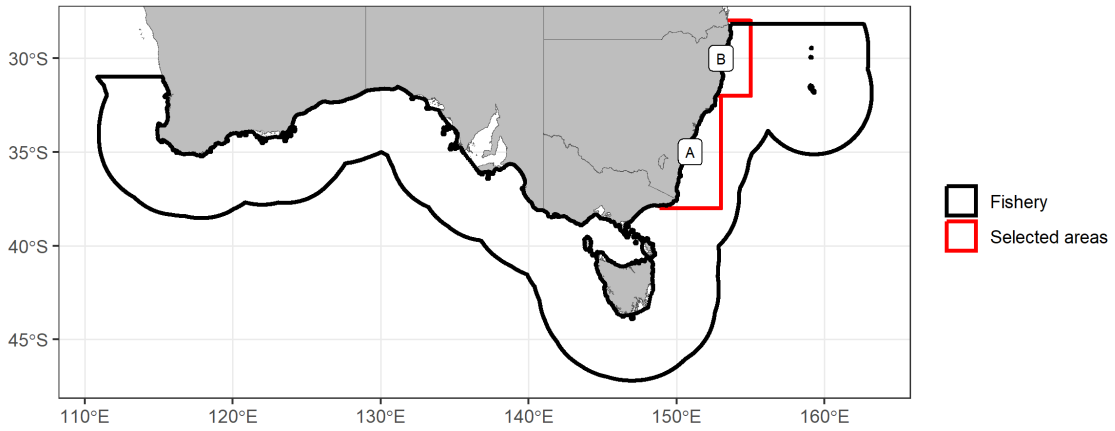


Figure 2.7: Map of the fishery region showing the locations for which detailed maps of biomes and assemblages are shown in the following figures (Figure 2.8 to Figure 2.9).

Since the previous assessments over a decade ago, there has been considerable research and habitat identification and modelling of demersal habitats around Australia (Althaus et al., 2009; Hobday et al., 2011a; Pitcher et al., 2015, 2016; Williams et al., 2009, 2010a; Williams et al., 2010b, 2010c, 2011). This has culminated in Pitcher et al. (2018) in an FRDC–funded project, redefined much of the Australian seafloor based on mesoscale surrogates collated from data from biological surveys, environmental data and protected area/fishery closure data. Habitat assemblages were predicted, mapped (Figure 2.7 to Figure 2.9) and overlaid with the footprint of the fishery being assessed.

The new data and new methodology is not directly mappable to the original analyses but these assessments are currently more comprehensive than the previous assessments, and will therefore be used in preference to the original SICA. The temporal range of the fishery effort data of Pitcher et al. (2018) was from 1985 -~2013.

There are over 50 habitat assemblages that overlap the SPF jurisdiction. Habitats include sedimentary rock, fine and coarse sediments, mud, gravel, and small and large sponges. Activities associated with fishing occurred over benthic habitat assemblages 4, 5, 6 and 1 of Biome 5 (East Australian shelf and slope region) (Table 2.16). Most effort occurred in assemblage 4, followed by 5, 6 and 1 over the assessment period. Consequently, these benthic assemblages were considered the most vulnerable in the SPF Purse Seine sub-fishery when assessing fishing related activities in this assessment.

Table 2.16: Benthic habitats that occur within the jurisdictional boundary of the Small Pelagic Fishery - Purse Seine sub-fishery. Further details of these assemblages were not available. Bold text denotes habitats where fishing effort has occurred (4 habitats).

Biome Number	Biome	ERAEF Assemblage Number	Habitat Type
05	**East Australian shelf and slope region**	**1**	
05	**East Australian shelf and slope region**	**4**	
05	**East Australian shelf and slope region**	**5**	
05	**East Australian shelf and slope region**	**6**	
05	East Australian shelf and slope region	7	

Table 2.16: ***(continued)***

Biome Number	Biome	ERAEF Assemblage Number	Habitat Type
05	East Australian shelf and slope region	8	
05	East Australian shelf and slope region	9	
05	East Australian shelf and slope region	10	
05	East Australian shelf and slope region	11	
05	East Australian shelf and slope region	12	
05	East Australian shelf and slope region	13	
05	East Australian shelf and slope region	14	
05	East Australian shelf and slope region	15	
05	East Australian shelf and slope region	16	
05	East Australian shelf and slope region	17	
05	East Australian shelf and slope region	18	
05	East Australian shelf and slope region	19	
08	Southeast Australian shelf and slope region	1	
08	Southeast Australian shelf and slope region	2	
08	Southeast Australian shelf and slope region	3	
08	Southeast Australian shelf and slope region	4	
08	Southeast Australian shelf and slope region	5	
08	Southeast Australian shelf and slope region	6	
08	Southeast Australian shelf and slope region	7	
08	Southeast Australian shelf and slope region	8	
08	Southeast Australian shelf and slope region	9	
08	Southeast Australian shelf and slope region	10	

Table 2.16: ***(continued)***

Biome Number	Biome	ERAEF Assemblage Number	Habitat Type
08	Southeast Australian shelf and slope region	11	
08	Southeast Australian shelf and slope region	12	
08	Southeast Australian shelf and slope region	13	
08	Southeast Australian shelf and slope region	14	
08	Southeast Australian shelf and slope region	15	
08	Southeast Australian shelf and slope region	16	
08	Southeast Australian shelf and slope region	17	
08	Southeast Australian shelf and slope region	18	
08	Southeast Australian shelf and slope region	19	
08	Southeast Australian shelf and slope region	20	
08	Southeast Australian shelf and slope region	21	
08	Southeast Australian shelf and slope region	22	
08	Southeast Australian shelf and slope region	23	
08	Southeast Australian shelf and slope region	24	
08	Southeast Australian shelf and slope region	25	
08	Southeast Australian shelf and slope region	26	
07	Southern Australian shelf and slope region	4	
07	Southern Australian shelf and slope region	5	
07	Southern Australian shelf and slope region	6	
07	Southern Australian shelf and slope region	7	
07	Southern Australian shelf and slope region	8	
07	Southern Australian shelf and slope region	9	

Table 2.16: ***(continued)***

Biome Number	Biome	ERAEF Assemblage Number	Habitat Type
07	Southern Australian shelf and slope region	10	
07	Southern Australian shelf and slope region	11	
07	Southern Australian shelf and slope region	12	
07	Southern Australian shelf and slope region	13	
07	Southern Australian shelf and slope region	14	
07	Southern Australian shelf and slope region	15	
07	Southern Australian shelf and slope region	16	
07	Southern Australian shelf and slope region	17	
07	Southern Australian shelf and slope region	18	
07	Southern Australian shelf and slope region	19	
07	Southern Australian shelf and slope region	20	
07	Southern Australian shelf and slope region	21	
07	Southern Australian shelf and slope region	22	
07	Southern Australian shelf and slope region	23	
07	Southern Australian shelf and slope region	24	
07	Southern Australian shelf and slope region	25	
07	Southern Australian shelf and slope region	26	
07	Southern Australian shelf and slope region	27	
09	Southwest Australian shelf region	3	
09	Southwest Australian shelf region	4	
09	Southwest Australian shelf region	5	
09	Southwest Australian shelf region	6	
09	Southwest Australian shelf region	7	
09	Southwest Australian shelf region	8	
09	Southwest Australian shelf region	9	
09	Southwest Australian shelf region	10	

Table 2.16: *(continued)*

Biome Number	Biome	ERAEF Assemblage Number	Habitat Type
09	Southwest Australian shelf region	11	
09	Southwest Australian shelf region	12	
09	Southwest Australian shelf region	16	
04	West Australian slope region	2	
04	West Australian slope region	3	
04	West Australian slope region	4	
04	West Australian slope region	5	
04	West Australian slope region	9	
04	West Australian slope region	12	

Scoping Document S2B2. Pelagic Habitats

Table 2.17: Pelagic habitats for the Small Pelagic Fishery - Purse Seine sub-fishery. Shading denotes habitats occurring within the jurisdictional boundary of the fishery. Bold text refers to pelagic habitats where fishing effort has occurred.

ERAEF Pelagic Habitat No.	Pelagic Habitat type	Depth (m)	Comments	Source
P1	**Eastern Pelagic Province - Coastal**	**0 – 200**		**ERA pelagic habitat database based on pelagic communities definitions**
P2	Eastern Pelagic Province - Oceanic	0 – > 600	this is a compilation of the range covered by Oceanic Community (1) and (2)	ERA pelagic habitat database based on pelagic communities definitions
P3	Heard/ McDonald Islands Pelagic Provinces - Oceanic	0 - >1000	this is a compilation of the range covered by Oceanic Community (1) and (2)	ERA pelagic habitat database based on pelagic communities definitions
P4	North Eastern Pelagic Province - Oceanic	0 – > 600	this is a compilation of the range covered by Oceanic Community (1) and (2)	ERA pelagic habitat database based on pelagic communities definitions
P5	Northern Pelagic Province - Coastal	0 – 200		ERA pelagic habitat database based on pelagic communities definitions
P6	North Western Pelagic Province - Oceanic	0 – > 800	this is a compilation of the range covered by Oceanic Community (1) and (2)	ERA pelagic habitat database based on pelagic communities definitions
P7	Southern Pelagic Province - Coastal	0 – 200	this is a compilation of the range covered by Coastal pelagic Tas and GAB	ERA pelagic habitat database based on pelagic communities definitions
P8	Southern Pelagic Province - Oceanic	0 – > 600	this is a compilation of the range covered by Oceanic Communities (1, 2 and 3)	ERA pelagic habitat database based on pelagic communities definitions

Table 2.17: *(continued)*

ERAEF Pelagic Habitat No.	Pelagic Habitat type	Depth (m)	Comments	Source
P9	Southern Pelagic Province - Seamount Oceanic	0 – > 600	this is a compilation of the range covered by Seamount Oceanic Communities (1), (2), and (3)	ERA pelagic habitat database based on pelagic communities definitions
P10	Western Pelagic Province - Coastal	0 – 200		ERA pelagic habitat database based on pelagic communities definitions
P11	Western Pelagic Province - Oceanic	0 – > 400	this is a compilation of the range covered by Oceanic Community (1) and (2)	ERA pelagic habitat database based on pelagic communities definitions
P12	Eastern Pelagic Province - Seamount Oceanic	0 – > 600	this is a compilation of the range covered by Seamount Oceanic Communities (1) and (2)	ERA pelagic habitat database based on pelagic communities definitions
P13	Heard/McDonald Islands Pelagic Provinces - Plateau	0 -1000	this is the same as community Heard Plateau 0-1000m	ERA pelagic habitat database based on pelagic communities definitions
P14	North Eastern Pelagic Province - Coastal	0 – 200		ERA pelagic habitat database based on pelagic communities definitions
P15	North Eastern Pelagic Province - Plateau	0 – > 600	this is a compilation of the range covered by the North Eastern Seamount Oceanic (1) and (2)	ERA pelagic habitat database based on pelagic communities definitions
P16	North Eastern Pelagic Province - Seamount Oceanic	0 – > 600		ERA pelagic habitat database based on pelagic communities definitions
P17	Macquarie Island Pelagic Province - Oceanic	0 – 250		ERA pelagic habitat database based on pelagic communities definitions
P18	Macquarie Island Pelagic Province - Coastal	0 - > 1500	this is a compilation of the range covered by Oceanic Community (1) and (2)	ERA pelagic habitat database based on pelagic communities definitions

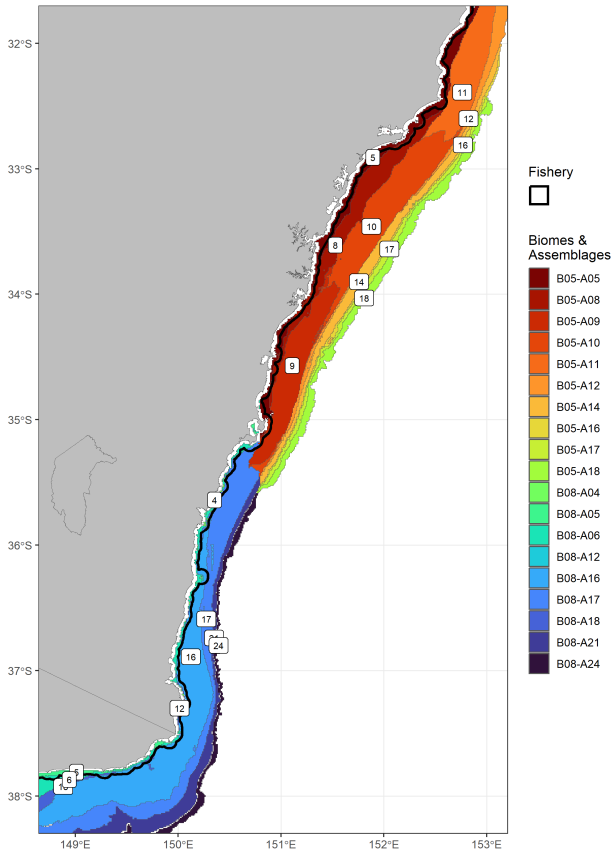


Figure 2.8: Map of the fishery region A showing the biomes and assemblages derived by Pitcher et al. (2018). Please note that the map may contain biomes and assemblage numbers that do not overlap the fishery. Biomes: 05 = East Australian shelf and slope region; 08 = Southeast Australian shelf and slope region. For detailed descriptions of the biome and assemblage numbers, please refer to Table 2.16.

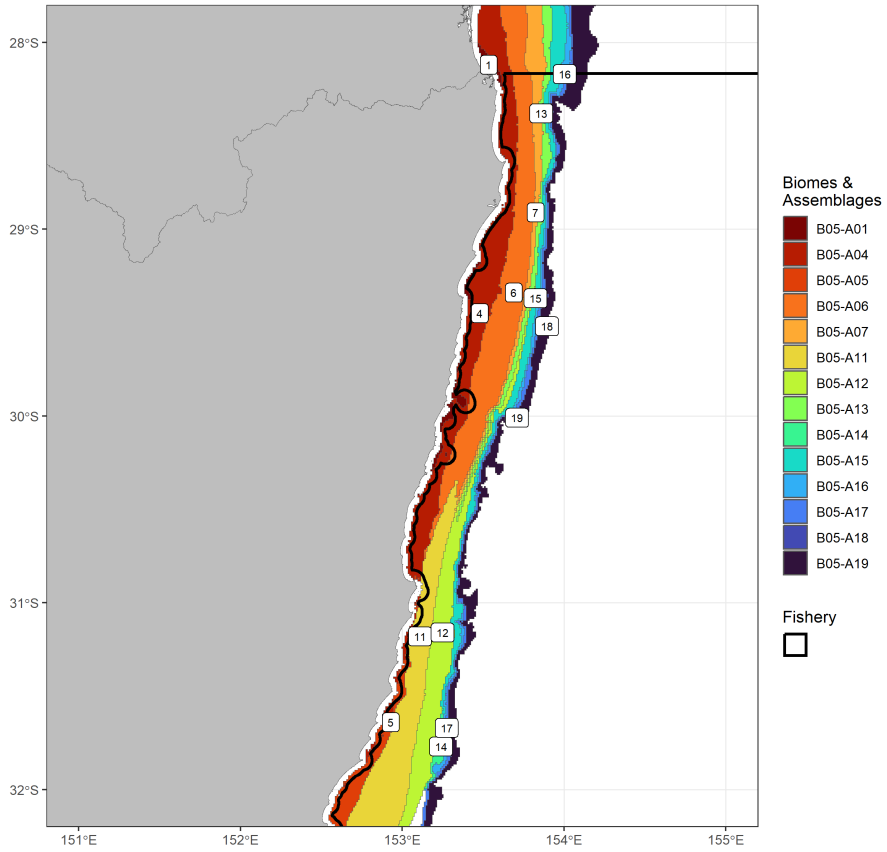


Figure 2.9: Map of the fishery region B, showing the biomes and assemblages derived by Pitcher et al. (2018). Please note that the map may contain biomes and assemblage numbers that do not overlap the fishery. Biomes: 05 = East Australian shelf and slope region. For detailed descriptions of the biome and assemblage numbers, please refer to Table 2.16.

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 based on the 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 (Interim Marine and Coastal Regionalisation for Australia Technical Group, 1998; Last et al., 2005). The spatial boundaries for the pelagic communities are based on pelagic bioregionalisation and oceanography (Condie et al., 2003; Lyne & 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 2.18: Demersal communities in which fishing activity can occur (white shading). Shaded blue cells indicate all communities present within the province. Crosses refer to communities where fishing has occurred in the Small Pelagic Fishery - Purse Seine sub-fishery.

Demersal Community	Cape Province	North Eastern Transition	North Eastern Province	Central Eastern Transition	Central Eastern Province	South Eastern Transition	Central Bass	Tasmanian Province	Western Tasmanian Transition	Southern Province	South Western Transition	Central Western Province	Central Western Transition	North Western Province	North Western Transition	Timor Province	Timor Transition	Heard/McDonald Islands	Macquarie Island
Inner Shelf 0 – 110 m[1]				X	X														
Outer Shelf 110 – 250 m																			
Upper Slope 250 – 565 m																			
Mid–Upper Slope 565 – 820 m																			
Mid Slope 820 – 1100 m																			
Lower Slope/ Abyssal > 1100 m																			
Inner Shelf Arafura 0 – 110 m																			
Inner Shelf Groote 0 – 110 m																			
Inner Shelf Cape York 0 – 110 m																			
Inner Shelf Gulf of Carpentaria 0 – 110 m																			
Cape York Shelf Reef 0 – 110 m																			
Inner Shelf Reef 0 – 110 m[7 8]																			
Slope Reef 110 – 250 m[8]																			

Table 2.18: *(continued)*

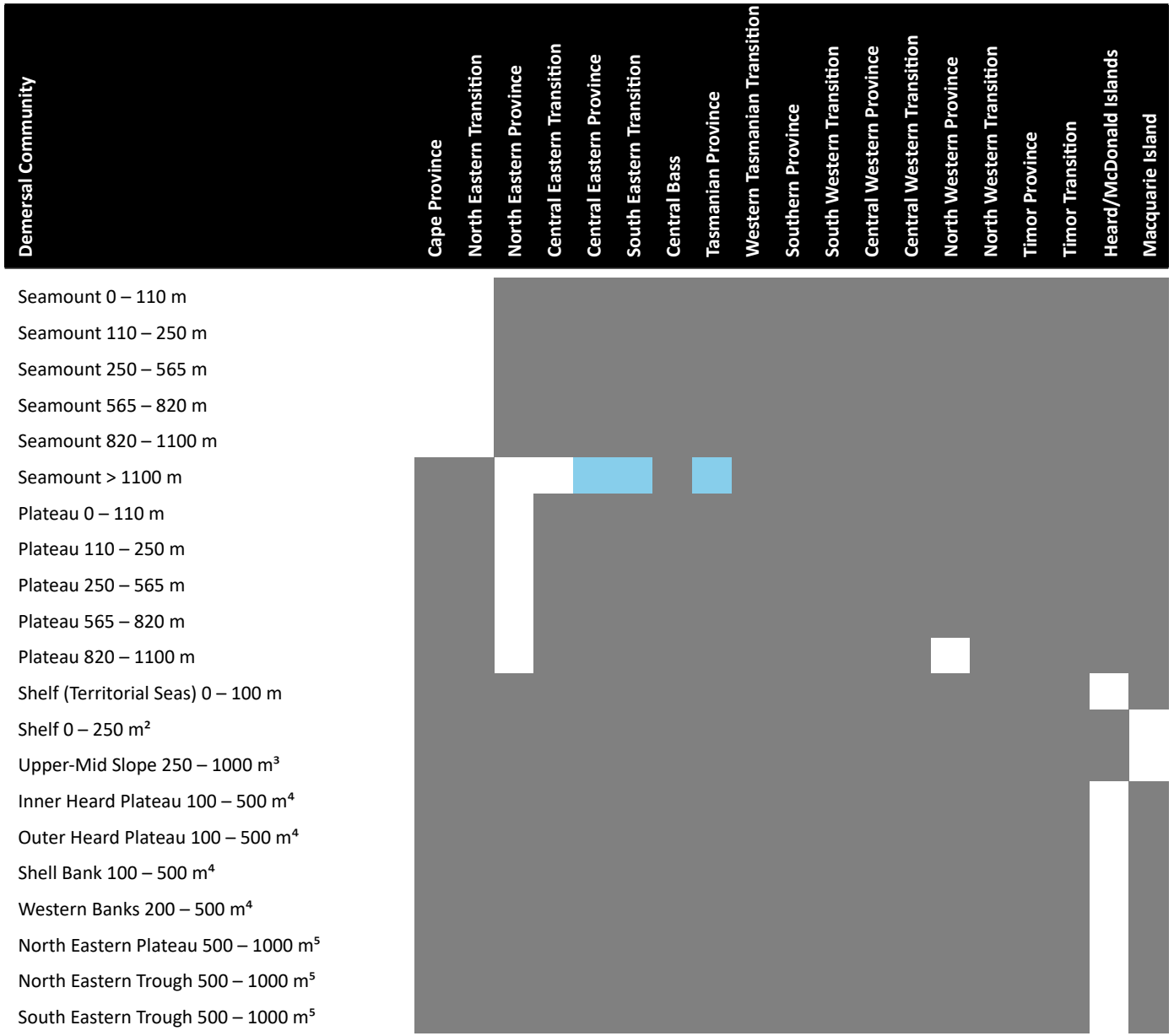


Table 2.18: ***(continued)***

Demersal Community	Cape Province	North Eastern Transition	North Eastern Province	Central Eastern Transition	Central Eastern Province	South Eastern Transition	Central Bass	Tasmanian Province	Western Tasmanian Transition	Southern Province	South Western Transition	Central Western Province	Central Western Transition	North Western Province	North Western Transition	Timor Province	Timor Transition	Heard/McDonald Islands	Macquarie Island
Western Trough 500 – 1000 m[5]	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■		■
Southern Upper Slope 500 – 1000 m[5]	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■		■
Shell Bank Deep > 1000 m[6]	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■		■
North East Lower Slope/ Abyssal > 1000 m[6]	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■		■
Southern Lower Slope/ Abyssal > 1000 m[6]	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■		

Note:

[1] Three inner shelf communities occur in the Southern (Eyre, Eucla and South West Coast).

At Macquarie Island: [2] inner & outer shelves (0-250m), and [3] upper and midslope communities combined (250-1000m).

At Heard/McDonald Islands: [4] outer and upper slope plateau communities combined to form four communities: Shell Bank, inner and outer Heard Plateau (100-500m) and Western Banks (200-500m), [5] mid and upper plateau communities combined into 3 trough, southern slope and North Eastern plateau communities (500-1000m), and [6] 2 groups at Heard Is: Deep Shell Bank (>1000m) and North East Lower slope/abyssal,

[7] Great Barrier Reef in the North Eastern Province and Transition and [8] Rowley Shoals in North Western Transition.

Table 2.19: Pelagic communities in which fishing activity occurs in the Small Pelagic Fishery - Purse Seine sub-fishery (cross; x). Shaded cells indicate all communities that exist in the province.

Pelagic Community	Northeastern	Eastern	Southern	Western	Northern	Northwestern	Heard and McDonald Is	Macquarie Is
Coastal pelagic 0-200m[1] [2]		X						
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								
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								

Note:

[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 Island: coastal pelagic zone to 250m.

[3] At Heard and McDonald Is: coastal pelagic zone broadened to cover entire plateau to maximum of 1000 m.

2.2.3 Units Excluded from Analysis

Species lists for Level 2 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.

A list of the species/species groups/taxa excluded in this fishery is provided in Table 2.20.

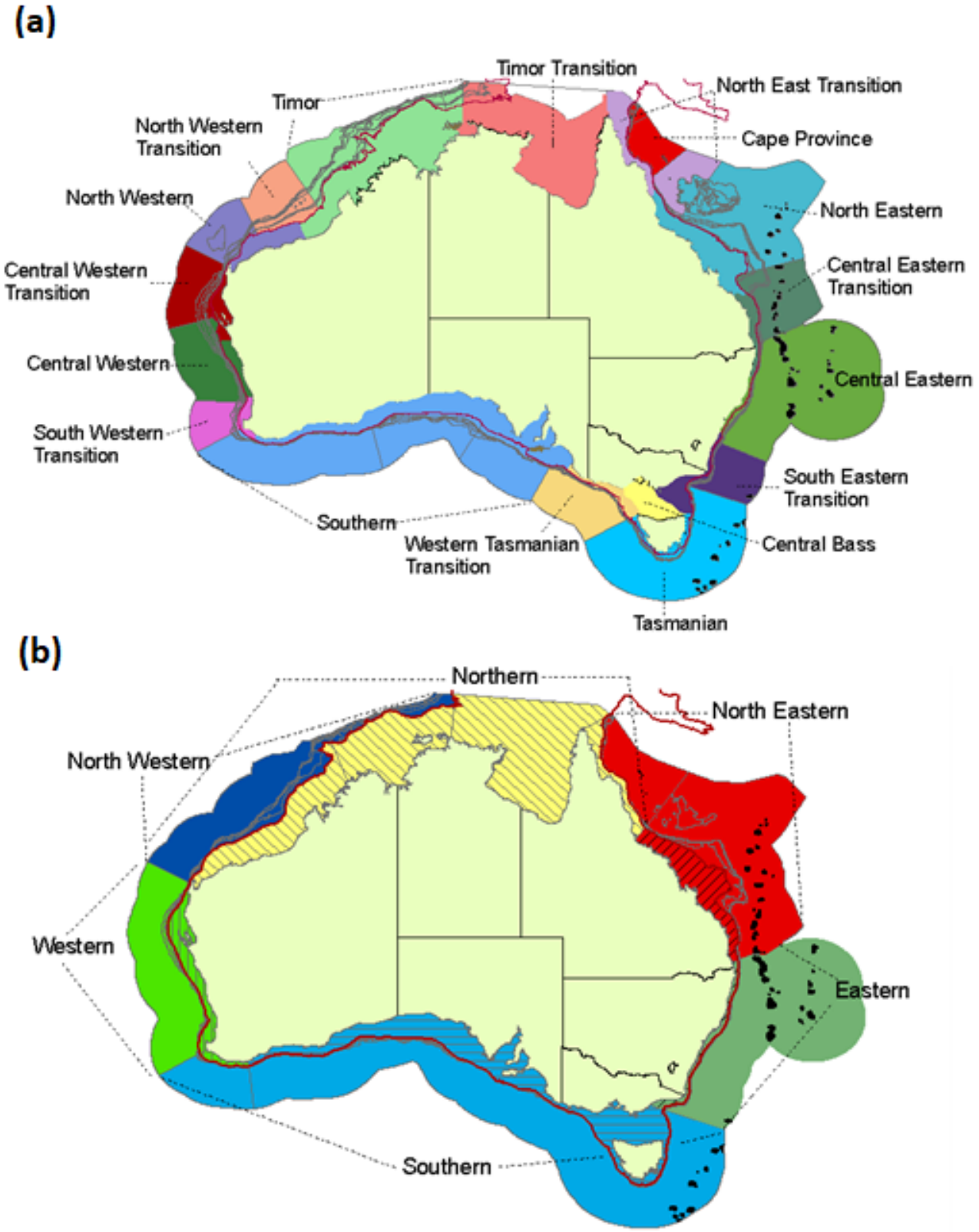


Figure 2.10: (a) Demersal communities around mainland Australia based on bioregionalisation schema. Some inshore (0-110 m) communities comprise more than one community e.g., Timor Transition comprises four distinct communities. (b) Australian pelagic provinces. Hatched areas indicate coastal epipelagic zones overlying the shelf. Offshore (oceanic) provinces comprise two or more overlaying pelagic zones as indicated in Table 2.19. Seamounts (black) and plateaux (light green) are illustrated in their demersal or pelagic provinces.

Table 2.20: Species/species groups/taxa excluded from analysis because they were either not identified at the species level, not interacted in the fishery or outside the fishery's jurisdictional boundary. No obs/ints: No observations or interactions. These entries have been excluded from the protected species list since the last ERA because they have not been observed within the fishery and/or occur outside the depth range of the fishery. OBS: refers to AFMA Observer data. LOG: refers to AFMA Logbook data.

Role in Fishery	Taxa	Family Name	CAAB Code	Scientific Name	Common Name	Rationale
BC	Asteroidea	Goniasteridae, Asteriidae, Asterinidae, Oreasteridae, Ophidiasteridae	25102000	Class Asteroidea - undifferentiated	Starfish	OBS, added 25 species to list (25122015, 25125014, 25122081, 25122021, 25122013, 25154001, 25154011, 25143005, 2514315, 25143001, 25105001, 25111017, 25122104, 25122001, 25144002, 25128001, 25140028, 25140027, 25140043, 25140029, 25140010, 25140025, 25127017, 25125037, 25125043)
BC	Crustaceans	Portunidae	28911000	Portunidae - undifferentiated	Swimming Crabs	OBS, added 20 species to list (28911001, 28911002, 28911003, 28911004, 28911005, 28911005, 28911006, 28911008, 28911010, 28911014, 28911015, 28911022, 28911024, 28911034, 28911036, 28911051, 28911063, 28911066, 28911067, 28911084)
BC	Chondrichthyan	Dasyatidae	37035000	Dasyatidae - undifferentiated	Stingrays - unspecified	OBS, added 8 species to list (37035001, 37035002, 37035004, 37035008, 37035010, 37035011, 37035022, 37035024)
BC	Teleost	Clupeidae	37085790	*Clupea harengus*	Herring	LOG, possible mis-identification: outside fishery area
BC	Teleost	Sphyraenidae	37382000	Sphyraenidae - undifferentiated	Sea Pikes	OBS, added 10 species to list (37382001, 37382002, 37382003, 37382004, 37382005, 37382006, 37382007, 37382008, 37382009, 37382011)

Table 2.20: *(continued)*

Role in Fishery	Taxa	Family Name	CAAB Code	Scientific Name	Common Name	Rationale
BC	Teleost	Pleuronectidae	37461000	Pleuronectidae - undifferentiated	Righteye Flounders - undifferentiated	OBS, added 1 species to list, 37461019
BC	Teleost	Soleidae	37462000	Soleidae - undifferentiated	Soles	OBS, 1 existing species in list, 37462010, added 16 species to list (37462001, 37462004, 37462005, 37462006, 37462007, 37462009, 37462015, 37462016, 37462017, 37462018, 37462020, 37462029, 37462031, 37462033, 37462036, 37462049)
BC	Teleost	Monacanthidae	37465903	Monacanthidae	Leatherjackets (mixed)	OBS, added 32 species to list (37465001, 37465002, 37465003, 37465005, 37465006, 37465007, 37465009, 37465012, 37465013, 37465022, 37465024, 37465025, 37465026, 37465035, 37465036, 37465038, 37465039, 37465041, 37465045, 37465049, 37465050, 37465051, 37465052, 37465053, 37465059, 37465060, 37465063, 37465065, 37465066, 37465068, 37465083, 37465085)
BC	Chondrichthyan		37990003	Sharks - other	Sharks (mixed)	LOG, OBS, insufficient taxonomic resolution, 3 existing species in list (37018001, 37018014, 37019004)

Table 2.20: ***(continued)***

Role in Fishery	Taxa	Family Name	CAAB Code	Scientific Name	Common Name	Rationale
BC	Teleost	Bothidae, Psettodidae & Pleuronectidae (all spp)	37990009	Bothidae, Psettodidae & Pleuronectidae (all spp)	Flounders (mixed all types)	OBS, Pleuronectidae already added to list under 37461000, added 25 species to list (37457001, 37460001, 37460010, 37460012, 37460013, 37460016, 37460017, 37460021, 37460028, 37460029, 37460030, 37460033, 37460034, 37460042, 37460043, 37460049, 37460050, 37460051, 37460059, 37460061, 37460066, 37460067, 37460068, 37460071)
	Benthos		99000001	Various bits of the sea floor which may be alive	Benthos	OBS, insufficient taxonomic resolution

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

Objectives are identified for each sub-fishery for the five ecological components (key/secondary commercial, bycatch/byproduct, 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:

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

For fisheries that have completed Ecological Sustainable Development (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) and/or provided by existing fisheries legislation, policies or Guidelines, those should be used (e.g., AFMA ERM Guide objective). 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**).

Key Commercial and Secondary Commercial Species

Core objectives:

- Avoid recruitment failure of the key/secondary commercial species
- Avoid negative consequences for species or population sub-components

Table 2.21: Scoping Document S3. Identification of operational objectives and rationale for C1-C2 component. Operational objectives that are eliminated are shaded out. EMO: Existing Management Objective; AMO: Existing AFMA Objective

Sub-component	Example Operational Objectives	Example indicators	Rationale
1. Population size	1.1 No trend in biomass.	Biomass, numbers, density, CPUE, yield.	1.1 Increases in biomass of the key/secondary commercial species would be acceptable.
	1.2 Maintain biomass above a specified level.		1.2. To ensure that population at acceptable level by the assessment.
	1.3 Maintain catch at specified level.		1.3. TAC levels are specified.
	1.4 Species do not approach extinction or become extinct.		1.4. This is a general objective for all AFMA fisheries as per Fisheries Management Act 1991 (objective (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).
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 the known distribution range.	2.1 Not currently monitored. No specific management objective based on the geographic range of key/secondary commercial species.

Table 2.21: *(continued)*

Sub-component	Example Operational Objectives	Example indicators	Rationale
3. Genetic structure	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 Using an integrated assessment that included genetic, morphological, otolith, growth, reproductive and fishery data, found evidence for at least four isolated stocks for the Australian Sardine (Izzo et al., 2017).
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 Covered in general by 1.2 EMO and AMO. The size range of species suggests that the fishery is not targeting recruitment or spawning grounds.
5. Reproductive Capacity	5.1 Fecundity of the population does not change outside acceptable bounds (e.g., more than X% of reference population fecundity).	Egg production of population. Abundance of recruits.	5.1 Covered by 1.2 EMO and AMO. Reproductive capacity in terms of egg production may be easier to monitor via changes in Age/size/sex structure.
	5.2 Recruitment to the population does not change outside acceptable bounds.		5.2 Covered by 1.2 EMO and AMO. May be easier to monitor via changes in Age/size/sex structure in 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 bait, lights).	6.1. Changes to behaviour that are deleterious to the species and populations are to be avoided.

Byproduct and Bycatch

Core objectives:

- Avoid recruitment failure of the byproduct and bycatch species
- Avoid negative consequences for species or population sub-components

Table 2.22: Scoping Document S3. Identification of operational objectives and rationale for BP-BC component. Operational objectives that are eliminated are shaded out. EMO: Existing Management Objective; AMO: Existing AFMA Objective

Sub-component	Example Operational Objectives	Example indicators	Rationale
1. Population size	1.1 No trend in biomass.	Biomass, numbers, density, CPUE, yield.	1.1 Increases in biomass of the byproduct and bycatch species would be acceptable.

Table 2.22: ***(continued)***

Sub-component	Example Operational Objectives	Example indicators	Rationale
	1.2 Maintain biomass above a specified level.		1.2. To ensure that population at acceptable level by the assessment. Covered by EMO and AMO that ensures the fishery does not threaten bycatch species.
	1.3 Maintain catch at specified level.		1.3. TAC levels are specified. EMO/AMO - annual reviews of all information on bycatch species with the aim of developing species specific bycatch limits.
	1.4 Species do not approach extinction or become extinct.		1.4. This is a general objective for all AFMA fisheries as per Fisheries Management Act 1991 (objective (b): mentions specifically non-target species and the long-term sustainability of the marine environment).
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 byproduct/bycatch species.
3. Genetic structure	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. No reference levels established. No specific management objective based on the genetic structure of bycatch 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 EMO – move on provisions require that if bycatch in any one haul exceeds set limits then the vessel must not use that fishing method within 5 nm of that site for at least five days.
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 Beyond the generality of the EMO "Fishing is conducted in a manner that does not threaten stocks of byproduct / bycatch species", reproductive capacity is not currently measured for bycatch/byproduct species and is largely covered by other objectives.

Table 2.22: *(continued)*

Sub-component	Example Operational Objectives	Example indicators	Rationale
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 Trawling does not appear to attract bycatch species or alter their behaviour and movement patterns, resulting in the attraction of species to fishing grounds.

Protected Species

Core objectives:

- Avoid recruitment failure of protected species
- Avoid negative consequences for protected species or population sub-components
- Avoid negative impacts on the population from fishing

Table 2.23: Scoping Document S3. Identification of operational objectives and rationale for PS component. Operational objectives that are eliminated are shaded out. EMO: Existing Management Objective; AMO: Existing AFMA Objective

Sub-component	Example Operational Objectives	Example indicators	Rationale
1. Population size	1.1 Species do not further approach extinction or become extinct.	Biomass, numbers, density.	1.1 EMO – This is a general objective for all AFMA fisheries as per Fisheries Management Act 1991 objective (1b): 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); and objective (2): ensuring, through proper conservation and management measures, that the living resources of the AFZ are not endangered by over-exploitation; Therefore the fishery is conducted in a manner that avoids mortality of, or injuries to, endangered, threatened or protected species.
	1.2 No trend in biomass.	CPUE, yield.	1.2 A positive trend in biomass is desirable for protected species.
	1.3 Maintain biomass above a specified level.		1.3 Maintenance of protected species biomass above specified levels not currently a fishery operational objective.
	1.4 Maintain catch at specified level.		1.4 The above EMO states 'must avoid mortality/injury to protected species'.
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 Southern Ocean.	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.

Table 2.23: *(continued)*

Sub-component	Example Operational Objectives	Example indicators	Rationale
3. Genetic structure	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 Because population size of protected species is often small, protected species 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 is 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 The reproductive capacity of protected species is of concern because potential fishery induced changes in reproductive ability may have immediate 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 Trawling operations may attract protected species and alter behaviour and movement patterns, resulting in the habituation of protected species to fishing vessels. The overall effect may be to prevent juveniles from learning to fend for themselves therefore increasing the animals' reliance on fishing vessels. Subsequently this could substantially increase the risk of injury/mortality by collision, entrapment or entanglement with a vessel or fishing gear.
7. Interactions with fishery	7.1 Survival after interactions is maximised. 7.2 Interactions do not affect the viability of the population or its ability to recover.	Survival rate of species after interactions. Number of interactions, biomass or numbers in population.	7.1, 7.2, EMO – The fishery is conducted in a manner that avoids mortality of, or injuries to, endangered, threatened or protected species. Includes the prohibition on discarding offal (bycatch, fish processing waste, unwanted dead fish), gear restrictions and reduced lighting levels to minimise interactions and attraction of the vessel to protected species.

Habitats

Core objectives:

- Avoid negative impacts on quality of environment
- Avoid reduction in the amount and quality of habitat

Table 2.24: Scoping Document S3. Identification of operational objectives and rationale for Habitats component. Operational objectives that are eliminated are shaded out. EMO: Existing Management Objective; AMO: Existing AFMA Objective

Sub-component	Example Operational Objectives	Example indicators	Rationale
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 control the discharge or discarding of waste (fish offal) and limit lighting on the vessels. MARPOL regulations prohibit discharge of oils, discarding of plastics.
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, trawling operations not believed to strongly influence air quality.
3. Substrate quality	3.1 Sediment quality does not change outside acceptable bounds.	Sediment chemistry, stability, particle size, debris, pollutant concentrations.	3.1 EMO – General objective for all AFMA fisheries as per Fisheries Management Act 1991 (objective 1b): 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. The fishery is conducted, in a manner that minimises the impact of fishing operations on benthic habitat.
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 Trawling activities may result in changes to the local habitat types on fishing grounds.
5. Habitat structure and function	5.1 Size, shape and condition of habitat types do not vary outside acceptable bounds.	Size structure, species composition and morphology of biotic habitats.	5.1 Trawling activities may result in local disruption to pelagic and benthic processes.

Communities

Core objectives:

- Avoid negative impacts on the composition/function/distribution/structure of the community

Table 2.25: Scoping Document S3. Identification of operational objectives and rationale for Communities component. Operational objectives that are eliminated are shaded out. EMO: Existing Management Objective; AMO: Existing AFMA Objective

Sub-component	Example Operational Objectives	Example indicators	Rationale
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 – General objective for all AFMA fisheries as per Fisheries Management Act 1991 (objective 1b): 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) 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.
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 Demersal trawling operations have unknown impacts on the benthos in the fishing grounds. The current MPA and conservation areas reserve large areas of the known habitat types from fishing disturbance.
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. Number of trophic levels.	4.1 Trawling activities for key/secondary commercial species have the potential to remove a significant component of the predator functional group. Increased abundance of the prey groups may then allow shifts in relative abundance of higher trophic level organisms.
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 Dredging operations not perceived to have a detectable effect on bio and geochemical cycles, but other activities may e.g., aquaculture.

2.2.5 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 organisms/habitat.

Scoping Document S4. Hazard Identification Scoring Sheet

This table is completed once for each sub-fishery. Table A.1 provides a set of examples of fishing activities for the effects of fishing to be used as a guide to assist in scoring the hazards.

Fishery name Small Pelagic Fishery - Purse Seine sub-fishery

Table 2.26: Hazard identification, score (i.e., presence/absence) and rationale(s) for the Small Pelagic Fishery - Purse Seine sub-fishery.

Direct impact of Fishing	Fishing Activity	Presence (1) Absence (0)	Documentation of Rationale
Capture	Bait collection	0	Not required by this fishery method.
	Fishing	1	Actual fishing, i.e., capture of small pelagic species due to deployment and retrieval of Purse Seine net as well as bycatch, byproduct and, potentially protected species and organisms caught but not landed.
	Incidental behaviour	0	Activities such as recreational fishing do not occur
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 Purse Seine net but animal able to free itself, e.g., seal/shark, escaping target species.
	Incidental behaviour	0	Activities such as recreational fishing do not occur
	Gear loss	1	Whole or parts of nets are occasionally lost. Gear retrieval depends on circumstances, however ghost fishing is not considered to be a significant issue with this gear. Potential lost items known to entangle animals includes netting, ropes, buoys, etc. - requires monitoring.
	Anchoring/ mooring	0	Does not occur

Table 2.26: ***(continued)***

Direct impact of Fishing	Fishing Activity	Presence (1) Absence (0)	Documentation of Rationale
	Navigation/ steaming	1	Navigation/steaming to fishing grounds may result in collisions (e.g., seabirds or whales vessel interactions), seabird collisions with night-time lights/navigation lights or alteration of habitat.
Addition/ movement of biological material	Translocation of species	0	No bait used and vessel travel relatively constrained and no known reports
	On board processing	0	No processing
	Discarding catch	1	Discarding occurs.
	Stock enhancement	0	None occurs
	Provisioning	0	None occurs
	Organic waste disposal	1	If uncontaminated, food waste may be discharged into the sea while the fishing vessel is in transit, if the waste is discharged subject to location-specific conditions. MARPOL regulations via Protection of the Sea (Prevention of Pollution from Ships) Act 1983 prohibits food waste if contaminated by any other garbage types.
Addition of non-biological material	Debris	0	MARPOL regulations via Protection of the Sea (Prevention of Pollution from Ships) Act 1983 prohibits rubbish generated during general fishing vessel operations to be discharged at sea. Rubbish must be collected onboard and disposed of ashore.
	Chemical pollution	0	MARPOL regulations via Protection of the Sea (Prevention of Pollution from Ships) Act 1983 prohibits domestic and operational waste discharge from vessels. Leakage of substances such as fuel, oil, bilge discharges, natural decay of antifouling agents may occur in normal course of operations.
	Exhaust	1	Vessel introduces exhaust into the environment.
	Gear loss	1	MARPOL regulations via Protection of the Sea (Prevention of Pollution from Ships) Act 1983 prohibits fishing gear to be discharged at sea. Accidental gear losses of whole nets occasionally occur and usually retrieved. Little information on minor components loss.
	Navigation/ steaming	1	Navigation to and from fishing grounds introduces noise and visual stimuli into the environment. Depth sounders/ acoustic net positioning systems have potential to disturb marine species.

Table 2.26: ***(continued)***

Direct impact of Fishing	Fishing Activity	Presence (1) Absence (0)	Documentation of Rationale
	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	Fishing may disturb seabed sediments and structure although danish seining reputed to have low impact on seafloor.
	Boat launching	0	Not applicable. Vessels in fishery come from designated ports.
	Anchoring/ mooring	0	Anchoring/mooring may affect the physical processes in the area where anchors and anchor chains contact the seafloor.
	Navigation/ steaming	1	Navigation /steaming may affect the physical processes on the benthos and the pelagic by turbulent action of propellers or wake formation.
External Hazards	Other capture fishery methods	1	Other fisheries operating in the SPF-PS fishery area: CTS otter trawl; *GHAT* fisheries: Gillnet, Scalefish Hook (demersal longline, auto-longline, dropline), and Shark Hook (demersal longline), trap; also overlapping with SBTF, ESTF, and ETBF; Southern Squid Jig fishery; Bass Strait Scallop fishery; recreational, Indigenous, and state fisheries.
	Aquaculture	1	Mollusc (Sydney rock oysters) aquaculture occurs broadly along the SE coast of the mainland. May change the water chemistry by depleting nutrients and/or attracting predators to the local regions.
	Coastal development	1	Sewage discharge, agricultural runoff, pollution from ports and coastal towns could impact shelf fisheries and may affect breeding grounds and nursery areas for some of the species in the fishery.
	Other extractive activities	1	Ongoing development and expansion of oil and gas pipelines, oil and gas exploration and extraction drilling, and seismic survey for further oil and gas exploration occurs across southern Australia (notably Bass Strait).
	Other non-extractive activities	1	Major coastal shipping activity from Sydney-Melbourne-Adelaide including defence. Submarine cables (Basslink) occur in the fishery jurisdiction.
	Other anthropogenic activities	1	Tourist activities and charter fishing occur in the fishery.

2.2.6 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:

- Assessment Reports: see Table 0.3 and references within.
- Management Plan https://www.legislation.gov.au/Details/F2014C01077
- Management Regulations: https://www.legislation.gov.au/Series/F2019L00383
- AFMA At a glance web page https://www.afma.gov.au/fisheries/small-pelagic-fishery
- Bycatch Action Plans
- Small Pelagic Fishery Dolphin Strategy 2017: https://www.afma.gov.au/sites/default/files/2023-02/Small-Pelagic-Fishery-Dolphin-Mitigation-Strategy-FINAL.pdf
- Commonwealth Harvest Strategy Policy 2018: https://www.agriculture.gov.au/sites/default/files/sitecollectiondocuments/fisheries/domestic/hsp.pdf

Other publications that provided information include:

- ABARES Fishery Status Reports: referenced in this report
- Strategic Plans

Further details and data on the fishery and on the processes and methods used for the assessment can also be found in the appendices A to C.

2.2.7 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, 12 out of 26 possible internal activities were identified as occurring in this fishery. All six external activities were identified. Thus, a total of 32 activity-component scenarios will be considered at Level 1. This results in 72 total scenarios (of 160 possible) to be developed and evaluated using the unit lists (species, habitats, communities).

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 and secondary; bycatch and byproduct; protected species; habitats; 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 (Richard Stocklosa e-systems Pty Ltd (March 2003) Review of CSIRO Risk Assessment Methodology: ecological risk assessment for the effects of fishing) 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. A 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 sub component
- 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

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/secondary commercial, bycatch and byproduct, and protected species, habitats, and communities). Only those activities that scored a 1 (presence) will be analysed at Level 1.

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 (Table 3.1). 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 3.1: 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 in Step 2 is not used directly, but the analysis is used in making judgments about the level of intensity in 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.

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 (Table 3.2). 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 3.2: Temporal scale score of activity.

Decadal	Every several years	Annual	Quarterly	Weekly	Daily
(1 day every 10 years or so)	(1 day every several years)	(1-100 days per year)	(100-200 days per year)	(200-300 days per year)	(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 4. 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 a score of 3 is appropriate.

The temporal scale score in Step 3 is not used directly, but the analysis is used in making judgements about the level of intensity in 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.

3.4 Choose the Sub-component Most Likely to be Affected by Activity (Step 4)

The most vulnerable sub-component must be used for the analysis of each identified hazard. This selection must be made based on the 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.

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 the 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 the 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.

3.6 Select the Most Appropriate Operational Objective (Step 6)

To provide a 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.

3.7 Score the Intensity of the Activity for the Component (Step 7)

The score for the intensity of an activity considers the direct impacts in line with the categories shown in the conceptual model (Figure 1.2: 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 in Table 3.3.

Table 3.3: 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.

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 defined in Table 3.4. A more detailed description of the consequences at each level for each component (key/secondary 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 Tables B.1 to B.5 in Appendix B).

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.

Table 3.4: 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)

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 (Table 3.5). 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 3.5: Description of Confidence scores for Consequences. The confidence score appropriate to the rationale is used, and documented on the SICA Document.

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

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.

SICA steps 1-10. Tables of descriptions of consequences for each component and each sub-component provide a guide for scoring the level of consequence (see Tables above).

3.10.1 Key/Secondary Commercial Species Component

Table 3.6: Level 1 (SICA) Document L1.1
Key commercial/secondary commercial species.

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 (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
Capture	Bait collection	0									
	Fishing	1	3	3		Australian Sardine (*Sardinops sagax*)		3			There are no key or secondary commercial species that are not assessed. No further action required for this activity.
	Incidental behaviour	0									
Direct impact without capture	Bait collection	0									
	Fishing	1	3	3	Population size	Australian Sardine (*Sardinops sagax*)	1.2	3	2	2	This activity is directly related to fishing effort and therefore rather localised and limited to two areas off the NSW coast, with effort between approximately 26 and 90 days per year. Purse Seine fishing is known to damage fish due to slipping methods and hence is expected to have highest potential risk for the population size sub-component. Intensity: moderate - impact of this activity on population size local but severe. Consequence: minor - impact not detectable at fishery's scale. Confidence: high - the survival rate of sardine species is known to be approximately 12% regarding standard slipping methods used in Purse Seine fishing (Marcalo et al., 2018).
	Incidental behaviour	0									

Table 3.6: *(continued)*

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 (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
	Gear loss	1	1	3	Population size	Australian Sardine (*Sardinops sagax*)	1.2	2	1	1	Whole or parts of nets are occasionally lost with gear loss possible over entire range of the sub-fishery, but more likely to occur in the area of greatest fishing effort. Gear retrieval depends on circumstances. Lost gear may result in mortality of key commercial species. Intensity: minor - lost gear considered to occasionally occur. Consequence: negligible - impact considered unlikely to be measurable at the scale of the small pelagic stocks. Confidence: low - lack of data on interactions between small pelagic species and lost Purse Seine fishing gear.
	Anchoring/ mooring	0									
	Navigation/ steaming	1	3	3	Behaviour/ movement	Australian Sardine (*Sardinops sagax*)	1.2	1	1	2	Navigation/ steaming to, from, and between fishing spots occurred around the two areas off the NSW coast where fishing effort took place. Direct impact without capture due to Navigation/ steaming was considered most likely to affect behaviour/ movement of small pelagic species. Intensity: negligible - Australian Sardine is a demersal species and will not collide with a vessel. Consequence: negligible – any impact unlikely to result in detectable change to behaviour and movement, time taken to recover to pre-disturbed state on the scale of hours. Confidence: high - 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									

Table 3.6: ***(continued)***

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 (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
	Discarding catch	1	3	3	Population size	Australian Sardine (*Sardinops sagax*)	1.2	2	2	1	This activity is directly related to fishing effort and therefore rather localised and limited to two areas off the NSW coast, with effort between approximately 26 and 90 days per year. Discarding catch was considered most likely to affect Population size of small pelagic species due to attracting predators that will prey on them. Intensity: minor - discarding occurs in restricted locations and detectability at the scale of the fishery was considered rare due to short-lived effect as opportunistic scavengers are expected to take up discards quickly. Consequence: minor - mortality rate unlikely to be detectable at the fishery scale. Confidence: low - there is no data on mortality rate of discarded key commercial species due to predators.
	Stock enhancement	0									
	Provisioning	0									
	Organic waste disposal	1	3	3	Behaviour/ movement	Australian Sardine (*Sardinops sagax*)	6.1	1	1	2	This activity is directly related to fishing effort and therefore rather localised and limited to two areas off the NSW coast, with effort between approximately 26 and 90 days per year. Disposal of organic waste is expected to pose greatest potential risk to the Behaviour/ movement of key commercial species resulting in either attraction, e.g., food scraps, or repulsion, e.g., raw sewage. Intensity: negligible - the effect of each disposal event was considered to be remotely detectable at both spatial and temporal scale. Consequence: negligible - effect on the key commercial species unlikely to be detectable. Confidence: high - general fishing waste disposal was considered unlikely to significantly affect the behaviour/ movement of the mobile key commercial species.

Table 3.6: ***(continued)***

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 (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
Addition of non-biological material	Debris	0									
	Chemical pollution	0									
	Exhaust	1	3	3	Behaviour/ movement	Australian Sardine (*Sardinops sagax*)	6.1	1	1	2	This activity is directly related to fishing effort and therefore rather localised and limited to two areas off the NSW coast, with effort between approximately 26 and 90 days per year. Exhaust emission is expected to pose the greatest potential risk for the behaviour/ movement of this species resulting in repulsion. Intensity: negligible - the effect of this activity was considered unlikely to be detectable at any spatial and temporal scale. Consequence: negligible - most exhaust fumes enters the atmosphere, or immediately below the water from engines, dissolved gases and particulates not believed to greatly affect water and hence demersal key commercial species. Confidence: high - localised exhaust unlikely to impact the behaviour/ movement of this species.
	Gear loss	1	1	3	Behaviour/ movement	Australian Sardine (*Sardinops sagax*)	6.1	2	1	2	Fishing effort is localised and limited to two areas off the NSW coast, with effort between approximately 26 and 90 days per year. Gear loss believed to occur occasionally. Lost gear not resulting in damage/ mortality most likely to affect behaviour/ movement of this species. Intensity: minor - lost gear–species interactions (if they occur) are considered to be rare. Consequence: negligible - considered unlikely to be measurable at the scale of this stock. Confidence: high - known that very little gear is lost, and interaction with species is considered unlikely.

Table 3.6: ***(continued)***

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 (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
	Navigation/ steaming	1	3	3	Behaviour/ movement	Australian Sardine (*Sardinops sagax*)	6.1	1	1	2	Navigation to and from fishing grounds and steaming between sets occurred where the rather localised fishing effort took place which was limited to two areas off the NSW coast, with effort between approximately 26 and 90 days per year. Navigation/ steaming of fishing vessels was expected to pose greatest potential risk for the Behaviour/ movement of key commercial species resulting in disruption to feeding by introducing noise to the environment. Intensity: negligible - unlikely to have a measurable impact. Consequence: negligible - the effect of noise from navigation/ steaming considered unlikely to be detectable at spatial or temporal scale. Confidence: high - it is considered unlikely to be strong interactions between this activity and small pelagic species' behaviour/ movement.
	Activity/ presence on water	1	3	3	Behaviour/ movement	Australian Sardine (*Sardinops sagax*)	6.1	1	1	2	This activity is directly related to fishing effort and therefore rather localised and limited to two areas off the NSW coast, with an effort between approximately 26 and 90 days per year. Activity/ presence of vessels on water was expected to pose greatest potential risk for the behaviour/ movement of small pelagic species resulting in disruption of feeding and/ or movement. Intensity: negligible - 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 - impacts unlikely to be detectable for small pelagic species. Confidence: high - localised vessel presence/ activity considered unlikely to impact and have consequences for the behaviour/ movement of highly mobile small pelagic species.

Table 3.6: ***(continued)***

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 (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
Disturb physical processes	Bait collection	0									
	Fishing	1	3	3	Behaviour/ movement	Australian Sardine (*Sardinops sagax*)	6.1	1	1	2	This activity is directly related to fishing effort and therefore rather localised and limited to two areas off the NSW coast, with an effort between approximately 26 and 90 days per year. Disturbance of physical processes via Purse Seine 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: negligible - fishing considered to only impact physical processes over a small < 1 nm area. Consequence: negligible - any consequence of water column disturbance unlikely to be detectable for small pelagic species. Confidence: high - localised disruption of water column unlikely to impact and have consequences for the behaviour/ movement of highly mobile pelagic species.
	Boat launching	0									
	Anchoring/ mooring	0									

Table 3.6: ***(continued)***

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 (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
	Navigation/ steaming	1	3	3	Behaviour/ movement	Australian Sardine (*Sardinops sagax*)	6.1	1	1	2	Navigation to and from fishing grounds and steaming between sets occurred where the rather localised fishing effort took place which was limited to two areas off the NSW coast, with an effort between approximately 26 and 90 days per year. Disturbance to physical processes due to Navigation/ steaming of fishing vessels was expected to pose greatest potential risk for the Behaviour/ movement of this species resulting in disruption to feeding and/ or migration. Intensity: negligible - Navigation/ steaming 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 - any impact of Navigation/ steaming unlikely to be measurable for this species. Confidence: high - Navigation/ steaming unlikely to impact and have consequences for the behaviour/ movement of this species.
External Impacts	Other fisheries	1	6	6	Population size	Australian Sardine (*Sardinops sagax*)	1.2	4	3	1	Other fisheries operating in the same waters as SPF-PS fishery and also target this species include the SPF midwater trawl fishery; and the state trawl fisheries in NSW, TAS, VIC, WA, and SA, with the latter one taking significant amounts. Intensity: major - catches of the key commercial species in the other fisheries can be severe and fishing effort occurs often and at a broad scale. Consequence: moderate - current assessment of this species is that it is under-exploited, but being a forage species, large and unpredictable fluctuations in biomass can occur, which warrants caution. Confidence: low - although catch of this species is recorded, large biomass fluctuations due to environmental factors are difficult to predict.

Table 3.6: ***(continued)***

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 (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
	Aquaculture	1	5	6	Behaviour/ movement	Australian Sardine (*Sardinops sagax*)	6.1	2	2	1	Aquaculture occurs at sites throughout the SPF-PS area in harbours, bays and estuaries (State waters) adjacent to inner shelf habitats. Particularly shellfish aquaculture is frequent on the mainland coast with impacts including accumulation of (in)organic matter and nutrient depletion, with the greatest potential risk of changing the behaviour/ movement of Australian Sardine, which is a coastal species that can often be found in inshore waters which could coincide with aquaculture sites. Intensity: minor - co-location of aquaculture sites and Australian Sardine could occur rarely. Consequence: minor - aquaculture expected to have minimal impact on behaviour/ movement of this species. Confidence: low - there is little data on the co-location of aquaculture sites and this species.
	Coastal development	1	5	6	Behaviour/ movement	Australian Sardine (*Sardinops sagax*)	6.1	3	2	1	Coastal development occurs throughout the SPF. Australian Sardine is a coastal species that can usually be found from inshore waters to the edge of the continental shelf and thus occur along the areas where coastal development exists. Coastal development poses greatest potential risk for the Behaviour/ movement of this species due to altered water/ habitat quality. Intensity: moderate - both broad coastal development and localised centres. Consequence: minor - coastal development expected to have minimal impact on Australian Sardine's behaviour/ movement. Confidence: low - there is little data available.

Table 3.6: ***(continued)***

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 (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
	Other extractive activities	1	4	6	Behaviour/ movement	Australian Sardine (*Sardinops sagax*)	6.1	3	2	1	Ongoing development and expansion of oil and gas pipelines, oil and gas exploration and extraction drilling, and seismic survey for further oil and gas exploration occurs across southern Australia (e.g., Bass Strait). Greatest potential risks are to the Behaviour/ movement of Australian Sardine resulting in disruption to feeding and/ or migration. Intensity: moderate - local effects may be severe. Consequence: minor - effect on behaviour/ movement expected to be minimal. Confidence: low as potential effects are unknown for this species.
	Other non extractive activities	1	5	6	Behaviour/ movement	Australian Sardine (*Sardinops sagax*)	6.1	3	2	1	Ongoing shipping, naval activities and ocean dumping occur throughout the SPF. Greatest potential risk of these activities are the Behaviour/ movement of Australian Sardine. Intensity: moderate - activity occurs over a broad spatial scale. Consequence: minor - detectability is considered to be unlikely also because Australian Sardine are highly mobile and a strong avoidance ability was expected. Confidence: low - little information on potential effects.
	Other anthropogenic activities	1	5	6	Behaviour/ movement	Australian Sardine (*Sardinops sagax*)	6.1	2	2	1	Tourism and recreational boating occur throughout the SPF area with the greatest potential risk to affect the Behaviour/ movement of Australian Sardine. Intensity: minor - activities may occur over a wide range but were considered to be localised and only impact a small proportion of the population at a time. Consequence: minor - restricted area effected and activity would happen rarely and be short lived. Confidence: low - limited available information.

3.10.2 Byproduct/Bycatch Species Component

Table 3.7: Level 1 (SICA) Document 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 (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
Capture	Bait collection	0									
	Fishing	1	3	3	Population size	Australian Blacktip Shark (*Carcharhinus tilstoni*)	1.2	3	2	1	Fishing effort was limited to two areas off the NSW coast, with effort between approximately 26 and 90 days per year. Population size likely to be affected before major changes in other sub-components due to damaging/ injuring of individuals. Australian Blacktip Sharks are the most likely species to be affected as they make up most of shark species caught in the SPF-PS fishery and sharks typically have low fecundity and slow growth rate. Intensity: moderate - this activity occurs locally but may be severe. Consequence: minor - it was considered to be rare that Australian Blacktip Sharks are injured (or even die) due to this activity. Confidence: low - post-capture survival rate of sharks varies greatly: Sharks entangled in the walls of the Purse Seine net can have high survival rates, particularly if they are released before being taken on board the vessel. Sharks that are brought on board after the net has been hauled (which takes up to an hour) have much lower survival rates, particularly if they have been compressed in the sack with the rest of the catch (Poisson et al., 2014; Poisson et al., 2012).
	Incidental behaviour	0									
Direct impact without capture	Bait collection	0									

Table 3.7: ***(continued)***

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 (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
	Fishing	1	3	3	Behaviour/ movement	Australian Blacktip Shark (*Carcharhinus tilstoni*)	6.1	3	2	1	Fishing effort was limited to two areas off the NSW coast, with effort between approximately 26 and 90 days per year. Behaviour/ movement likely to be affected before major changes in other sub-components as a result of fishing activity disrupting feeding behaviour. Australian Blacktip Sharks are the most likely species to be affected as they make up most of shark species caught in the SPF-PS sub-fishery and sharks typically have low fecundity and slow growth rate. Intensity: moderate - activity occurs local and is short-lived but severe. Consequence: minor - impacts would be localised and change not detectable at the scale of the fishery. Confidence: low - insufficient information on the impact of Purse Seine fishing on shark feeding behaviour with the impact likely being species related.
	Incidental behaviour	0									
	Gear loss	1	1	3	Population size	Australian Blacktip Shark (*Carcharhinus tilstoni*)	1.2	2	1	1	Whole or parts of nets are occasionally lost with retrieval depending on circumstances. Population size likely to be affected before major changes in other sub-components due to entrapment of individuals. Australian Blacktip Sharks are the most likely species to be affected as they make up the largest biomass of shark species caught in the SPF-PS and may get entangled in the net if gear loss occurred. Intensity: minor - gear loss is considered to occasionally occur and interaction of shark with gear remote. Consequence: negligible - impact considered unlikely to be measurable at the scale of this stock. Confidence: low - no quantitative data on gear loss is available.
	Anchoring/ mooring	0									

Table 3.7: *(continued)*

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 (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
	Navigation/ steaming	1	3	3	Population size	Australian Blacktip Shark (*Carcharhinus tilstoni*)	1.2	1	1	2	Fishing effort was rather localised and limited to two areas off the NSW coast, with effort between approximately 26 and 90 days per year. Navigation/ steaming to, from, and between fishing spots has the potential to cause collision with animals. Population size likely to be affected before major changes in other sub-components due to injury/ death from collision. Australian Blacktip Sharks are the most likely species to be affected as they swim at the water surface. Intensity: negligible - Australian Blacktip Sharks are highly mobile and able to move out of a vessel's path. Consequence: negligible - any impact is unlikely to be detectable. Confidence: high - expert consensus is that Australian Blacktip Sharks and vessels rarely collide.
Addition/ movement of biological material	Translocation of species	0									
	On board processing	0									

Table 3.7: ***(continued)***

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 (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
	Discarding catch	1	3	3	Behaviour/ movement	Australian Blacktip Shark (*Carcharhinus tilstoni*)	6.1	2	2	2	Discarding most likely occurred over two areas off the NSW coast, during fishing operations. Behaviour and movement likely to be affected before major changes in other sub-components if scavengers and predators (e.g., sharks) are attracted due to the addition of discards. Discarding catch is considered most likely to affect the Behaviour/ movement of Australian Blacktip Sharks, as they are in the area through the attraction of discards and they make up most of shark species caught in the SPF-PS fishery. Intensity: minor - discarding occurs in restricted locations and detectability at the scale of the fishery was considered rare due to short-lived effect as opportunistic scavengers are expected to take up discards quickly. Consequence: minor - these changes are likely to be short-lived and undetectable. Confidence: high - it is known that sharks learn to associate fishing vessels with food due to discarding (Stevens et al., 2000) and it can therefore be expected that they adjust their behaviour due to this.
	Stock enhancement	0									
	Provisioning	0									

Table 3.7: ***(continued)***

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 (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
	Organic waste disposal	1	3	3	Behaviour/ movement	Australian Blacktip Shark (*Carcharhinus tilstoni*)	6.1	1	1	2	If uncontaminated, food wastes may be discharged into the sea while the fishing vessel is in transit (MARPOL regulations). This activity was therefore related to the fishing effort which was limited to two areas off the NSW coast, with effort between approximately 26 and 90 days per year. Behaviour/ movement likely to be affected before major changes in other sub-components as a result of the attraction (e.g., food scraps) or repulsion (e.g., raw sewage) of the organic waste. Australian Blacktip Sharks are the most likely species to be affected as they make up most of shark species caught in the SPF-PS and sharks typically have low fecundity and slow growth rate. Intensity: negligible - each disposal event wouldn't have a detectable change on behaviour/ movement. Consequence: negligible - impact is unlikely to be detectable. Confidence: high - expert consensus is that general fishing waste disposal is unlikely to impact the behaviour/ movement of sharks.
Addition of non-biological material	Debris	0									
	Chemical pollution	0									

Table 3.7: ***(continued)***

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 (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
	Exhaust	1	3	3	Behaviour/ movement	Australian Blacktip Shark (*Carcharhinus tilstoni*)	6.1	1	1	2	Fishing vessels travelled to, from, and between fishing spots within the two rather localised areas off the NSW coast where effort took place between approximately 26 and 90 days per year. Exhaust emissions were possible over this scale. Behaviour/ movement likely to be affected before major changes in other sub-components due to the deterrent nature of the exhaust emissions. Australian Blacktip Sharks are the most likely species to be affected as they are closest to the water surface where pollutants will first affect. Intensity: negligible - although the hazard could occur over a large range/ scale, exhaust wouldn't have a detectable change on behaviour/ movement. Consequence: negligible - the impact of exhaust emissions is unlikely to be detectable. Confidence: high - expert consensus is that exhaust was considered unlikely to impact the behaviour/ movement of highly mobile species.
	Gear loss	1	1	3	Population size	Eastern Shovelnose Ray (*Aptychotrema rostrata*)	1.2	2	1	1	Fishing effort was rather localised and limited to two areas off the NSW coast, with effort between approximately 26 and 90 days per year. Whole or parts of nets are occasionally lost with retrieval depending on circumstances. Population size likely to be affected before major changes in other sub-components due to entrapment of individuals. Eastern Shovelnose Rays are the most likely species to be affected as they occur at the bottom and may get entangled in ghost nets due to their body shape and long snout. Also, they are endemic to Australia and, being an elasmobranch species, have a relatively low fecundity. Intensity: minor - lost gear–species interactions (if they occur) are considered to be rare. Consequence: negligible - considered unlikely to be measurable at the scale of this stock. Confidence: low - no quantitative data on gear loss is available.

Table 3.7: ***(continued)***

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 (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
	Navigation/ steaming	1	3	3	Behaviour/ movement	Australian Blacktip Shark (*Carcharhinus tilstoni*)	6.1	1	1	1	Navigation to and from fishing grounds and steaming between sets occurred where the rather localised fishing effort took place which was limited to two areas off the NSW coast, with effort between approximately 26 and 90 days per year. This activity introduces noise and visual stimuli into the environment. Behaviour and movement likely to be affected before major changes in other sub-components due to the repellent nature of the noise and visual stimuli. Australian Blacktip Sharks are the most likely species to be affected as they swim at the water surface. Intensity: negligible - sharks are highly mobile and easily move away from vessels. Consequence: negligible - any impact is unlikely to be detectable. Confidence: low - it is not known to what extent navigation/ steaming in the SPF-PS has on sharks.
	Activity/ presence on water	1	3	3	Behaviour/ movement	Australian Blacktip Shark (*Carcharhinus tilstoni*)	6.1	1	1	1	Fishing effort was rather localised and limited to two areas off the NSW coast, with effort between approximately 26 and 90 days per year and introduces noise and visual stimuli into the environment. Behaviour and movement likely to be affected before major changes in other sub-components due to the repellent nature of the noise and visual stimuli. Australian Blacktip Sharks are the most likely species to be affected as they swim at the water surface. Intensity: negligible - sharks are highly mobile and easily move away from vessels. Consequence: negligible - any impact is unlikely to be detectable. Confidence: low - it is not known to what extent noise and visual stimuli from fishing has on sharks.
Disturb physical processes	Bait collection	0									

Table 3.7: *(continued)*

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 (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
	Fishing	1	3	3	Behaviour/ movement	Australian Blacktip Shark (*Carcharhinus tilstoni*)	6.1	1	1	2	Fishing effort was rather localised and limited to two areas off the NSW coast, with effort between approximately 26 and 90 days per year, introducing direct disruption of the water column. Disturbance of physical processes via Purse Seine fishing was expected to pose greatest potential risk for the Behaviour/ movement of the Australian Blacktip Shark which mostly occur near the surface and may be feeding on the species targeted by the fishing vessels resulting in momentary disruption to feeding and/ or movement. This species are the mostly caught shark species in the fishery with a low fecundity and slow growth rate. Intensity: negligible - fishing considered to only impact physical processes over a small < 1 nm area. Consequence: negligible - any consequence of water column disturbance unlikely to be detectable for this stock. Confidence: high - localised disruption of water column unlikely to impact and have consequences for the behaviour/ movement of highly mobile pelagic species.
	Boat launching	0									
	Anchoring/ mooring	0									

Table 3.7: ***(continued)***

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 (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
	Navigation/ steaming	1	3	3	Behaviour/ movement	Australian Blacktip Shark (*Carcharhinus tilstoni*)	6.1	1	1	1	Navigation to and from fishing grounds and steaming between sets occurred where the rather localised fishing effort took place which was limited to two areas off the NSW coast, with effort between approximately 26 and 90 days per year. This activity creates turbulent action from the propellers. Behaviour and movement likely to be affected before major changes in other sub-components due to the repellent nature of this turbulence. Australian Blacktip Sharks are the most likely species to be affected as they swim at the water surface where most turbulence would occur. Intensity: negligible - sharks are highly mobile and easily move away from turbulence around vessels. Consequence: negligible - any impact is unlikely to be detectable. Confidence: low - it not known to what extent turbulence due to navigation/ steaming in the SPF-PS has on sharks.
External Impacts	Other fisheries	1	6	6	Population size	Australian Blacktip Shark (*Carcharhinus tilstoni*)	1.2	4	3	2	Fishing occurs throughout the year by several other fisheries in the SPF-PS managed region. Population size likely to be affected before major changes in other sub-components due to removal of individuals. Australian Blacktip Sharks (most commonly caught shark in the SPF-PS) are the most likely species to be affected as they would also be potentially caught in trawl, gillnet, and long-line fisheries. Intensity: major - other Australian Government and state fisheries occur often and at a broad spatial scale. Consequence: moderate - this has a measurable impact on the stock. Confidence: high - data recorded on bycatch of sharks.

Table 3.7: ***(continued)***

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 (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
	Aquaculture	1	5	6	Behaviour/ movement	Australian Blacktip Shark (*Carcharhinus tilstoni*)	6.1	2	2	1	Aquaculture occurs at sites throughout the SPF-PS area in harbours, bays and estuaries (State waters) adjacent to inner shelf habitats. Particularly shellfish aquaculture is frequent on the mainland coast with impacts including accumulation of (in)organic matter and nutrient depletion, with the greatest potential risk of affecting the Behaviour and movement before major changes in other sub-components due to affecting movement and relocation of prey. Australian Blacktip Sharks (most commonly caught shark in the SPF-PS) are the most likely species to be affected as they would adjust their behaviour and movement to that of their prey. Intensity: minor - detectability on stock scale was considered rare. Consequence: minor - aquaculture expected to have minimal impact on behaviour/ movement of this species. Confidence: low - there is little data on how this activity would affect shark behaviour/ movement.
	Coastal development	1	5	6	Behaviour/ movement	Australian Blacktip Shark (*Carcharhinus tilstoni*)	6.1	3	2	1	Coastal development occurs throughout the SPF-PS area. Most likely to affect behaviour/ movement before major changes in other sub-components due to the altered water/ habitat quality in coastal waters. Australian Blacktip Shark are the most likely species to be affected due to affecting movement and relocation of prey and are the mostly caught shark species in the fishery. Intensity: moderate -both broad coastal development and localised centres. Consequence: minor - coastal development expected to have minimal impact on the species' behaviour/ movement. Confidence: low - insufficient information on the impact of this activity on the behaviour of sharks.

Table 3.7: ***(continued)***

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 (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
	Other extractive activities	1	4	6	Behaviour/ movement	Australian Blacktip Shark (*Carcharhinus tilstoni*)	6.1	3	2	1	Ongoing development and expansion of oil and gas pipelines, oil and gas exploration and extraction drilling, and seismic survey for further oil and gas exploration occurs across southern Australia (e.g., Bass Strait). Greatest potential risks are to the Behaviour/ movement resulting in momentary disruption to feeding and/ or movement. Australian Blacktip Sharks are the most likely species to be affected as they swim at the surface where noise exposure is highest and are the mostly caught shark species in the fishery. Intensity: moderate - local effects are potentially severe. Consequence: minor - effect on population dynamics expected to be minimal. Confidence: low - effects of this activity on shark behaviour is unknown.
	Other non extractive activities	1	5	6	Behaviour/ movement	Australian Blacktip Shark (*Carcharhinus tilstoni*)	6.1	3	1	1	Ongoing shipping, naval activities and ocean dumping occurs throughout the year throughout the SPF-PS. Behaviour and movement likely to be affected before major changes in other subcomponents due to an avoidance reaction. Australian Blacktip Sharks are the most likely species to be affected as they swim on the surface. Intensity: moderate - these activities occur throughout the SPF-PS. Consequence: negligible - any impact is unlikely to be detectable. Confidence: low - the effects of these activities on shark behaviour/ movement in the SPF-PS are unknown.

Table 3.7: ***(continued)***

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 (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
	Other anthropogenic activities	1	5	6	Behaviour/ movement	Australian Blacktip Shark (*Carcharhinus tilstoni*)	6.1	2	2	1	Tourism and recreational boating occur throughout the SPF-PS area with the greatest potential risk to affect the Behaviour/ movement resulting in momentary disruption to feeding and/ or movement. This species is considered the most likely species to be affected as they are the mostly caught shark species in the fishery and can be disturbed by the visual and noise stimuli due to this activity. Intensity: minor - These effects are considered to be localized and only impact a small proportion of the population. Intensity: minor - activities may occur over a wide range but were considered to be localised and the detectability of their impact considered to be rare. Consequence: minor - minimal impact of this activity on the behaviour/ movement at stock level. Confidence: low - it is unknown how these activities may impact (long-term) shark behaviour.

3.10.3 Protected Species Component

A level 1 assessment for the protected species component is not required, as there are currently no protected species recorded in this fishery.

3.10.4 Habitats Component

Table 3.8: Level 1 (SICA) Document L1.4 - Habitats 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 (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
Capture	Bait collection	0									
	Fishing	1	3	3	Habitat structure and function	Eastern Pelagic Province - Coastal (0 - 200 m)	5.1	3	1	1	Most fishing activity occurred along the edge of the continental shelf over two restricted areas between 2017-2021 and approximately 26-90 days a year. Purse Seine fishing for small pelagic species is mainly likely to affect pelagic habitat structure and function transiently as the net passes through the water. Intensity: moderate - impact severe but local. Consequence: negligible - water column expected to resume state rapidly. Confidence: low - insufficient knowledge of pelagic habitat processes.
	Incidental behaviour	0									
Direct impact without capture	Bait collection	0									
	Fishing	1	3	3	Habitat structure and function	Eastern Pelagic Province - Coastal (0 - 200 m)	5.1	3	1	1	Most fishing activity occurred along the edge of the continental shelf over two restricted areas between 2017-2021 and approximately 26-90 days a year. Purse seine fishing for small pelagic species is mainly likely to affect pelagic habitat structure and function transiently as the net passes through the water. Intensity: moderate - severe but local. Consequence: negligible -water column expected to resume state rapidly. Confidence: low - insufficient knowledge of pelagic habitat processes.

Table 3.8: ***(continued)***

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 (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
	Incidental behaviour	0									
	Gear loss	1	1	3	Habitat structure and function	East Australian shelf and slope region (Assemblage 4)	5.1	2	1	1	Most fishing activity occurred along the edge of the continental shelf over two restricted areas between 2017-21 and approximately 26-90 days a year. Whole or parts of nets are occasionally lost in the area of greatest fishing effort. Gear retrieval depends on circumstances. The greatest potential risk of lost gear is affecting the habitat structure and function of the East Australian shelf and slope region due to potential impact on tall erect fauna on either hard or soft habitats. If lost gear is irretrievable in deeper waters, it may impact benthos and it may eventually become habitat. Intensity: minor - considered a rare event. Consequence: negligible - habitat modification likely to be undetectable. Confidence: low - no quantitative data on gear loss is available.
	Anchoring/ mooring	0									
	Navigation/ steaming	1	3	3	Habitat structure and function	Eastern Pelagic Province - Coastal (0 - 200 m)	5.1	1	1	2	Navigation to and from fishing grounds and steaming between sets occurred where the rather localised fishing effort took place which was limited to two areas off the NSW coast, with an effort between approximately 26 and 90 days per year. The pelagic water quality of the Eastern Coastal Pelagic habitat may change with increased turbulence and changes in water mixing that could occur from movement of vessels through water. Intensity: negligible - remote likelihood of detection at any spatial or temporal scale. Consequence: negligible - impact unlikely to be detectable against natural variation at the scale of the habitat. Confidence: high - logical consideration.

Table 3.8: ***(continued)***

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 (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
Addition/ movement of biological material	Translocation of species	0									
	On board processing	0									
	Discarding catch	1	3	3	Substrate quality	East Australian shelf and slope region (Assemblage 4)	3.1	2	2	2	Discarding byproduct species known to occur related to the rather localised fishing effort which was limited to two areas off the NSW coast, with an effort between approximately 26 and 90 days per year. Most discards will be opportunistically taken up by the increased relative abundance of predators attracted by this process (e.g., sharks and other scavengers). Some discards may reach the benthos, where they could be expected to be taken up rapidly by demersal species, depending on volume. Substrate quality on the shelf and slope region most likely to be impacted because discarding of catch may result in accumulation of carcasses, leading to altered sediment chemistry in and above substrate and bioturbators and filter feeders smothered. Intensity: minor - discarding occurs in restricted locations and detectability at the scale of the fishery was considered rare due to short-lived effect as opportunistic scavengers are expected to take up discards quickly. Consequence: minor - only short-lived changes in benthos structure and expected to have only minimal impact on substrate quality. Confidence: high - operators generally discard waste over the course of fishing operations leading to no localised accumulations of waste.
	Stock enhancement	0									
	Provisioning	0									

Table 3.8: ***(continued)***

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 (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
	Organic waste disposal	1	3	3	Water quality	Eastern Pelagic Province - Coastal (0 - 200 m)	1.1	1	1	2	If uncontaminated, food wastes may be discharged into the sea while the fishing vessel is in transit (MARPOL regulations). This activity was therefore related to the fishing effort which was limited to two areas off the NSW coast, with an effort between approximately 26 and 90 days per year. Water quality of pelagic habitats is considered to experience greatest impact of organic waste disposal. Intensity: negligible - due to the overall volume, a disposal event wouldn't be detectable at a temporal or spatial scale. Consequence: negligible - volume of disposal considered to be too small to have a detectable effect on the water quality at the scale of the fishery. Confidence: high - localised short term increases in nutrient not expected to adversely affect water column.
Addition of non-biological material	Debris	0									
	Chemical pollution	0									

Table 3.8: ***(continued)***

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 (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
	Exhaust	1	3	3	Air quality	Eastern Pelagic Province - Coastal (0 - 200 m)	2.1	1	1	2	Fishing vessels travelled to, from, and between fishing spots within the two rather localised areas off the NSW coast where effort took place between approximately 26 and 90 days per year. Exhaust emissions were possible over this scale. Exhaust from running engines may impact the air quality of the species within Eastern Coastal Pelagic habitat (e.g., marine birds). Intensity: negligible - although the hazard may occur throughout fishery area, impact area is only within metres of the vessel and therefore remote likelihood of detection at any spatial or temporal scale. Consequence: negligible - rapid dispersal of pollutants in winds and therefore impact unlikely to be detectable at the scale of the habitat. Confidence: high - effect of exhaust was considered to be very localised and logical consideration.
	Gear loss	1	1	3	Habitat structure and function	East Australian shelf and slope region (Assemblage 4)	5.1	2	1	1	Whole or parts of nets are occasionally lost with gear loss possible over entire range of the sub fishery, but more likely to occur in the area of greatest fishing effort. Gear retrieval depends on circumstances. Lost gear may change habitat structure of the shelf and slope region by balling up or snag on higher relief reefs, potentially smothering and damaging habitat in the vicinity and eventually becoming habitat and creating new structure. Intensity: minor -gear loss is considered rare and therefore its effect undetectable at any temporal or spatial scale. Consequence: negligible - the impact of lost gear unlikely to be detectable at the scale of the habitat. Confidence: low - no quantitative data on gear loss is available.

Table 3.8: ***(continued)***

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 (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
	Navigation/ steaming	1	3	3	Water quality	Eastern Pelagic Province - Coastal (0 - 200 m)	1.1	1	1	2	Navigation to and from fishing grounds and steaming between sets occurred where the rather localised fishing effort took place which was limited to two areas off the NSW coast, with an effort between approximately 26 and 90 days per year. This activity may result in disruption of water quality by introducing noise, light, and changes to water chemistry or turbidity or of pollutants or chemicals (unlikely). Intensity: negligible -changes to the pelagic air and water quality of the Eastern Coastal Pelagic habitat are likely to be undetectable over any temporal and spatial scale due to rapid dispersal of presence in air and water. Consequence: negligible - it was considered unlikely that there would be detectable impacts against natural variation at habitat scale. Confidence: high - logical consideration.
	Activity/ presence on water	1	3	3	Water quality	Eastern Pelagic Province - Coastal (0 - 200 m)	1.1	1	1	2	Vessel activity/ presence on the water occurred around and at the locations where fishing effort took place which was limited to two areas off the NSW coast, with an effort between approximately 26 and 90 days per year. Vessel activity/ presence introduces noise and visual stimuli into the environment. Activity/ presence on water of Purse Seine fishing vessels was expected to pose greatest potential risk for the water quality of the Eastern Coastal Pelagic habitat. Intensity: negligible - remote likelihood of impact on the pelagic environment at any spatial or temporal scale. Consequence: negligible - it was considered unlikely that there would be detectable impacts at habitat scale. Confidence: high - logical consideration.
Disturb physical processes	Bait collection	0									

Table 3.8: ***(continued)***

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 (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
	Fishing	1	3	3	Habitat structure and function; Water quality	Eastern Pelagic Province - Coastal (0 - 200 m)	5.1; 1.1	1	1	2	Fishing effort was rather localised and limited to two areas off the NSW coast, with an effort between approximately 26 and 90 days per year. Purse Seine fishing for small pelagic species is mainly likely to affect pelagic habitat structure and function transiently as the net passes through the water and causes turbulence in the water column. 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. Intensity: negligible - remote likelihood of detection at any spatial or temporal scale. Consequence: negligible - impact by this activity on habitat structure and function and water quality is unlikely to be detectable at the scale of the pelagic habitat against natural variation. Confidence: high - logical consideration.
	Boat launching	0									
	Anchoring/ mooring	0									

Table 3.8: ***(continued)***

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 (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
	Navigation/ steaming	1	3	3	Habitat structure and function; Water quality	Eastern Pelagic Province - Coastal (0 - 200 m)	5.1; 1.1	1	1	2	Navigation to and from fishing grounds and steaming between sets occurred where the rather localised fishing effort took place which was limited to two areas off the NSW coast, with an effort between approximately 26 and 90 days per year. Disturbance of physical processes will occur during the normal course of steaming. 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. Intensity: negligible - remote likelihood of detection at any spatial or temporal scale. Consequence: negligible - impact by this activity on habitat structure and function and water quality is unlikely to be detectable at the scale of the pelagic habitat against natural variation. Confidence: high - logical consideration.

Table 3.8: ***(continued)***

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 (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
External Impacts	Other fisheries	1	6	6	Habitat structure and function	East Australian shelf and slope region (Assemblage 4)	5.1	4	3	1	Other fisheries operating over the same grounds as the SPF-PS include, CTS otter trawl; GHAT fisheries: Gillnet, Scalefish Hook (demersal longline, auto-longline, dropline), and Shark Hook (demersal longline), trap; also overlapping with SBTF, ESTF, and ETBF; Southern Squid Jig fishery; and Bass Strait Scallop fishery. Fishing activity of these fisheries occurs daily and over a large area. Cumulative effects on habitat structure and function are a concern for all habitats, but particularly those at depths of >100m which may be trawled or netted. Sediment-based habitats supporting large sponges are likely to be most subject to effort. Intensity: major - occurrence of accumulative fishing activity and therefore impact on habitat structure and function occur often, at a broad scale, and can be severe. Consequence: moderate - although impact of some fishing methods can have a severe local impact on habitat, majority of gears have small seafloor footprint and thus a sustainable level of impact at broader scale. Confidence: low - little data is available on the accumulative impact of fisheries on the habitat structure and function at habitat scale.

Table 3.8: ***(continued)***

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 (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
	Aquaculture	1	5	6	Habitat structure and function; Water quality	East Australian shelf and slope region (Assemblage 4)	5.1; 1.1	2	2	1	Aquaculture occurs at sites throughout the SPF-PS area in harbours, bays and estuaries (State waters) adjacent to inner shelf habitats. Particularly shellfish aquaculture is frequent on the mainland coast with impacts including accumulation of (in)organic matter and nutrient depletion, with the greatest potential risk of changing, respectively, the habitat structure and function and water quality of the East Australian shelf and slope region habitat. Intensity: minor - local effects quickly dispersed and unlikely to be detected against natural variability at any temporal or spatial scale. Consequence: minor - impacts have likely only minimal impact on water quality at habitat scale. Confidence: low - actual impacts of shellfish aquaculture on environment remain uncertain and can range from negligible to significant (Crawford, 2001).
	Coastal development	1	5	6	Water quality; Substrate quality	East Australian shelf and slope region (Assemblage 4)	1.1; 3.1	3	2	1	Coastal development occurs throughout the coastal range of the SPF-PS fishery. Frequent, local impacts at small-moderate spatial scales are likely to have most impact on the water and substrate quality of the inshore shelf and slope region. Intensity: moderate - effects at broader spatial scale, or severe but localized such as removal or degradation of inshore habitats, particularly nursery habitats. Consequence: minor - greatest impacts likely to be inshore including waters less than 25m (not within fishery boundary) but detection further out onto the inner shelf unknown. Confidence: low - little data on the cumulative effects of this activity at habitat scale.

Table 3.8: ***(continued)***

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 (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
	Other extractive activities	1	4	6	Habitat structure and function	Eastern Pelagic Province - Coastal (0 - 200 m)	5.1	3	2	1	Ongoing development and expansion of oil and gas pipelines, oil and gas exploration and extraction drilling, and seismic survey for further oil and gas exploration occurs across the SPF-PS fishery area. This activity will most likely affect the habitat structure and function due to introducing noise into the environment regarding development of new infrastructure and existing infrastructure. Intensity: moderate - local effects can be severe. Consequence: minor - minimal impact at habitat scale. Confidence: low - little information exists on effects of pipelines etc. on surrounding habitats although modelling suggests very contracted impact area.
	Other non extractive activities	1	5	6	Habitat structure and function	Eastern Pelagic Province - Coastal (0 - 200 m)	5.1	3	2	1	Major shipping activity occurs throughout the SPF-PS fishery area on a daily basis. This activity most likely affects the structure and function of the pelagic habitat by introducing noise and turbulence due to vessel activity at the water. Intensity: moderate - east coast shipping occurs over large spatial scale with the immediate effects being severe but local. Consequence: minor - area of impact confined to immediate area of vessels and therefore unlikely to detect impact at habitat scale. Confidence: low - little information exists on the accumulative effects of shipping at habitat scale.
	Other anthropogenic activities	1	5	6	Habitat structure and function	Eastern Pelagic Province - Coastal (0 - 200 m)	5.1	2	2	1	Tourism and recreational boating occur throughout the SPF-PS area and most likely affects the structure and function of the pelagic habitat due to introducing noise and visual stimuli through whale-watching, fishing tours, anchoring, recreational diving etc. Intensity: minor - impact of these activities on habitat occur in restricted locations and detectability at these scales is unlikely. Consequence: minor - considered to have a minimal impact on the structure and function of the pelagic habitat. Confidence: low - limited information.

3.10.5 Communities Component

Table 3.9: Level 1 (SICA) Document L1.5 - Communities 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 (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
Capture	Bait collection	0									
	Fishing	1	3	3	Functional group composition	Eastern Coastal Pelagic 0 - 200 m	2.1	3	2	1	Fishing effort occurred along the edge of the continental shelf over two restricted areas between 2017-2021 and approximately 26-90 days a year. Purse Seine fishing for small pelagic species most likely to effect Functional Group Composition, i.e., removal of the small pelagic functional group from the Eastern Coastal Pelagic community. Intensity: moderate - impact potentially severe at local scales but moderate at broader spatial scale. Consequence: minor - fishing has minimal impact on community structure or dynamics. Confidence: low - insufficient knowledge of the role of small pelagics in the Eastern Coastal Pelagic community.
	Incidental behaviour	0									
Direct impact without capture	Bait collection	0									

Table 3.9: *(continued)*

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 (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
	Fishing	1	3	3	Functional group composition	Eastern Coastal Pelagic 0 - 200 m	2.1	3	1	1	Fishing effort occurred along the edge of the continental shelf over two restricted areas between 2017-2021 and approximately 26-90 days a year. Purse Seine fishing (not resulting in capture) most likely to effect functional group composition due to damage or mortality to the small pelagic functional group of the Eastern Coastal Pelagic community. Intensity: moderate - impact local but severe. Consequence: negligible - the impact of damage or mortality to non-caught small pelagic species is unlikely to be detectable at scale of the community. Confidence: low - insufficient knowledge on effects of Purse Seine net on non-captured individuals in terms of functional group composition.
	Incidental behaviour	0									
	Gear loss	1	1	3	Species composition	Central Eastern Transition Inner Shelf 0 - 110 m	1.1	2	1	1	Fishing effort occurred along the edge of the continental shelf over two restricted areas between 2017-21 and approximately 26-90 days a year. Gear loss possible over the range of area of effort on the Central Eastern Transition Inner Shelf. Species composition likely to be affected before major changes in other sub-components. Benthic species most likely to be affected due to entanglement, smothering or habitat alteration. Intensity: minor - gear loss is considered rare. Consequence: negligible - effect on community due to gear loss is immeasurable. Confidence: low - insufficient knowledge on impact of lost gear on species composition.
	Anchoring/ mooring	0									

Table 3.9: *(continued)*

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 (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
	Navigation/ steaming	1	3	3	Distribution of the community	Eastern Coastal Pelagic 0 - 200 m	3.1	1	1	2	Navigation to and from fishing grounds and steaming between sets occurred where the fishing effort took place which was limited to two areas off the NSW coast, with an effort between approximately 26 and 90 days per year. Eastern Coastal Pelagic communities most likely affected due to occurrence of fishing effort. Navigation and steaming introduces noise and visual stimuli into the environment posing greatest potential risk for the distribution of community by potentially altering distribution of community members. Intensity: negligible - detection of impact unlikely. Consequence: negligible - unlikely to detect any measurable effect on communities. Confidence: high - logical consideration.
Addition/ movement of biological material	Translocation of species	0									
	On board processing	0									

Table 3.9: ***(continued)***

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 (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
	Discarding catch	1	3	3	Distribution of the community	Eastern Coastal Pelagic 0 - 200 m	3.1	2	2	1	Discarding byproduct species known to occur related to the fishing effort which was limited to two areas off the NSW coast, with an effort between approximately 26 and 90 days per year. Discarding catch most likely to affect distribution of community by attracting scavengers. Eastern Coastal Pelagic communities most likely affected due to occurrence of fishing effort. Intensity: minor - discarding occurs in restricted locations and detectability at the scale of the fishery was considered rare due to short-lived effect as opportunistic scavengers are expected to take up discards quickly. Consequence: minor - localized accumulations of waste rapidly dispersed so species are unlikely to become habituated to using discards as a food source as they are opportunistic. Confidence: low - insufficient knowledge available.
	Stock enhancement	0									
	Provisioning	0									
	Organic waste disposal	1	3	3	Distribution of the community	Eastern Coastal Pelagic 0 - 200 m	3.1	1	1	2	If uncontaminated, food wastes may be discharged into the sea while the fishing vessel is in transit (MARPOL regulations). This activity was therefore related to the fishing effort which was limited to two areas off the NSW coast, with an effort between approximately 26 and 90 days per year. Organic waste disposal most likely to attract scavengers in the Eastern Coastal Pelagic community, affecting the distribution of community temporarily. Intensity: negligible - due to the overall volume, a disposal event wouldn't be detectable at a temporal or spatial scale. Consequence: negligible - effect unlikely to be measurable at community scale. Confidence: high - logical consideration.

Table 3.9: ***(continued)***

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 (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
Addition of non-biological material	Debris	0									
	Chemical pollution	0									
	Exhaust	1	3	3	Distribution of the community	Eastern Coastal Pelagic 0 - 200 m	3.1	1	1	2	Fishing vessels travelled to, from, and between fishing spots within the two rather localised areas off the NSW coast where effort took place between approximately 26 and 90 days per year. Exhaust emissions were possible over this scale. Exhaust emissions most likely to affect distributions of communities by affecting distribution of birds in the Eastern Coastal Pelagic community in the vicinity of vessels. Intensity: negligible - although the hazard may occur throughout fishery area, impact area is only within metres of the vessel and therefore remote likelihood of detection at any spatial or temporal scale. Consequence: negligible - exhaust is rapidly dissipated and the impact on birds unlikely to be detectable at community scale. Confidence: high - logical consideration.
	Gear loss	1	1	3	Distribution of the community	Central Eastern Transition Inner Shelf 0 - 110 m	3.1	2	1	1	Fishing effort occurred along on the edge of the continental shelf over two restricted areas between 2017-21 and approximately 26-90 days a year. Gear loss possible over the range of area of effort. Lost gear most likely to affect distribution of the Central Eastern Transition Inner Shelf community by altering habitat and dependent species. Intensity: minor - lost gear is considered rare. Consequence: negligible - the impact is unlikely to be detectable. Confidence: low - insufficient knowledge on effect of lost gear on distribution of the community.

Table 3.9: ***(continued)***

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 (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
	Navigation/ steaming	1	3	3	Distribution of the community	Eastern Coastal Pelagic 0 - 200 m	3.1	1	1	2	Navigation to and from fishing grounds and steaming between sets occurred where the rather localised fishing effort took place which was limited to two areas off the NSW coast, with an effort between approximately 26 and 90 days per year. Navigation and steaming introduces noise and visual stimuli into the environment posing greatest potential risk for the distribution of community by disturbing fish in the Eastern Coastal Pelagic community. Intensity: negligible - detection of impact unlikely at any spatial or temporal scale. Consequence: negligible - unlikely to detect any measurable effect on communities. Confidence: high - logical consideration.
	Activity/ presence on water	1	3	3	Distribution of the community	Eastern Coastal Pelagic 0 - 200 m	3.1	1	1	2	Vessel activity/ presence on the water occurred around and at the locations where fishing effort took place which was limited to two areas off the NSW coast, with an effort between approximately 26 and 90 days per year. Vessel activity/ presence introduces noise and visual stimuli into the environment. Activity/ presence on water of Purse Seine fishing vessels was expected to pose greatest potential risk for the distribution of the Easter Coastal Pelagic community by affecting the behaviour of sensitive species (e.g., marine mammals and sharks). Intensity: negligible - remote likelihood of detectable impact on the pelagic environment at any spatial or temporal scale. Consequence: negligible - any change to community distribution would be undetectable against background variation, except for short duration of fishing operation. Confidence: high - logical consideration.
Disturb physical processes	Bait collection	0									

Table 3.9: ***(continued)***

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 (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
	Fishing	1	3	3	Distribution of the community	Eastern Coastal Pelagic 0 - 200 m	3.1	1	1	2	Fishing effort was limited to two areas off the NSW coast, with an effort between approximately 26 and 90 days per year, introducing direct disruption of the water column by dragging the Purse Seine net through the water causing turbulence. Such disturbance of physical processes via Purse Seine fishing was expected to pose greatest potential risk for the Distribution of the Eastern Coastal Pelagic community with species moving outside the area of turbulence caused by the net. Intensity: negligible - fishing considered to only impact physical processes over a small < 1 nm area. Consequence: negligible - any consequence of water column disturbance unlikely to be detectable for pelagic communities. Confidence: high - localised disruption of water column unlikely to impact and have consequences for the distribution of highly mobile pelagic communities.
	Boat launching	0									
	Anchoring/ mooring	0									

Table 3.9: *(continued)*

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 (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
	Navigation/ steaming	1	3	3	Species composition	Eastern Coastal Pelagic 0 - 200 m	1.1	1	1	2	Navigation to and from fishing grounds and steaming between sets occurred where the fishing effort took place which was limited to two areas off the NSW coast, with an effort between approximately 26 and 90 days per year, with vessel propellors introducing direct disruption of the water column and causing turbulence and water movement. Such disturbance of physical processes was expected to pose the greatest potential risk for the species composition of the Eastern Coastal Pelagic community as some species may not survive in these environments. Intensity: negligible - remote likelihood of detection of impact at any spatial or temporal scale. Consequence: negligible - impact by this activity unlikely to be detectable at community scale against natural variation. Confidence : high - logical consideration.
External Impacts	Other fisheries	1	6	6	Trophic/ size structure	Central Eastern Transition Inner Shelf 0 - 110 m	4.1	4	3	1	Other fisheries operating over the same grounds as the SPF-PS include, CTS otter trawl; GHAT fisheries: Gillnet, Scalefish Hook (demersal longline, auto-longline, dropline), and Shark Hook (demersal longline), trap; also overlapping with SBTF, ESTF, and ETBF; Southern Squid Jig fishery; and Bass Strait Scallop fishery. Fishing activity of these fisheries occurs daily and over a large area. Other fisheries likely to affect wide range of species and the overall exploitation levels would affect the trophic and size structure of the Central Eastern Transition Inner Shelf demersal communities by targeting specific functional groups within the same demersal communities. Intensity: major - fishing effort by other fisheries occurs often and at a broad spatial scale. Consequence: moderate - the cumulative impact of fishing on the communities would be measurable yet sustainable. Confidence: low - insufficient knowledge of cumulative impact of fisheries on trophic dynamics.

Table 3.9: ***(continued)***

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 (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
	Aquaculture	1	5	6	Distribution of the community	Central Eastern Transition Inner Shelf 0 - 110 m	3.1	2	2	1	Aquaculture occurs at sites throughout the SPF-PS area in harbours, bays and estuaries (State waters) adjacent to inner shelf habitats. Particularly shellfish aquaculture is frequent on the mainland coast with impacts including accumulation of (in)organic matter and nutrient depletion which both would change the habitat quality which again would most likely affect distribution of the Central Eastern Transition Inner Shelf community. Intensity: minor - local effects unlikely to be detected against natural variability at these scales. Consequence: minor - impacts likely minimal at community scale. Confidence: low - actual impacts of shellfish aquaculture on environment can range from negligible to significant (Crawford, 2001).
	Coastal development	1	5	6	Distribution of the community	Central Eastern Transition Inner Shelf 0 - 110 m	3.1	3	2	1	Coastal development occurs across the range of the SPF-PS fishery affecting species' habitat in inshore waters with the greatest potential risk of affecting the distribution of the Central Eastern Transition Inner Shelf community due to dense human population, and therefore highest level of coastal development, in this area. Intensity: moderate - effects at broader spatial scale, or severe but localized such as removal or degradation of inshore habitats, particularly nursery habitats. Consequence: minor - greatest impacts likely to be inshore including waters less than 25m with minimal impact at community level. Confidence: low - insufficient knowledge of community level effects by coastal development.

Table 3.9: ***(continued)***

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 (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
	Other extractive activities	1	4	6	Distribution of the community	Eastern Coastal Pelagic 0 - 200 m	3.1	3	2	1	Ongoing development and expansion of oil and gas pipelines, oil and gas exploration and extraction drilling, and seismic survey for further oil and gas exploration occurs across the SPF-PS fishery area (notably Bass Strait). Greatest potential risk is the effect of anthropogenic noise on the distribution of the Eastern Coastal Pelagic community as this may cause mobile species to migrate away from such exposure. Intensity: moderate - local effects may be severe. Consequence: minor - considered minimal impact on community. Confidence: low - insufficient knowledge of impact by anthropogenic noise on communities.
	Other non extractive activities	1	5	6	Distribution of the community	Eastern Coastal Pelagic 0 - 200 m	3.1	3	2	1	Major shipping activity occurs throughout SPF-PS fishery area on a daily basis with the greatest potential risk of affecting the distribution of the Eastern Coastal Pelagic communities through disturbance particularly on marine mammals. Intensity: moderate - local effects can be severe. Consequence: minor - minimal impact on community level. Confidence: low - although there exists information on impact of shipping on some marine mammal species, impacts on community level remain poorly understood.

	Other anthropogenic activities	1	5	6	Distribution of the community	Eastern Coastal Pelagic 0 - 200 m	3.1	2	2	1	Tourism and recreational boating occur throughout the SPF-PS area with the greatest potential risk to affect the distribution of the Eastern Coastal Pelagic communities due to disturbance of species through whale watching, fishing tours, anchoring, recreational diving, etc. Intensity: minor - impact of these activities on communities occur in restricted locations and detectability at these scales is unlikely. Consequence: minor - tourism and recreational boating considered to have a minimal impact on pelagic communities. Confidence: low - although there exists information on the effect of tourism and recreational boating on some marine mammals, there exist insufficient information on the impact of this activity at community level.

3.11 Summary of SICA Results

A summary table (**Level 1 (SICA) Document L1.6**) of consequence scores for all activity/component combinations and a table showing those that scored 3 or above for consequence (shaded), and differentiating those that did so with high confidence (in bold) is outlined in Table 3.10.

Table 3.10: Level 1 (SICA) Document L1.6.
Summary table of consequence scores for all activity/component c ombinations. Internal activities that scored 3 or more are coloured light blue and bold if high confidence. * existing stock assessment for all species within component. - assessment not required. n.a: component not assessed. Note: external hazards are not considered at Level 2.

Impact	Activity	Key/ secondary commer-cial species	Bycatch/ byproduct species	Protected species	Habitat	Communities
Capture	Bait collection	0	0	n.a	0	0
	Fishing	*	2	n.a	1	2
	Incidental behaviour	0	0	n.a	0	0
Direct impact without capture	Bait collection	0	0	n.a	0	0
	Fishing	**2**	2	n.a	1	1
	Incidental behaviour	0	0	n.a	0	0
	Gear loss	1	1	n.a	1	1
	Anchoring/ mooring	0	0	n.a	0	0
	Navigation/ steaming	**1**	**1**	n.a	**1**	**1**
Addition/ movement of biological material	Translocation of species	0	0	n.a	0	0
	On board processing	0	0	n.a	0	0
	Discarding catch	2	**2**	n.a	**2**	2
	Stock enhancement	0	0	n.a	0	0
	Provisioning	0	0	n.a	0	0
	Organic waste disposal	**1**	**1**	n.a	**1**	**1**
Addition of non-biological material	Debris	0	0	n.a	0	0
	Chemical pollution	0	0	n.a	0	0
	Exhaust	**1**	**1**	n.a	**1**	**1**
	Gear loss	**1**	1	n.a	1	1
	Navigation/ steaming	**1**	1	n.a	**1**	**1**
	Activity/ presence on water	**1**	1	n.a	**1**	**1**
Disturb physical processes	Bait collection	0	0	n.a	0	0
	Fishing	**1**	**1**	n.a	**1**	**1**
	Boat launching	0	0	n.a	0	0
	Anchoring/ mooring	0	0	n.a	0	0
	Navigation/ steaming	**1**	1	n.a	**1**	**1**
External Impacts	Other fisheries	3	**3**	n.a	3	3
	Aquaculture	2	2	n.a	2	2
	Coastal development	2	2	n.a	2	2
	Other extractive activities	2	2	n.a	2	2
	Other non extractive activities	2	1	n.a	2	2
	Other anthropogenic activities	2	2	n.a	2	2

Figure 3.1 to Figure 3.4 show the frequency distribution of consequence scores for all components that were assessed.

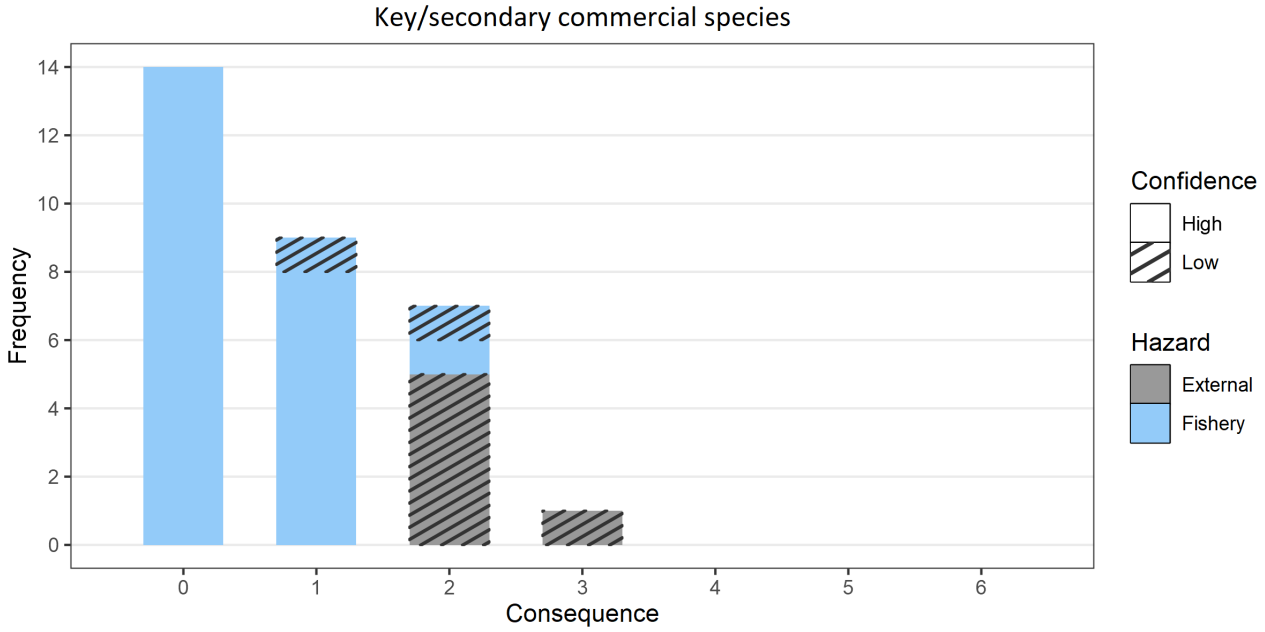


Figure 3.1: Key/secondary commercial species component: Frequency of consequence score by high and low confidence.

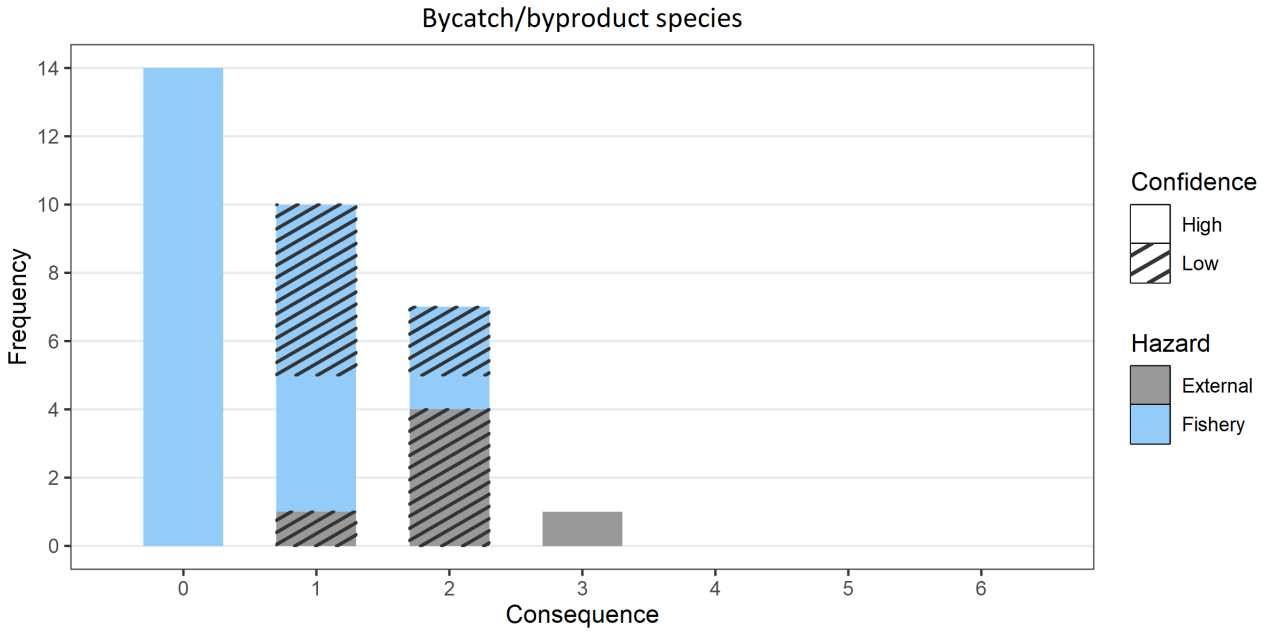


Figure 3.2: Bycatch/byproduct species component: Frequency of consequence score by high and low confidence.

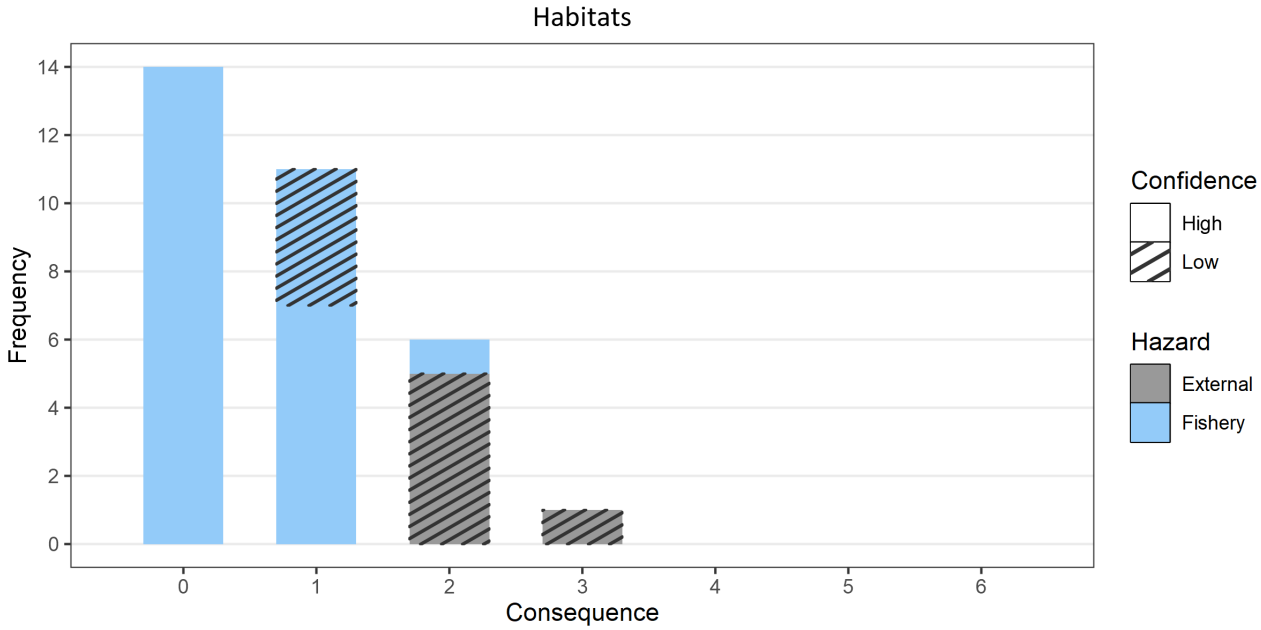


Figure 3.3: Habitats component: Frequency of consequence score by high and low confidence.

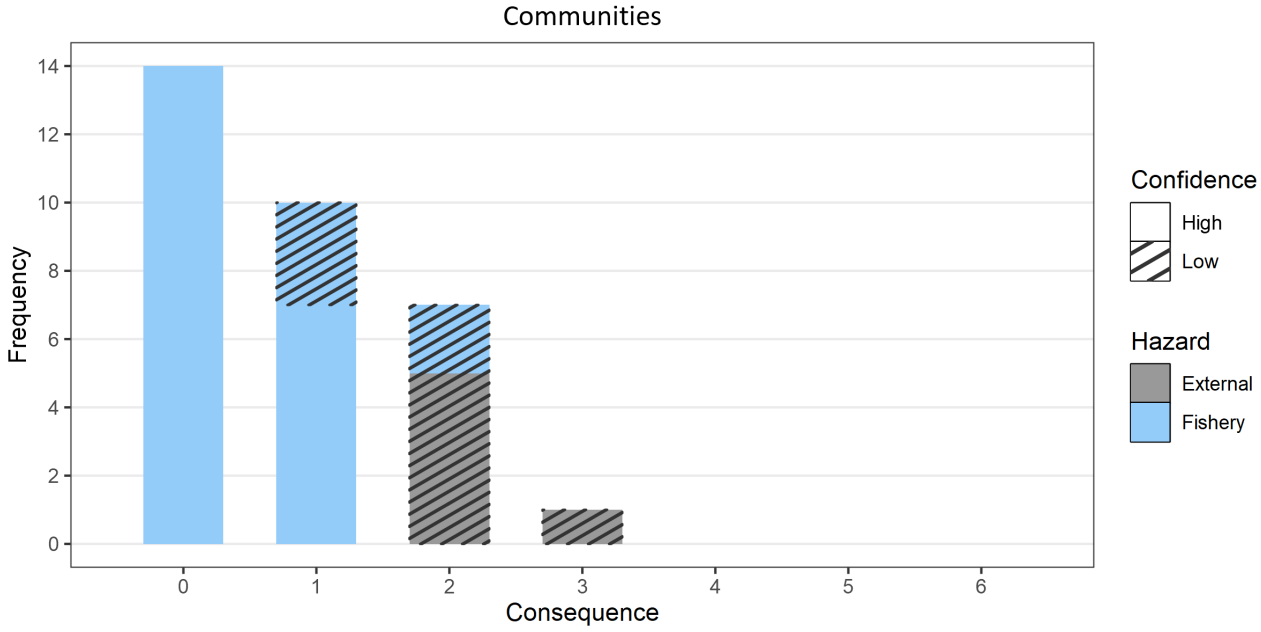


Figure 3.4: Communities component: Frequency of consequence score by high and low confidence.

3.12 Evaluation/Discussion of Level 1

All internal hazards (fishing activities) were eliminated at Level 1 (risk scores 1 or 2; Table 3.10); Figure 3.1-Figure 3.4).

Hazards assessed as moderately affected by external impacts consisted of other fisheries in the region also capturing the same key commercial or byproduct/bycatch species. The habitats and communities ecological components were also assessed to be moderately impacted by other fisheries. All remaining external hazards were assessed at low risk (i.e., risk score = 1 or 2) across each of the ecological components.

The external hazard, coastal development assessed as low risk (risk score = 2) to key commercial and byproduct species, habitats and communities due to localised pollution and sediment run-off from coastal developments. Sediments can increase turbidity and the reduction in light penetration can negatively affect nursery habitats that depend on them. Confidence is low because the impacts of coastal development are still poorly understood and there is a lack of data on water quality issues and recovery times of species and habitats and communities.

There have been new management arrangements developed and implemented in the SPF since the last ERAEF assessment was conducted for this sub-fishery (e.g., Bycatch Action Plans to reduce protected species interactions; spatial closures to protect species; reduction in fishing effort; electronic logbooks). In addition, there have been changes in (i) ERAEF methodology (ii) ERAEF species classification and (iii) availability of new information.

No level 1 SICA for protected species was conducted, as none were recorded to have interacted with Purse Seine gear over this assessment period. This contrasts the previous (2006) assessment which used all protected species that occur in the fishery area. The previous assessment identified 29 high risk species following a Level 2 and residual risk analysis comprising dolphins, whales and seals. However, it was noted that they can freely move in and out of the net as it is top-opening. While there have been no recorded protected species interactions with Purse Seine gear over this assessment period, an increase in Observer coverage and/or e-monitoring may help confirm this and therefore the likely presence of potential false negatives.

3.13 Components to be Examined at Level 2

As a result of the preliminary SICA analysis, the components that are to be examined at Level 2 are those with any consequence scores of 3 or above. All four ecological components were eliminated at Level 1. Therefore, no Level 2 assessment for these ecological components is required.

4 General Discussion and Research Implications

4.1 Level 1

All internal hazards (fishing activities) were eliminated at Level 1 (risk scores 1 or 2; Table 3.10); Figure 3.1-Figure 3.4).

Hazards assessed as moderately affected from external impacts consisted of other fisheries in the region also capturing the same key commercial or byproduct/bycatch species. The habitats and communities ecological components were also assessed to be moderately impacted by other fisheries. All remaining external hazards were assessed as low risk (i.e., risk score = 1 or 2) across each of the ecological components.

The external hazard, coastal development assessed as low risk (risk score = 2) to key commercial and byproduct species, habitats and communities due to localised pollution and sediment run-off from coastal developments. Sediments can increase turbidity and the reduction in light penetration can negatively affect nursery habitats that depend on them. Confidence is low because impacts of coastal development are still poorly understood and there is a lack of data on water quality issues and recovery times of species and habitats and communities.

There have been new management arrangements developed and implemented in the SPF since the last ERAEF assessment was conducted for this sub-fishery (e.g., Bycatch Action Plans to reduce protected species interactions; spatial closures to protect species; reduction in fishing effort; electronic logbooks). In addition, there have been changes in (i) ERAEF methodology (ii) ERAEF species classification and (iii) availability of new information.

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4.2 Level 2

4.2.1 Habitats at Risk

No Level 2 assessment was required for habitats since it was eliminated at Level 1.

4.2.2 Community Assemblages at Risk

No Level 2 assessment was required for communities since it was eliminated at Level 1.

4.3 Key Uncertainties/Recommendations for Research and Monitoring

It is recommended that (i) harvested fishes are recorded at the lowest possible taxonomic level, e.g., species and (ii) and confirmation of protected species interactions.

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Glossary of Terms

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., target 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 and references within).
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).
Fishing mortality

- F_{MSM}: Maximum sustainable fishing mortality.
- F_{Lim}: Limit fishing mortality which is half of the maximum sustainable fishing mortality.
- F_{Crash}: minimum unsustainable fishing mortality rate that may lead to population extinction in the longer term.

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.
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 target 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.
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”.

A APPENDIX Examples of Fishing Activities

Table A.1: 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 use 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.

Table A.1: *(continued)*

Direct impact of Fishing	Fishing Activity	Examples of activities include
	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	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 target 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 target 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	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.

Table A.1: *(continued)*

Direct impact of Fishing	Fishing Activity	Examples of activities include
	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.

Table A.1: *(continued)*

Direct impact of Fishing	Fishing Activity	Examples of activities include
	Other extractive activities	Oil and gas pipelines, drilling, seismic activity.
	Other non-extractive activities	Defense, 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.

B APPENDIX Level 1 Description of Consequences for Each Component

Table B.1: Key/secondary commercial species. Description of consequences for each component and each sub-component. Use table as a guide for scoring the level of consequence for target species (Modified from Fletcher et al., 2002).

Sub-component	Score/level 1 (Negligible)	Score/level 2 (Minor)	Score/level 3 (Moderate)	Score/level 4 (Major)	Score/level 5 (Severe)	Score/level 6 (Intolerable)
Population size	Insignificant change to population size/growth rate (r). Unlikely to be detectable against background variability for this population.	Possible detectable change in size/growth rate (r) but minimal impact on population size and none on dynamics.	Full exploitation rate but long-term recruitment dynamics not adversely damaged.	Affecting recruitment state of stocks and/or their capacity to increase	Likely to cause local extinctions if continued in longer term.	Local extinctions are imminent/immediate.
Geographic range	No detectable change in geographic range. Unlikely to be detectable against background variability for this population.	Possible detectable change in geographic range but minimal impact on population range and none on dynamics, change in geographic range up to 5% of original.	Change in geographic range up to 10% of original.	Change in geographic range up to 25% of original.	Change in geographic range up to 50% of original.	Change in geographic range > 50% of original.
Genetic structure	No detectable change in genetic structure. Unlikely to be detectable against background variability for this population.	Possible detectable change in genetic structure. Any change in frequency of genotypes, effective population size or number of spawning units up to 5%.	Change in frequency of genotypes, effective population size or number of spawning units up to 10%.	Change in frequency of genotypes, effective population size or number of spawning units up to 25%.	Change in frequency of genotypes, effective population size or number of spawning units, change up to 50%.	Change in frequency of genotypes, effective population size or number of spawning units > 50%.
Age/size/sex structure	No detectable change in age/size/sex structure. Unlikely to be detectable against background variability for this population.	Possible detectable change in age/size/sex structure but minimal impact on population dynamics.	Impact on population dynamics at maximum sustainable level, long-term recruitment dynamics not adversely affected.	Long-term recruitment dynamics adversely affected. Time to recover to original structure up to five generations free from impact.	Long-term recruitment dynamics adversely affected. Time to recover to original structure up to 10 generations free from impact.	Long-term recruitment dynamics adversely affected. Time to recover to original structure > 100 generations free from impact.

Table B.1: *(continued)*

Sub-component	Score/level 1 (Negligible)	Score/level 2 (Minor)	Score/level 3 (Moderate)	Score/level 4 (Major)	Score/level 5 (Severe)	Score/level 6 (Intolerable)
Reproductive capacity	No detectable change in reproductive capacity. Unlikely to be detectable against background variability for this population.	Possible detectable change in reproductive capacity but minimal impact on population dynamics.	Impact on population dynamics at maximum sustainable level, long-term recruitment dynamics not adversely affected.	Change in reproductive capacity adversely affecting long-term recruitment dynamics. Time to recovery up to five generations free from impact.	Change in reproductive capacity adversely affecting long-term recruitment dynamics. Time to recovery up to 10 generations free from impact.	Change in reproductive capacity adversely affecting long-term recruitment dynamics. Time to recovery > 100 generations free from impact.
Behaviour/movement	No detectable change in behaviour/movement. Unlikely to be detectable against background variability for this population. Time taken to recover to pre-disturbed state on the scale of hours.	Possible detectable change in behaviour/movement but minimal impact on population dynamics. Time to return to original behaviour/movement on the scale of days to weeks.	Detectable change in behaviour/movement with the potential for some impact on population dynamics. Time to return to original behaviour/movement on the scale of weeks to months.	Change in behaviour/movement with impacts on population dynamics. Time to return to original behaviour/movement on the scale of months to years.	Change in behaviour/ movement with impacts on population dynamics. Time to return to original behaviour/movement on the scale of years to decades.	Change to behaviour/ movement. Population does not return to original behaviour/movement.

Table B.2: Bycatch species. Description of consequences for each component and each sub-component. Use table as a guide for scoring the level of consequence for by-catch/byproduct species (Modified from Fletcher et al., 2002).

Sub-component	Score/level 1 (Negligible)	Score/level 2 (Minor)	Score/level 3 (Moderate)	Score/level 4 (Major)	Score/level 5 (Severe)	Score/level 6 (Intolerable)
Population size	Insignificant change to population size/growth rate (r). Unlikely to be detectable against background variability for this population.	Possible detectable change in size/growth rate (r) but minimal impact on population size and none on dynamics.	No information is available on the relative area or susceptibility to capture/ impact or on the vulnerability of life history traits of this type of species Susceptibility to capture is suspected to be less than 50% and species do not have vulnerable life history traits. For species with vulnerable life history traits to stay in this category susceptibility to capture must be less than 25%.	Relative state of capture/susceptibility suspected/known to be greater than 50% and species should be examined explicitly.	Likely to cause local extinctions if continued in longer term.	Local extinctions are imminent/immediate.
Geographic range	No detectable change in geographic range. Unlikely to be detectable against background variability for this population.	Possible detectable change in geographic range but minimal impact on population range and none on dynamics, change in geographic range up to 5% of original.	Change in geographic range up to 10% of original.	Change in geographic range up to 25% of original.	Change in geographic range up to 50% of original.	Change in geographic range > 50% of original.

Table B.2: *(continued)*

Sub-component	Score/level 1 (Negligible)	Score/level 2 (Minor)	Score/level 3 (Moderate)	Score/level 4 (Major)	Score/level 5 (Severe)	Score/level 6 (Intolerable)
Genetic structure	No detectable change in genetic structure. Unlikely to be detectable against background variability for this population.	Possible detectable change in genetic structure. Any change in frequency of genotypes, effective population size or number of spawning units up to 5%.	Detectable change in genetic structure. Change in frequency of genotypes, effective population size or number of spawning units up to 10%.	Change in frequency of genotypes, effective population size or number of spawning units up to 25%.	Change in frequency of genotypes, effective population size or number of spawning units up to 50%.	Change in frequency of genotypes, effective population size or number of spawning units > 50%.
Age/size/sex structure	No detectable change in age/size/sex structure. Unlikely to be detectable against background variability for this population.	Possible detectable change in age/size/sex structure but minimal impact on population dynamics.	Detectable change in age/size/sex structure. Impact on population dynamics at maximum sustainable level, long-term recruitment dynamics not adversely damaged.	Long-term recruitment dynamics adversely affected. Time to recover to original structure up to five generations free from impact.	Long-term recruitment dynamics adversely affected. Time to recover to original structure up to 10 generations free from impact.	Long-term recruitment dynamics adversely affected. Time to recover to original structure > 100 generations free from impact.
Reproductive capacity	No detectable change in reproductive capacity. Unlikely to be detectable against background variability for this population.	Possible detectable change in reproductive capacity but minimal impact on population dynamics.	Detectable change in reproductive capacity, impact on population dynamics at maximum sustainable level, long-term recruitment dynamics not adversely damaged.	Change in reproductive capacity adversely affecting long-term recruitment dynamics. Time to recovery up to five generations free from impact.	Change in reproductive capacity adversely affecting long-term recruitment dynamics. Time to recovery up to 10 generations free from impact.	Change in reproductive capacity adversely affecting long-term recruitment dynamics. Time to recovery > 100 generations free from impact.

Table B.2: *(continued)*

Sub-component	Score/level 1 (Negligible)	Score/level 2 (Minor)	Score/level 3 (Moderate)	Score/level 4 (Major)	Score/level 5 (Severe)	Score/level 6 (Intolerable)
Behaviour/movement	No detectable change in behaviour/movement. Unlikely to be detectable against background variability for this population. Time taken to recover to pre-disturbed state on the scale of hours.	Possible detectable change in behaviour/movement but minimal impact on population dynamics. Time to return to original behaviour/movement on the scale of days to weeks.	Detectable change in behaviour/movement with the potential for some impact on population dynamics. Time to return to original behaviour/movement on the scale of weeks to months.	Change in behaviour/movement with impacts on population dynamics. Time to return to original behaviour/movement on the scale of months to years	Change in behaviour/movement with impacts on population dynamics. Time to return to original behaviour/movement on the scale of years to decades.	Change to behaviour/ movement. Population does not return to original behaviour/movement.

Table B.3: Protected species. Description of consequences for each component and each sub-component. Use table as a guide for scoring the level of consequence for protected species (Modified from Fletcher et al., 2002).

Sub-component	Score/level 1 (Negligible)	Score/level 2 (Minor)	Score/level 3 (Moderate)	Score/level 4 (Major)	Score/level 5 (Severe)	Score/level 6 (Intolerable)
Population size	Almost none are killed.	Insignificant change to population size/growth rate (r). Unlikely to be detectable against background variability for this population.	State of reduction on the rate of increase are at the maximum acceptable level. Possible detectable change in size/ growth rate (r) but minimal impact on population size and none on dynamics of protected species.	Affecting recruitment state of stocks or their capacity to increase.	Local extinctions are imminent/immediate.	Global extinctions are imminent/immediate.
Geographic range	No interactions leading to impact on geographic range.	No detectable change in geographic range. Unlikely to be detectable against background variability for this population.	Possible detectable change in geographic range but minimal impact on population range and none on dynamics. Change in geographic range up to 5% of original.	Change in geographic range up to 10% of original.	Change in geographic range up to 25% of original.	Change in geographic range up to 25% of original.
Genetic structure	No interactions leading to impact on genetic structure.	No detectable change in genetic structure. Unlikely to be detectable against background variability for this population.	Possible detectable change in genetic structure but minimal impact at population level. Any change in frequency of genotypes, effective population size or number of spawning units up to 5%.	Moderate change in genetic structure. Change in frequency of genotypes, effective population size or number of spawning units up to 10%.	Change in frequency of genotypes, effective population size or number of spawning units up to 25%.	Change in frequency of genotypes, effective population size or number of spawning units up to 25%.

Table B.3: *(continued)*

Sub-component	Score/level 1 (Negligible)	Score/level 2 (Minor)	Score/level 3 (Moderate)	Score/level 4 (Major)	Score/level 5 (Severe)	Score/level 6 (Intolerable)
Age/size/sex structure	No interactions leading to change in age/size/sex structure.	No detectable change in age/size/sex structure. Unlikely to be detectable against background variability for this population.	Possible detectable change in age/size/sex structure but minimal impact on population dynamics.	Detectable change in age/size/sex structure. Impact on population dynamics at maximum sustainable level, long-term recruitment dynamics not adversely damaged.	Severe change in age/size/sex structure. Impact adversely affecting population dynamics. Time to recover to original structure up to five generations free from impact.	Impact adversely affecting population dynamics. Time to recover to original structure > 10 generations free from impact.
Reproductive capacity	No interactions resulting in change to reproductive capacity.	No detectable change in reproductive capacity. Unlikely to be detectable against background variability for this population.	Possible detectable change in reproductive capacity but minimal impact on population dynamics.	Detectable change in reproductive capacity, impact on population dynamics at maximum sustainable level, long-term recruitment dynamics not adversely damaged.	Change in reproductive capacity, impact adversely affecting recruitment dynamics. Time to recover to original structure up to five generations free from impact.	Change in reproductive capacity, impact adversely affecting recruitment dynamics. Time to recover to original structure > 10 generations free from impact
Behaviour/movement	No interactions resulting in change to behaviour/ movement.	No detectable change in behaviour/movement. Time to return to original behaviour/movement on the scale of hours.	Possible detectable change in behaviour/movement but minimal impact on population dynamics. Time to return to original behaviour/movement on the scale of days to weeks	Detectable change in behaviour/movement with the potential for some impact on population dynamics. Time to return to original behaviour/movement on the scale of weeks to months	Change in behaviour/movement, impact adversely affecting population dynamics. Time to return to original behaviour/movement on the scale of months to years.	Change in behaviour/movement. Impact adversely affecting population dynamics. Time to return to original behaviour/movement on the scale of years to decades.

Table B.3: *(continued)*

Sub-component	Score/level 1 (Negligible)	Score/level 2 (Minor)	Score/level 3 (Moderate)	Score/level 4 (Major)	Score/level 5 (Severe)	Score/level 6 (Intolerable)
Interaction with fishery	No interactions with fishery.	Few interactions and involving up to 5% of population.	Moderate level of interactions with fishery involving up to10 % of population.	Major interactions with fishery, interactions and involving up to 25% of population.	Frequent interactions involving ~ 50% of population.	Frequent interactions involving the entire known population negatively affecting the viability of the population.

Table B.4: Habitats. Description of consequences for each component and each sub-component. Use table as a guide for scoring the level of consequence for habitats. Note that for sub-components Habitat types and Habitat structure and function, time to recover from impact scales differ from substrate, water and air. Rationale: structural elements operate on greater timeframes to return to pre-disturbance states (Modified from Fletcher et al., 2002).

Sub-component	Score/level 1 (Negligible)	Score/level 2 (Minor)	Score/level 3 (Moderate)	Score/level 4 (Major)	Score/level 5 (Severe)	Score/level 6 (Intolerable)
Substrate quality	Reduction in the productivity (similar to the intrinsic rate of increase for species) on the substrate from the activity is unlikely to be detectable. Time taken to recover to pre-disturbed state on the scale of hours.	Detectable impact on substrate quality. At small spatial scale time taken to recover to pre-disturbed state on the scale of days to weeks, at larger spatial scales recovery time of hours to days.	More widespread effects on the dynamics of substrate quality but the state are still considered acceptable given the percent area affected, the types of impact occurring and the recovery capacity of the substrate. For impacts on non-fragile substrates this may be for up to 50% of habitat affected, but for more fragile habitats, e.g., reef substrate, to stay in this category the % area affected needs to be smaller up to 25%.	The level of reduction of internal dynamics of habitats may be larger than is sensible to ensure that the habitat will not be able to recover adequately, or it will cause strong downstream effects from loss of function. Time to recover from local impact on the scale of months to years, at larger spatial scales recovery time of weeks to months.	Severe impact on substrate quality with 50 - 90% of the habitat affected or removed by the activity which may seriously endanger its long-term survival and result in changes to ecosystem function. Recovery period measured in years to decades.	The dynamics of the entire habitat is in danger of being changed in a major way, or > 90% of habitat destroyed.

Table B.4: *(continued)*

Sub-component	Score/level 1 (Negligible)	Score/level 2 (Minor)	Score/level 3 (Moderate)	Score/level 4 (Major)	Score/level 5 (Severe)	Score/level 6 (Intolerable)
Water quality	No direct impact on water quality. Impact unlikely to be detectable. Time taken to recover to pre-disturbed state on the scale of hours.	Detectable impact on water quality. Time to recover from local impact on the scale of days to weeks, at larger spatial scales recovery time of hours to days.	Moderate impact on water quality. Time to recover from local impact on the scale of weeks to months, at larger spatial scales recovery time of days to weeks.	Time to recover from local impact on the scale of months to years, at larger spatial scales recovery time of weeks to months.	Impact on water quality with 50 - 90% of the habitat affected or removed by the activity which may seriously endanger its long-term survival and result in changes to ecosystem function. Recovery period measured in years to decades.	The dynamics of the entire habitat is in danger of being changed in a major way, or > 90% of habitat destroyed.
Air quality	No direct impact on air quality. Impact unlikely to be detectable. Time taken to recover to pre-disturbed state on the scale of hours.	Detectable impact on air quality. Time to recover from local impact on the to recover to pre-disturbed state on the scale of hours.	Detectable impact on air quality. Time to recover from local impact on the scale of days to weeks, at larger spatial scales recovery time of hours to days.	Time to recover from local impact on the scale of months to years, at larger spatial scales recovery time of weeks to months.	Impact on air quality with 50 - 90% of the habitat affected or removed by the activity, which may seriously endanger its long-term survival and result in changes to ecosystem function. Recovery period measured in years to decades.	The dynamics of the entire habitat is in danger of being changed in a major way, or > 90% of habitat destroyed.

Table B.4: *(continued)*

Sub-component	Score/level 1 (Negligible)	Score/level 2 (Minor)	Score/level 3 (Moderate)	Score/level 4 (Major)	Score/level 5 (Severe)	Score/level 6 (Intolerable)
Habitat types	No direct impact on habitat types. Impact unlikely to be detectable. Time taken to recover to pre-disturbed state on the scale of hours to days.	Detectable impact on distribution of habitat types. Time to recover from local impact on the scale of days to weeks, at larger spatial scales recovery time of days to months.	Impact reduces distribution of habitat types. Time to recover from local impact on the scale of weeks to months, at larger spatial scales recovery time of months to < one year.	The reduction of habitat type areal extent may threaten ability to recover adequately, or cause strong downstream effects in habitat distribution and extent. Time to recover from impact on the scale of > one year to < decadal timeframes.	Impact on relative abundance of habitat types resulting in severe changes to ecosystem function. Recovery period likely to be > decadal.	The dynamics of the entire habitat is in danger of being changed in a catastrophic way. The distribution of habitat types has been shifted away from original spatial pattern. If reversible, will require a long-term recovery period, on the scale of decades to centuries.

Table B.4: *(continued)*

Sub-component	Score/level 1 (Negligible)	Score/level 2 (Minor)	Score/level 3 (Moderate)	Score/level 4 (Major)	Score/level 5 (Severe)	Score/level 6 (Intolerable)
Habitat structure and function	No detectable change to the internal dynamics of habitat or populations of species making up the habitat. Time taken to recover to pre-disturbed state on the scale of hours to days.	Detectable impact on habitat structure and function. Time to recover from impact on the scale of days to months, regardless of spatial scale.	Impact reduces habitat structure and function. For impacts on non-fragile habitat structure this may be for up to 50% of habitat affected, but for more fragile habitats, to stay in this category the % area affected needs to be smaller up to 20%. Time to recover from local impact on the scale of months to < one year, at larger spatial scales recovery time of months to < one year.	The level of reduction of internal dynamics of habitat may threaten ability to recover adequately, or it will cause strong downstream effects from loss of function. For impacts on non-fragile habitats this may be for up to 50% of habitat affected, but for more fragile habitats, to stay in this category the % area affected up to 25%. Time to recover from impact on the scale of > one year to < decadal timeframes.	Impact on habitat function resulting from severe changes to internal dynamics of habitats. Time to recover from impact likely to be > decadal.	The dynamics of the entire habitat is in danger of being changed in a catastrophic way which may not be reversible. Habitat losses occur. Some elements may remain but will require a long-term recovery period, on the scale of decades to centuries.

Table B.5: Communities. Description of consequences for each component and each sub-component. Use table as a guide for scoring the level of consequence for communities (Modified from Fletcher et al., 2002).

Sub-component	Score/level 1 (Negligible)	Score/level 2 (Minor)	Score/level 3 (Moderate)	Score/level 4 (Major)	Score/level 5 (Severe)	Score/level 6 (Intolerable)
Species composition	Interactions may be occurring which affect the internal dynamics of communities leading to change in species composition not detectable against natural variation.	Impacted species do not play a keystone role – only minor changes in relative abundance of other constituents. Changes of species composition up to 5%.	Detectable changes to the community species composition without a major change in function (no loss of function). Changes to species composition up to 10%.	Major changes to the community species composition (~25%) (involving keystone species) with major change in function. Ecosystem function altered measurably and some function or components are locally missing/declining/increasing outside of historical range and/or allowed/facilitated new species to appear. Recovery period measured in years.	Change to ecosystem structure and function. Ecosystem dynamics currently shifting as different species appear in fishery. Recovery period measured in years to decades.	Total collapse of ecosystem processes. Long-term recovery period required, on the scale of decades to centuries.
Functional group composition	Interactions which affect the internal dynamics of communities leading to change in functional group composition not detectable against natural variation.	Minor changes in relative abundance of community constituents up to 5%.	Changes in relative abundance of community constituents, up to 10% chance of flipping to an alternate state/ trophic cascade.	Ecosystem function altered measurably and some functional groups are locally missing/declining/increasing outside of historical range and/or allowed/facilitated new species to appear. Recovery period measured in months to years.	Ecosystem dynamics currently shifting, some functional groups are missing and new species/groups are now appearing in the fishery. Recovery period measured in years to decades.	Ecosystem function catastrophically altered with total collapse of ecosystem processes. Recovery period measured in decades to centuries.

Table B.5: *(continued)*

Sub-component	Score/level 1 (Negligible)	Score/level 2 (Minor)	Score/level 3 (Moderate)	Score/level 4 (Major)	Score/level 5 (Severe)	Score/level 6 (Intolerable)
Distribution of the community	Interactions which affect the distribution of communities unlikely to be detectable against natural variation.	Possible detectable change in geographic range of communities but minimal impact on community dynamics change in geographic range up to 5% of original.	Detectable change in geographic range of communities with some impact on community dynamics. Change in geographic range up to 10% of original.	Geographic range of communities, ecosystem function altered measurably and some functional groups are locally missing/declining/increasing outside of historical range. Change in geographic range for up to 25% of the species. Recovery period measured in months to years.	Change in geographic range of communities, ecosystem function altered and some functional groups are currently missing and new groups are present. Change in geographic range for up to 50% of species including keystone species. Recovery period measured in years to decades.	Change in geographic range of communities, ecosystem function collapsed. Change in geographic range for >90% of species including keystone species. Recovery period measured in decades to centuries.
Trophic/size structure	Interactions which affect the internal dynamics unlikely to be detectable against natural variation.	Change in mean trophic level, biomass/number in each size class up to 5%.	Changes in mean trophic level, biomass/number in each size class up to 10%.	Changes in mean trophic level. Ecosystem function altered measurably and some function or components are locally missing/declining/increasing outside of historical range and/or allowed/facilitated new species to appear. Recovery period measured in years to decades.	Changes in mean trophic level. Ecosystem function severely altered and some function or components are missing and new groups present. Recovery period measured in years to decades.	Ecosystem function catastrophically altered as a result of changes in mean trophic level, total collapse of ecosystem processes. Recovery period measured in decades to centuries.

Table B.5: *(continued)*

Sub-component	Score/level 1 (Negligible)	Score/level 2 (Minor)	Score/level 3 (Moderate)	Score/level 4 (Major)	Score/level 5 (Severe)	Score/level 6 (Intolerable)
Bio-geochemical cycles	Interactions which affect bio- & geochemical cycling unlikely to be detectable against natural variation.	Only minor changes in relative abundance of other constituents leading to minimal changes to bio- & geochemical cycling up to 5%.	Changes in relative abundance of other constituents leading to minimal changes to bio- & geochemical cycling, up to 10%.	Changes in relative abundance of constituents leading to major changes to bio- & geochemical cycling, up to 25%.	Changes in relative abundance of constituents leading to Severe changes to bio- & geochemical cycling. Recovery period measured in years to decades.	Ecosystem function catastrophically altered as a result of community changes affecting bio- and geo-chemical cycles, total collapse of ecosystem processes. Recovery period measured in decades to centuries.

C APPENDIX Reproducibility Details

C.1 Date and time of execution

2023-11-28 10:56:12

C.2 Version Control

C.2.1 Bitbucket

Repository: https://bitbucket.csiro.au/scm/era/eraef-ar_spf.git

Branch: Purse_Seine

Commit Number: 0b730febfa5f67ed85ee8c09b041e5aac3266250

C.2.2 Data Sources

Table C.1: Version control for data sources.

Item No.	Aspect	Version No./Git ID	Comments
1.	Bioregionalization information	23/03/2022	
1.1	New species distribution information added manually	10/03/2022	Date of last added species
2	Update of species attributes from FishBase	12/03/2022	
3	Manual updates to ERAEF species attributes	10/3/2022	Date of last added species
4	Database snapshots for fishery ERAEF extracts	12/03/2022	Fishery species table, species table and species attributes
5	Version front end tables snapshot	01/03/2022	Scoring tables - calculate productivity, susceptibility for each sub-fishery Intermediate information used for PSA and SAFE plots
6	PLSQL for generating PSA and SAFE calculations	v1.3, git commit: 3er330fdskek	
7	Effort overlaps	18/03/2022	

C.2.3 Excel templates

Table C.2: Version control for Excel templates. Lists current version of Excel files with a 'Changelog' sheet.

File	Version	Date
ManualInput/Appendix/Appendices.xlsx	1.1	2023-01-05
ManualInput/Level1/HazardsTemplateAFMA.xlsm	1.1	2023-09-04
ManualInput/Scoping/GeneralFisheryCharacteristics.xlsx	1.1	2023-01-05

C.3 Parameters

C.3.1 index.Rmd

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## [77,1] description: This is a technical report detailing an ecological risk assesm
## [77,2] ent for the effects of fishing.
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C.3.2 _bookdown.yml

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## [33] "- 09-references.Rmd"             "- 10-glossary.Rmd"
## [35] "- 11-appendix-automated.Rmd"     "- 12-appendix-manual.Rmd"
## [37] "- 13-backmatters.Rmd"
```

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