Australia's National
Science Agency

Ecological Risk Assessment for the Effects of Fishing

Report for the Bass Strait Central Zone Scallop 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., 2007a, 2011a). This assessment of the ecological impacts of the Bass Strait Central Zone Scallop 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 Bass Strait Central Zone Scallop Fishery ERA is based on analyses of data (to 2021) conducted in 2022-2023. The 2017-2021 assessment of the Bass Strait Central Zone Scallop Fishery consists of the following:

- Scoping
- Level 1 results for all components
- Level 2 PSA and bSAFE results
- Residual risk for high risk PSA species and/or high/extreme risk bSAFE species

Fishery Description

Gear Dredge
Area From SA/Vic Border to Vic/NSW Border including Central Bass Strait
Depth range ~24 to 101 m [95th percentile: 80 m; 99.9th percentile: 99.8 m]
Fleet size 10-12 vessels
Effort 3910 - 5247 hours p.a.
Landings 2929 t - 3268 t p.a. of Commercial Scallop
Discard rate fishery-wide estimate unavailable
Key commercial species Commercial Scallop (*Pecten fumatus*)
Management Input (e.g., area and seasonal closures) and output controls (e.g., TAC)
Observer program There is no Observer Program in this fishery.

Ecological Components Assessed

A total of 333 species across all ecological components were assessed in this ERAEF compared to 279 species in 2007 (Table 0.1).

Table 0.1: Ecological components assessed in 2024 (data from 2017 to 2021) and earlier assessments. NA: not assessed.

Ecological components assessed	2007	2024
Key/secondary commercial species	1	1
Commercial species/Bait	NA	NA
Byproduct species	1	1
Bycatch species	140	330
Protected species	137	1
Benthic habitats	28	22
Pelagic habitats	4	4
Demersal communities	20	15
Pelagic communities	12	6

The increase in the number of bycatch species between this and the previous assessment is due to the expansion of species group codes that were recorded in pre-season biomass surveys.

The substantial decrease in the number of protected species between this and the previous assessment is mainly due to including only species that were recorded in biomass pre-season surveys, as opposed to including all species that occur in the area of the fishery.

The new habitats methodology is not directly mappable to the original analyses conducted in 2007 but these assessments are more comprehensive than the previous assessment and therefore used.

Level 1 Results and Summary

Most hazards (fishing activities) were eliminated at Level 1 (risk scores 1 or 2). Those remaining consist of:

- Direct impact of capture by fishing (byproduct/bycatch species, habitats and communities; moderate),
- Direct impact without capture by fishing (habitats and communities; moderate),
- Addition/movement of biological material by translocation of species (key commercial species, habitats and communities; moderate),
- Addition/movement of biological material by discarding (habitats; moderate) and
- Disturb physical processes by fishing (habitats; moderate).

As a result of capture by fishing, the most vulnerable bycatch species chosen were the Longnose skate *Dentiraja confusus*, Greenback Stingaree *Urolophus viridis* and the Pale Octopus *Octopus pallidus* were assessed at moderate risk. The two chondrichthyan species were chosen largely due to the fact they have slow reproduction rates, are endemic to south-eastern Australia, and that post capture mortality is likely to increase with tow duration and air exposure. While not listed on Australia's EPBC Act, the Longnose Skate has been listed as critically endangered and the Greenback Stingaree as vulnerable by the IUCN. The Pale Octopus *Octopus pallidus* was also chosen as vulnerable bycatch species because it is endemic to south-eastern Australia, its stock is depleting in northern Tasmania and its habitat overlaps with fishing areas.

Handfishes have been recorded at the family taxonomic level from pre-season biomass surveys (i.e., Brachionichthyidae- undifferentiated). This group has been expanded to comprise species that occur within the area of the BSCZSF, notably, the Warty Handfish *Thymichthys verrucosus*, Australian Handfish *Brachionichthys australis*, Humpback Handfish *Brachiopsilus dossenus*, Narrowbody Handfish *Pezichthys compressus*, Moulton's Handfish *Sympterichthys moultoni* and Cockatoo Handfish *Pezichthys amplispinus*. These species were chosen as most vulnerable for some hazards in the Level 1 analysis, as they are endemic to Australia, and in some cases only occur in south-eastern Australia within narrow geographical distributions.

Also, most of these species appear to be data-deficient with respect to life history parameters (longevity, maturity etc.), apart from their size ranges and depth preferences.

As a result of capture by fishing by other fisheries, the most vulnerable bycatch species chosen were the Longnose skate *Dentiraja confusus*, Greenback Stingaree *Urolophus viridis* and the Pale Octopus *Octopus pallidus* which were assessed at moderate risk. The first two species are caught in the Southern and Eastern Scalefish and Shark Fishery (SESSF) by otter trawls and Danish seine and also by longlines in the Gillnet, Hook and Trap (GHAT) sector of the SESSF. As such they are susceptible to exploitation and population decline based on their typically long life spans, late age at maturity and low fecundity. Similarly, the Pale Octopus is also likely to be affected due to exploitation by several fisheries active in the Bass Strait; it is targeted by the Tasmanian Octopus Fishery (TOF), bycatch/byproduct in the GHATF, and targeted by a new, standalone commercial Octopus Fishery commenced in 2020 harvesting predominantly Pale Octopus in Eastern Victoria.

The habitats, communities ecological components were moderately impacted by other fisheries (i.e., external impacts). Hazards assessed as moderately contributing to external impacts included coastal development on key/secondary commercial species, and other extractive activities on habitats. Such activities include 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 that occurs across southern Australia.

Translocation of species was considered to be a moderate risk (3) to key commercial species (Commercial Scallop *Pecten fumatus*), due to the potential of introduced species (e.g., North Pacific Seastar *Asterias amurensis*). Both habitats and communities components were assessed at moderate risk and therefore triggered a Level 2 analysis, but was not analysed in this assessment.

There have been changes in (i) ERAEF methodology (ii) ERAEF species classification and (iii) availability of new information since the last ERA. Results of the two Level 1 BSCZSF SICA analyses (i.e., this assessment and 2007) showed that the same ecological components (except key/secondary commercial species) still have some units at high risk. Also, the changes resulted in different species being identified as most vulnerable with the same potential risk for direct impact of capture by fishing between the 2023 and 2007 Level 1 assessments. For example, the minor risk scores for the protected species component with respect to direct impact of capture by fishing was the Spiny Pipehorse *Solegnathus spinosissimus* in 2023 compared to the Big-bellied Seahorse *Hippocampus abdominalis* in 2007. No other species were identified at high risk for protected species component from internal hazards between assessments.

Table 0.2: Outcomes of assessments for ecological components conducted in 2022. ^: includes Commercial Bait species

Ecological Component	2022
Key/secondary commercial species^	Level 1
Byproduct and bycatch species	Level 2
Protected species	Level 1
Habitats	Level 1
Communities	Level 1

Level 2 Results and Summary

A total of 331 unique species were evaluated at Level 2 (161 with PSA and 172 with bSAFE, which includes any unassessable species in a bSAFE, subsequently assessed in a PSA). Under the revised ERAEF framework (AFMA, 2017), key commercial species that undergo tiered assessments are not assessed at Level 2. However, an ERA should be considered for species that are subject to lower tiered assessments (e.g., Tier 4/5, based on catch/effort or catch data only) when the model-based assumptions may not be satisfied.

PSA and Residual Risk

For ecological components in the sub-fishery not explicitly listed here, no species were assessed at Level 2.

Byproduct species

Table 0.3: Biomass Surveys including status detail (where available) of key commercial species in the Bass Strait Central Zone Scallop Fishery. NOF: not overfished, NSTOF: not subject to overfishing. ABARES: Australian Bureau of Agricultural and Resource Economics and Sciences. [1]: Based on ABARES classification. *: There was a biomass survey conducted in 2022 following this ERA reporting period.

Common Name	Scientific Name	ERA Classification	Biomass[1]/Fishing Mortality[1]	References	Year Last Assessed
Commercial Scallop	*Pecten fumatus*	Key Commercial	NSTOF / NOF	Koopman et al., (2021)	2021
Commercial Scallop	*Pecten fumatus*	Key Commercial	NSTOF / NOF	Koopman and Knuckey (2022)	2022*

One byproduct species was assessed in the PSA. The one species was found to be at low risk. Of these, none were non-robust (i.e., data deficient) species.

Bycatch species
A total of 160 out of 330 bycatch species were assessed in the PSA. Of these, three were unassessable in bSAFE. Of all assessed bycatch species, 39 were at high risk, 110 were at medium risk, and 11 were at low risk. Of these, 136 were non-robust (i.e., data deficient) species. Of the 39 high risk species, none have all 11 attributes, four are missing one to three attributes, and 35 are non-robust (i.e., missing more than three attributes). A residual risk analysis was performed on 39 species. Following the residual risk analysis, 17 of the 39 species remained at high risk, i.e., 22 species were reduced to medium risk. Therefore, overall, there were a total of 17 high risk species, 132 medium risk species and 11 low risk species.

bSAFE and Residual Risk

For ecological components in the sub-fishery not explicitly listed here, no species were assessed at Level 2.

Bycatch species
There were 172 out of 330 bycatch species considered in the bSAFE. Three species were unassessable due to missing biological attributes employed in the bSAFE method. Of the remaining 169 species, all 169 species were below the three reference points (low risk), none were medium risk, and none were high or extreme risk.

Summary

Overall, a total of 17 of the 45 species were assessed at high risk following a preliminary residual risk analysis (Table 0.4). All 17 were invertebrates of the phylum Echinodermata. These echinoderms comprised of seastars (1), basketstars (4), brittlestars (5), and sea cucumbers (7). Fifteen of these bycatch species were expanded from high group codes recorded from Commercial Scallop pre-season surveys.

Of the 17 high risk species, all had some missing biological productivity attributes, and all had missing distributional information that is used to calculate the overall susceptibility (total missing attributes: 4 -9). As such, these species could be potential false positives. The low productivity attributes are due to missing attribute data for most of these species. Also, the most conservative scores were used for attribute data that were missing. Efforts were made to obtain information on missing productivity and susceptibility attributes for invertebrates in the species list. Very little productivity attributes were found for most of these invertebrates, apart from minimum and maximum sizes and/or depth preferences. So, it is suggested that further efforts be made to obtain some of the missing attributes if they are available. In addition, there appears to be a lack of available digitized invertebrate species distribution information that is used to assess susceptibility. It is therefore suggested that this information be obtained and/or the likelihood of invertebrate species occurring in the fishery area be confirmed, for each of the 17 potential high risk species and also the 28 medium risk species that were reduced from high risk following a residual risk analysis.

There have been methodological changes to the Level 2 analysis since the last ERA assessment undertaken

for this fishery over 15 years ago. All species conducted at Level 2 were based on a PSA in the previous assessment. By contrast, both PSA and bSAFE Level 2 analyses have been undertaken in this assessment. The potential high risk seastar *Luidia australiae* in this assessment was also high risk in the previous assessment. Also, the potential high risk brittlestars and basketstars were all expanded species from Commercial Scallop pre-season surveys and not in the previous (2007) assessment. Six of the seven potential high risk sea cucumbers were expanded species from Commercial Scallop pre-season surveys and not in the previous assessment.

Table 0.4: Extreme or high-risk PSA or bSAFE species following a preliminary residual risk (RR) analysis in the Bass Strait Central Zone Scallop Fishery. No. Missing: Number of missing attributes in PSA. BC: bycatch.

Level 2 analysis	ERA Classification	Taxa	No. Missing	Scientific Name	Common Name	Final risk score
PSA	BC	NA	4	*Luidia australiae*	A Seastar	High
PSA	BC	NA	6	*Conocladus australis*	Southern Basketstar	High
PSA	BC	NA	6	*Astrosierra amblyconus*	A Basketstar	High
PSA	BC	NA	6	*Astrothrombus rugosus*	A Basketstar	High
PSA	BC	NA	6	*Gorgonocephalus pustulatum*	A Basketstar	High
PSA	BC	NA	9	*Ophiomisidium irene*	A Brittlestar	High
PSA	BC	NA	5	*Ophioplinthus accomodata*	A Brittlestar	High
PSA	BC	NA	5	*Amphiophiura urbana*	A Brittlestar	High
PSA	BC	NA	5	*Ophiactis resiliens*	A Brittlestar	High
PSA	BC	NA	5	*Ophiactis tricolor*	A Brittlestar	High
PSA	BC	NA	6	*Thyone tourvillei*	A Sea Cucumber	High
PSA	BC	NA	5	*Neoamphicyclus mutans*	A Sea Cucumber	High
PSA	BC	NA	9	*Bathyplotes sulcatus*	A Sea Cucumber	High
PSA	BC	NA	8	*Pseudostichopus hyalegerus*	A Sea Cucumber	High
PSA	BC	NA	5	*Leptosynapta dolabrifera*	A Sea Cucumber	High
PSA	BC	NA	5	*Scoliorhapis theeli*	A Sea Cucumber	High
PSA	BC	NA	5	*Taeniogyrus papillis*	A Sea Cucumber	High

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).

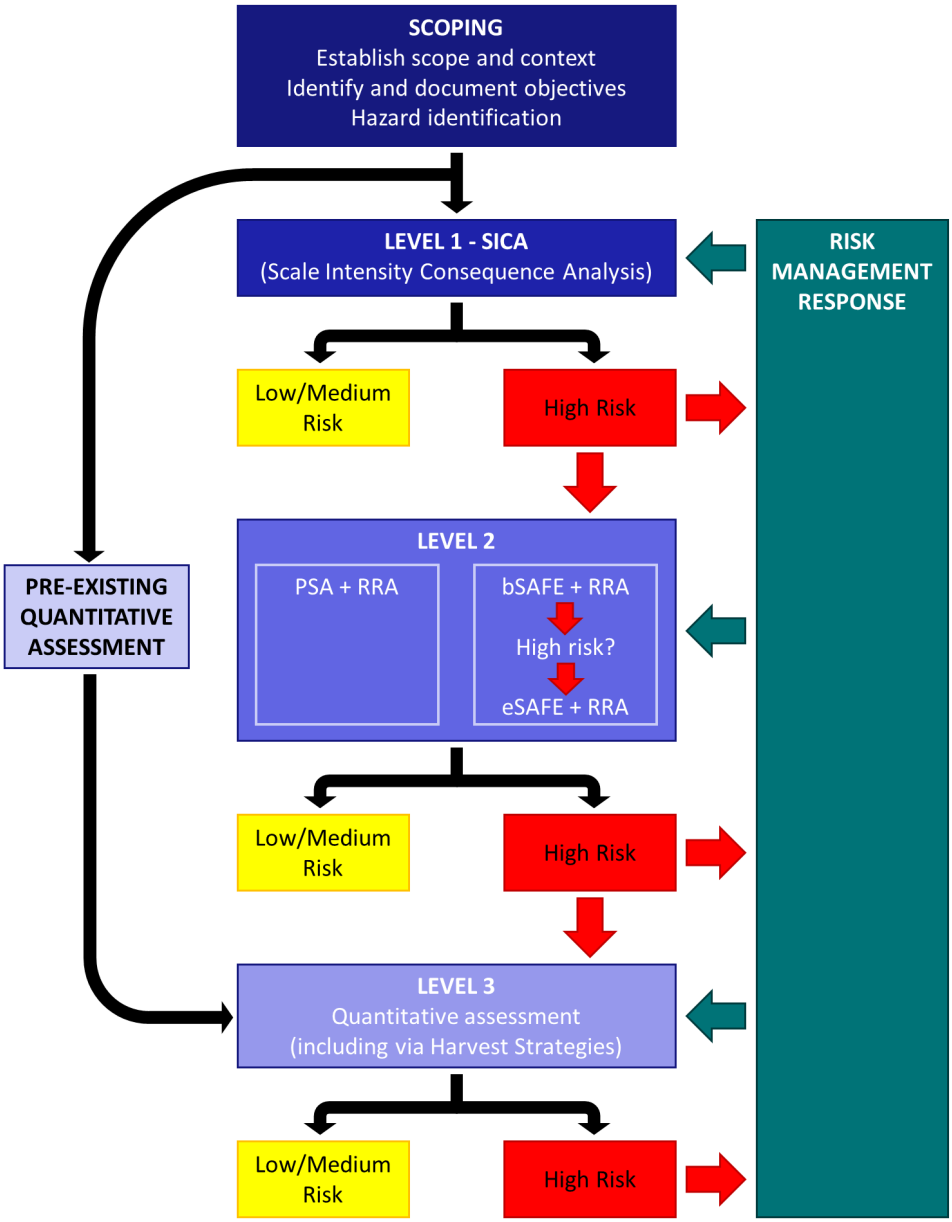


Figure 1.1: Structure of the 3 level hierarchical ERAEF methodology. SICA – Scale Intensity Consequence Analysis; PSA – Productivity Susceptibility Analysis; SAFE – Sustainability Assessment for Fishing Effects; RRA – Residual Risk Analysis. T1 – Tier 1. eSAFE may be used for species classified as high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

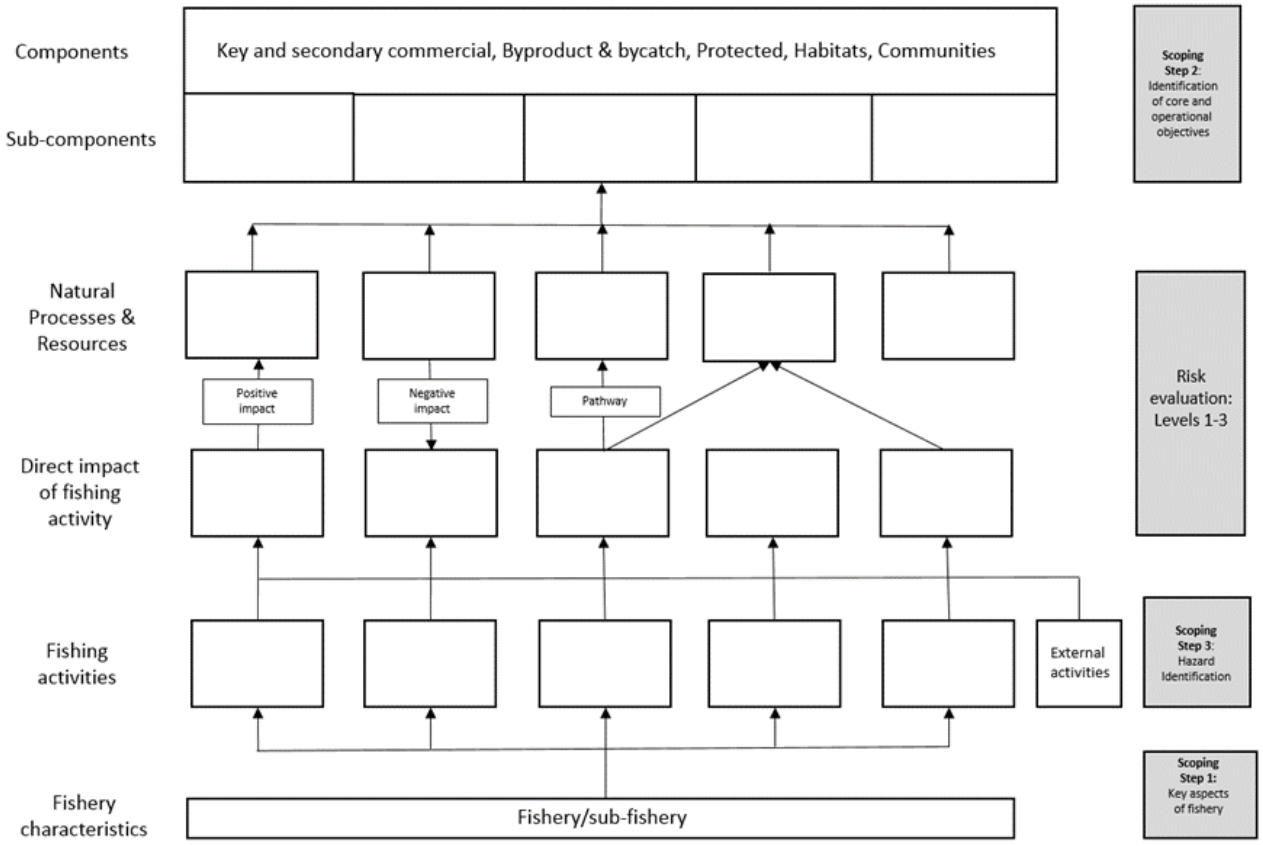


Figure 1.2: Generic conceptual model used in ERAEF.

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., 2007a).
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 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 analysis 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., 2007, 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).

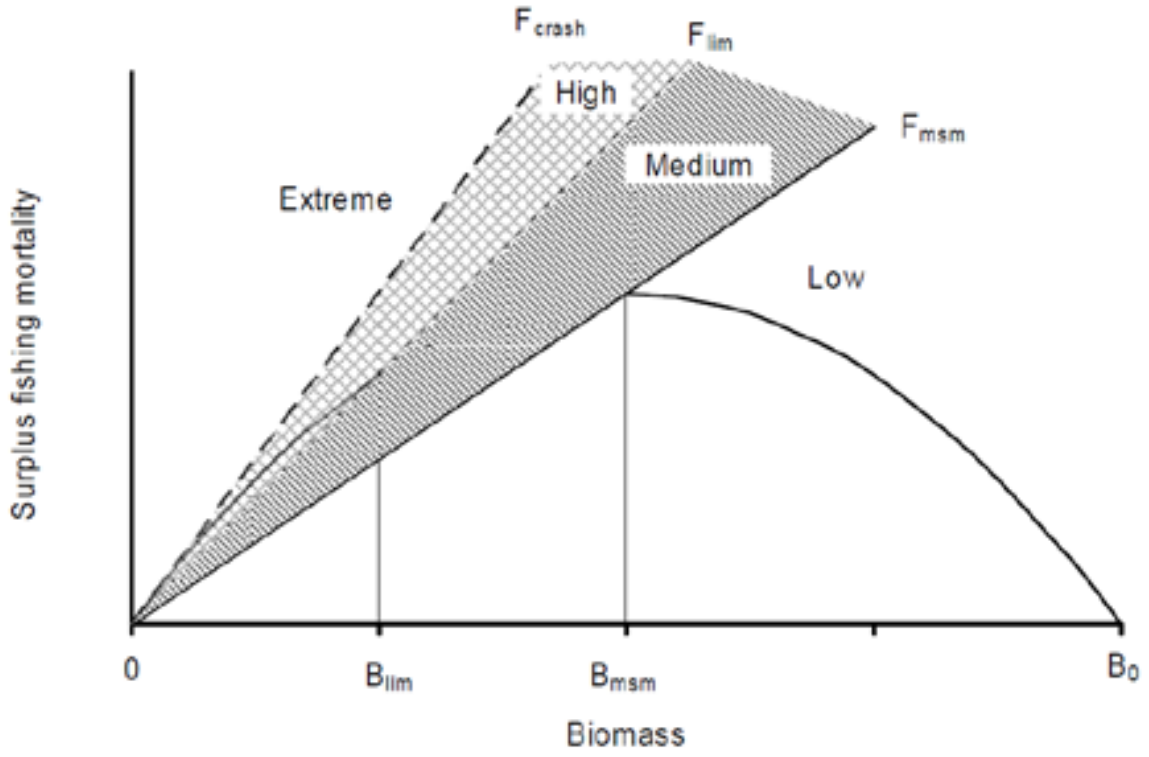


Figure 1.3: Stock productivity, biological reference points and ecological risk assessment for managing bycatch species.

- 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 two 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 Bass Strait Central Zone Scallop Fishery. A full description of the ERAEF method is provided in the methodology document (Hobday et al., 2007a; Hobday et al., 2011b).

2.1 Stakeholder Engagement

Table 2.1: Summary Document SD1. Summary of stakeholder involvement for Bass Strait Central Zone Scallop 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	03 Nov. 2022	Haydn Titterton (AFMA); Steve Hall (AFMA)	Project discussed, methods for Scoping analysis. Training provided on Scoping template files
Scoping	Phone calls and emails	21 Dec. 2022	Haydn Titterton (AFMA); Steve Hall (AFMA)	Scoping information provided to CSIRO
Scoping	Email	23 Dec. 2023	Miriana Sporcic (CSIRO)	Feedback on Scoping provided to AFMA
Data	Email	01 Feb. 2023	Steve Hall (AFMA)	Initial data provided to CSIRO
Scoping; data	Email	03 Feb. 2023	Steve Hall (AFMA)	Revised Scoping files provided to CSIRO
Scoping	Email	06 Feb. 2023	Miriana Sporcic (CSIRO)	Review of Scoping provided to AFMA
Scoping; data	Phone calls and emails	15 Feb. 2023	Haydn Titterton (AFMA); Steve Hall (AFMA)	Revised Scoping and data provided to CSIRO
Pre-season survey data	Emails	06 Mar. 2023	Matt Koopman (Fishwell Consulting)	Initial pre-season survey data provided to CSIRO
Pre-season survey data	Emails	29 Mar. 2023	Matt Koopman (Fishwell Consulting)	Revised pre-season survey provided to CSIRO
Species list; Level 1 (SICA)	Phone calls and emails	Apr. 2023 - May 2023	CSIRO; Sally Wayte (AFMA); Steve Hall (AFMA)	Species list created; draft Level 1 completed
Level 2, Residual Risk Analysis	-	Jun. 2023	CSIRO	Preliminary Level 2 and Residual Risk Analysis completed
Draft report	Email	28 Jun. 2023	Steve Hall (AFMA); Ryan Murphy (AFMA)	Draft report submitted to AFMA
Draft report	Email	07 Nov. 2023	Steve Hall (AFMA)	AFMA review provided 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 report	Email	06 Mar. 2024	Steve Hall (AFMA); Ryan Murphy (AFMA)	Updated draft report submitted to AFMA containing revised BSS pre-season survey data for distribution to ScallopRAG meeting 14 March 2023
Draft report	Presented Level 1 and Level 2 results	14 Mar. 2024	Stakeholders, assessment scientists, RAG members	Presentation of report results

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: Bass Strait Central Zone Scallop fishery

Date of revised ERAEF assessment: September 2024

Assessor: AFMA and authors of this report (CSIRO)

2.2.1.1 General Fishery Characteristics

Fishery Name

Bass Strait Central Zone Scallop Fishery

Sub-fisheries

The sub-fishery is the Bass Strait Central Zone Scallop Fishery (BSCZSF).

Sub-fisheries assessed

This Ecological Risk Assessment (ERA) will assess the Bass Strait Central Zone Scallop Fishery.

Start date/history

Commercial Scallop fishing in the Bass Strait commenced in the early 1970s and is managed under three jurisdictions. AFMA manages the BSCZSF, and the Victorian and Tasmanian Governments manage zones

generally out to 20 nm off their respective coastlines. The primary target species of the BSCZSF is the Commercial Scallop (*Pecten fumatus*) which is managed under quota. Doughboy Scallops (*Chlamys Mimachlamys*) are also a quota species within the fishery, however they are rarely targeted or retained as there is no commercial market for them.

Geographic extent of fishery

The BSCZSF encompasses the central area between the Victoria and Tasmanian Scallop fisheries. Offshore Constitutional Settlement Arrangements finalised in June 1986 rationalised the jurisdiction for Bass Strait Scallops. AFMA manages the Commonwealth Central Zone of the Bass Strait, between the zones managed by Victoria and Tasmania that generally lie within 20 nm of their respective coasts (Figure 2.1).

Whilst the fishery encompasses an area from the Victorian/South Australian border, through the centre of Bass Strait to the Victorian/New South Wales border, Scallop fishing is largely restricted to western Bass Strait around King Island, and eastern Bass Strait, around Flinders Island.

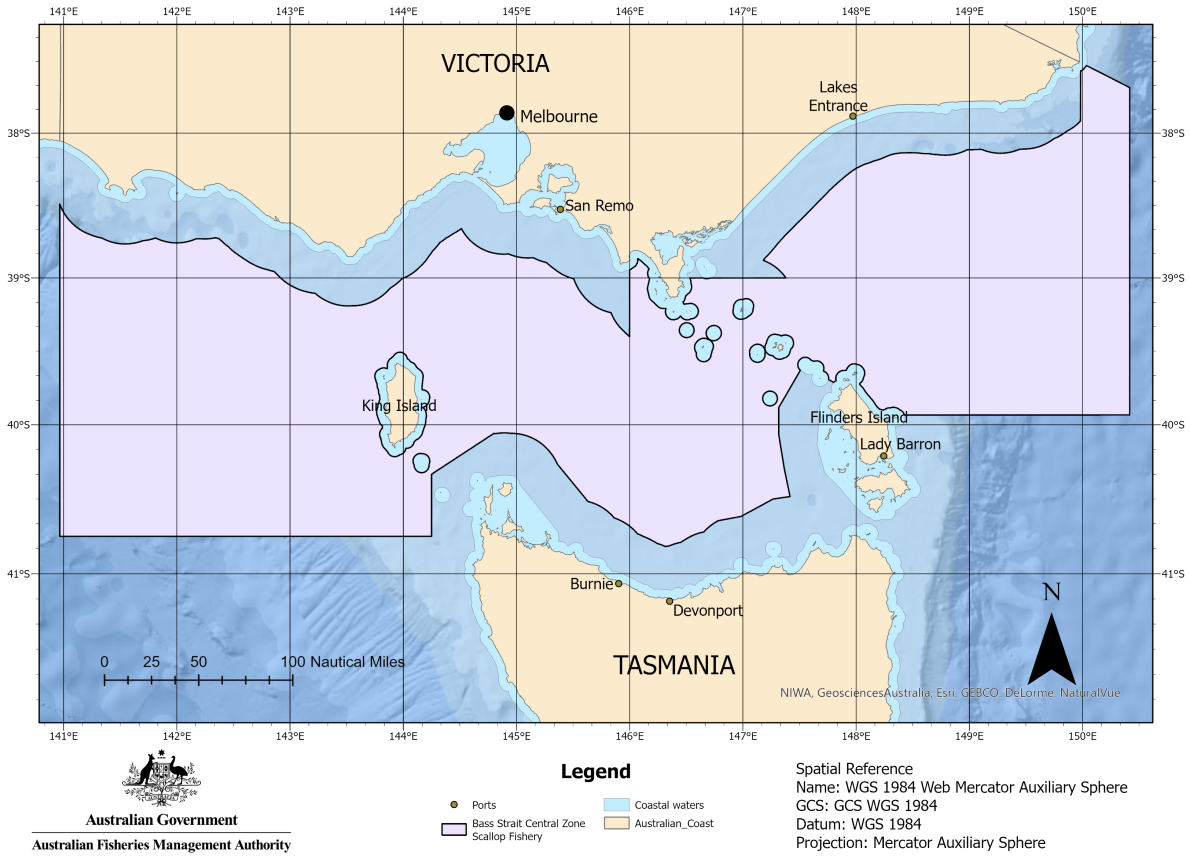


Figure 2.1: Geographic extent of fishery. Source: AFMA

Regions or Zones within the fishery

There are no distinct management zones for the BSCZSF. However, annual closures are implemented based on the results of an annual pre-season biomass survey, with the aim of protecting juvenile and adult spawning Scallops.

Under the BSCZSF Harvest Strategy the Industry Co-Management Committee will close, under voluntary arrangements, beds or areas that do not meet the prescribed discard rate, where 20% (or more) of Scallops are less than 85 mm in size.

The annual pre-season biomass survey design is provided to the Co-Management Committee and the Scallop Resource Assessment Group (ScallopRAG), to provide recommendations to AFMA on which beds to survey (AFMA, 2022a).

Fishing season

Generally, the fishing season opens in late June/early July and closes on 31 December each year.

Key/secondary commercial species and stock status

The BSCZSF is a single species fishery that targets the Commercial Scallop (*Pecten fumatus*). Whilst a TAC is also set for Doughboy Scallops (*Mimachlamys asperrima*), these are not targeted as there is no market for the species. For the Commercial Scallop stock, fishing mortality is not subject to overfishing, and biomass is not overfished (Bromhead et al., 2022).

Bait collection and usage

Bait is not used in the BSCZSF.

Current entitlements

Current entitlements are listed in Table 2.2.

Table 2.2: Entitlements over the last six quota years including number of concession holders, number of active vessels and number of inactive vessels/concessions.
Source: AFMA

Quota year	No. of concession holders	No. of active vessels	No. of inactive vessels / concessions	Comments
2017	59	12	1 inactive vessel / 2 inactive Concession holders	1 vessel nominated but did not fish; 2 Concession holders did not lease quota or fish
2018	55	12	2 inactive vessels / 3 inactive Concession holders	2 vessels nominated but did not fish; 3 Concession holders did not lease quota or fish
2019	53	12	1 inactive vessel / 7 inactive Concession holders	1 vessel nominated but did not fish; 7 Concession holders did not lease quota or fish
2020	47	10	1 inactive vessel / 2 inactive Concession holders	1 vessel nominated but did not fish; 2 Concession holders did not lease quota or fish
2021	44	10	1 inactive vessel / 16 inactive Concession holders	1 vessel nominated but did not fish; 16 Concession holders did not lease quota or fish
2022	34	7	3 inactive vessels / 27 inactive Concession holders	3 vessels nominated but did not fish; 27 Concession holders did not lease quota or fish

Current and recent TACs, quota trends by method

TACs from the last six fishing seasons for quota species are shown in Table 2.3.

Table 2.3: Agreed Total Allowable Catch (TAC (t)) for quota species in the BSCZSF fishing seasons (June/July – 31 December) 2017 to 2022. Research quota included in these TACs. Undercatch and Overcatch not included.

Species	2017	2018	2019	2020	2021
Commercial scallop	3000	3876	3897	3000	3905
Doughboy scallop	100	100	100	100	100

Current and recent fishery effort trends by method

Catch and effort data for the last few years are shown in Table 2.4.

Table 2.4: Fishing effort (hours trawled and number of shots) by BSCZSF operators 2017-2021. Source: AFMA.

Year	2017	2018	2019	2020	2021
Hours fished	5274	5414	3910	4727	4704
No. of shots	16836	17767	13747	19380	16587

Current and recent fishery catch trends by method

Catch and effort data for the last few years are shown in Table 2.5.

Table 2.5: Annual (calendar year) total catch (retained weight; kg) of the key commercial species caught in the BSCZSF. Commercial Scallop: *Pecten fumatus*; Doughboy Scallop: *Mimachlamys asperrima*. Source: AFMA Logbook data.

Year	Commercial Scallop	Doughboy scallop	Total
2017	2929422	330	2929752
2018	3268750	0	3268750
2019	2878630	0	2878630
2020	2614031	0	2614031
2021	2329887	40	2329927

2.2.1.1.1 Current and recent value of fishery ($)

The BSCZSF is characterised by historically variable catch, and relatively stable prices (Bromhead et al., 2022). The variable catch seen in the fishery is a result of the naturally fluctuating biomass of Scallops in the Bass Strait. Gross value of product (GVP) reflects this variability, ranging from less than $1 million to $7 million in the period 2009-10 to 2019-20 (Bromhead et al., 2022). The number of vessels active in the fishery has decreased over the same 10-year period, with 26 vessels active in 2009-10, and 12 active vessels in 2019-20. Average GVP per active vessel has generally trended upwards, particularly towards the end of the 2009-10 to 2019-20 period. Whilst recent estimates of net economic return are not available, growing biomass and a conservatively set TAC indicate that a NER are likely positive and improving, given increasing average GVP per active vessel (Bromhead et al., 2022).

For further details, see the ABARES Fishery Status Report 2022 for the BSCZSF: Bass Strait Central Zone Scallop Fishery - DAFF (agriculture.gov.au)

Relationship with other fisheries

Commonwealth fisheries that operate in the same area as the BSCZSF include the Commonwealth South East Trawl Sector, the Gillnet Hook and Trap Sector, the Eastern Tuna and Billfish Fishery, the Small Pelagic Fishery and the Southern Squid Jig Fishery. Due to the targeted nature of Scallop fishing in the BSCZSF, there is little direct interaction with other fisheries, apart from a geographic overlap in fishery jurisdiction. State

jurisdictions for Victoria and Tasmania are also directly adjacent to the BSCZSF, both of which have Scallop fisheries in Bass Strait (Table 2.6).

Table 2.6: Characteristics of Commonwealth fisheries related to the BSCZSF

Fishery	Key Commercial species	Interactions with BSCZSF	Fishing methods
South East Trawl Fishery	Flathead, Pink Ling, Blue Grenadier	There may be very low rates of incidental bycatch for demersal trawl.	Danish Seine, Demersal Trawl
Gillnet, Hook and Trap Fishery	Gummy Shark, Blue-eye Trevalla, Pink Ling,	Likely small amounts in nets which touch the seabed such as gillnets and seines.	Gillnet, Automatic Longline, Dropline, Manual Longline
Southern Squid Jig Fishery	Gould's Squid	No	Squid Jigging
Eastern Tuna and Billfish Fishery	Broadbill Swordfish, Yellowfin Tuna, Bigeye Tuna, Skipjack Tuna	No	Longline, Other Line, Purse Seine net
Victorian (Ocean) Scallop Fishery	Commercial Scallop	Yes	Scallop Dredge
Tasmanian Scallop Fishery	Commercial Scallop	Yes	Scallop Dredge

2.2.1.2 Gear

Fishing methods and gear

The only fishing gear used in the BSCZSF is a single towed Scallop harvester (dredge) that is towed along the benthos. The runners supporting the box are approximately 100 mm wide. This rigid box-shaped device is covered in 70-45 mm weldmesh and has a mouth approximately 45 cm in height and is typically 45 cm in height and is typically 3-4 m wide. Set in front of the mouth is the primary catching mechanism, a toothbar or scraper bar that is about 65 mm wide. This bar penetrates up to 50 mm into the sediments, and the teeth are 60-70 mm apart. Tumblers are used to sort catch and remove small Scallops and any other small bycatch.

Fishing gear restrictions

There are no gear specifications in the BSCZSF, however all operators use a Scallop harvester (dredge) and tumbler as described above in Section 2.2.1.1.1.

2.2.1.2.1 Selectivity of fishing methods

Scallops congregate in discrete beds in or on sediments ranging from mud to coarse sand. As Scallop harvesting is targeted at these discrete beds the proportion of non-target species in the catch is likely to be low when the density of Scallops is high. Operators prefer to target high-density beds because catch rates are high, and less effort is required to sort Scallops from non-target species. The proportion of non-target species in the catch is likely to increase when areas of low Scallop density are being fished.

Natural predators of the Commercial Scallop are starfish, whelks and octopus, suggesting these species would be found in areas of dense Scallop beds (AFMA, 2022c).

Spatial gear zone set

Not applicable for the BSCZSF. Only one type of gear is used in the fishery.

2.2.1.2.2 Depth range gear set

The gear is typically deployed in a depth range of 30-100 m, where dense Scallop beds occur.

How gear set

As described above in Section 2.2.1.2.1.

Area of gear impact per set or shot

The width of the dredge is 100 mm runners, supporting a wire box approximately 3-4 m wide. A scraper bar and teeth penetrate up to 50 mm into the sediment as the dredge is towed.

Capacity of gear

As described above in Section 2.2.1.2.1 and Section 2.2.1.2.2.

Effort per annum all boats

Effort per annum of all boats from 2017-2022 is shown in Table 2.7.

Table 2.7: Annual effort (number of hours fished) for the BSCZSF from 2017-2022.

Year	No. of hours fished
2017	5274
2018	5414
2019	3910
2020	4727
2021	4704

Lost gear and ghost fishing

Dredge loss is rare, and lost dredges can be recovered by fishers. Gear that is not recovered will not ghost fish, as the mouth of the dredge is open. Dredge loss has not occurred during this assessment period. Dredge loss has not been recorded during this assessment period.

2.2.1.3 Issues

Key/secondary commercial species issues and Interactions

The annual pre-season biomass survey provides the key information on stock structure and biomass in the BSCZSF. This data is central to the management of the fishery and informs the TAC, closures, and other management arrangements.

A project on the population dynamics, growth, morphology, and bed structure for Bass Strait Scallops has been identified as high priority. A proposal for this research to be undertaken is to be considered for funding by the AFMA Research Committee in early 2023 as parting of AFMA's 202324 funding round. The project will analyse data from past annual pre-season biomass surveys, as well as the Before-After, Control-Impact (BACI) survey commissioned by Beach Energy. This project will provide useful insights for the management of the fishery.

The BSCZSF Harvest Strategy is currently under review. As part of this review, a Harvest Control Rule (HCR) framework is being developed. The intention is to develop an HCR framework that will more effectively inform fishery management during periods of high biomass.

Byproduct and bycatch issues and interactions

Since 2003 bycatch has been recorded in logbooks. Bycatch in the fishery is very low, due to the targeted nature of fishing, the design of the Scallop dredge, and the use of a tumbler to sort catch.

The only species that could be potentially considered a byproduct are Doughboy Scallops. However, Doughboy Scallops are a managed species within the BSCZSF. A conservative Total Allowable Catch (TAC) is set for Doughboy Scallops each fishing season do provide an opportunity to retain some catch of the species.

Protected species issues and interactions

The previous Ecological Risk Assessment (ERA) for the BSCZSF in 2007 identified several protected species (PS) (Hobday et al., 2007a). Any interactions with these species are recorded within logbooks.

There were no recorded interactions with PS during this assessment period from Commonwealth Logbook Data.

Pre-season biomass surveys includes a bycatch component, which documents any protected species observed during each survey. Protected Species interaction rates seen in the biomass survey are not directly indicative of commercial fishing practices, as a range of environments are targeted in the survey. There only protected species recorded in the pre-season surveys was the Spiny Pipehorse (*Solegnathus spinosissimus*).

Habitat issues and interactions

Habitat was recently introduced as a component of the annual pre-season biomass survey. Any habitat data, including substrate, sponges, corals and ascidians are collected and summarised in pre-season survey reports.

Community issues and interactions

No threatened communities were identified by the Department Environment and Energy (2016) as occurring within the fishery area. According to the assessment, while the fishery includes areas of Giant Kelp Marine Forests of south-east Australian ecological community. The same Wildlife Trade Operation measures outlined for the Habitat issues section also apply to the protection of benthic communities.

Discarding

BSCZSF concession conditions stipulate that only Scallops can be retained. Any non-target species are therefore likely to be discarded. There are no size limits for commercial Scallops in the BSCZSF, however Scallops less than 85 mm in diameter are generally not considered to be commercially viable. Scallop tumblers are designed to remove small Scallops and other small specimens, and these are then further sorted by crew onboard the vessel.

2.2.1.4 Management: planned and those implemented

Management objectives

The objectives of the BSCZSF Management Plan 2002 are as follows:

- To manage the fishery efficiently and cost-effectively for the Commonwealth;
- To ensure that the exploitation of the resources in the fishery and the carrying on of any related activities are conducted in a manner consistent with the principles of ecologically sustainable development and the exercise of the precautionary principle, and 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;
- To maximise the economic efficiency in the exploitation of the resources of the fishery;
- To ensure AFMA's accountability to the fishing industry and to the Australian community in management of the resources of the fishery;
- To reach Government targets for the recovery of the costs of AFMA in relation to the fishery;
- To ensure, through proper conservation and management, that the living resources of the Australian Fishing Zone (AFZ) are not endangered by over-exploitation;
- To achieve the best use of the living resource of the AFZ.

Fishery management plan

The fisheries Management Plan 2002 is a key document in managing the BSCZSF (AFMA, 2022b). It stipulates obligations, procedures and conditions when fishing in the BSCZSF. In particular, it covers information on:

• Total allowable catch (TAC)

• Specific ecosystem requirements (e.g. information recorded on bycatch species; minimize interactions with marine mammals, marine reptiles, fish and seabirds

• Availability and limits of Statutory Fishing Rights (SFRs) and fishing permits

• Under-catch and over-catch obligations

• Area of the fishery

• Primary species of fish.

Input controls

- Closures are implemented and legislated annually under BSCZSF (Closures) Direction.
- Entry to the fishery is limited to the number of Statutory Fishing Rights (SFRs).
- The BSCZSF Co-Management Committee also has the capacity to implement closures in season based on fishing conditions.

Output controls

- A TAC system and a system of individual transferable quota (ITQ) SFRs under the Management Plan.
- A vessel must have a boat Statutory Fishing Right (SFR) allowing a vessel to Scallop dredge. This SFR will entitle a vessel to use Scallop gear in a specific area of water.
- Both Commercial Scallops and Doughboy Scallops are managed under quota in the BSCZSF. No other species are targeted within the fishery.
- In the absence of a pre-season biomass survey, AFMA will determine a TAC of no more than 150 t for Commercial Scallops.

Technical measures

Spatial closures are implemented each season to protect beds of spawning Scallops. Only beds that are surveyed during the pre-season biomass survey may be closed. The Harvest Strategy and a principles document outline the criteria for closures, including to implement a system of representative closures across the three regions of the BSCZSF: King Island, Apollo Bay and Flinders Island.

Regulations

The regulations are set out in the concession conditions for the fishery.

Initiatives, strategies and incentives

The BSCZSF Industry Co-Management Committee is an industry initiative to be more involved in actively managing the fishery. The Co-Management Committee has several roles, including to implement closures in-season based on Scallop condition observed during fishing activities. Where industry observes a Scallop bed that contains more than 20% of Scallops under 85 mm, the Co-Management Committee has the capacity to implement a fishing closure. The Committee also provides advice on the prioritisation of survey beds in preparation for the pre-season biomass survey.

Enabling processes

Pre-season biomass surveys investigate size, condition, and distribution of Scallops.

Other initiatives or agreements

Declaration of the Harvest Operations of the BSCZSF as an approved wildlife trade operation, October 2016. More information available at the following link: Wildlife trade operations - DCCEEW

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. Electronic logbooks (elogs) are an electronic alternative to submitting traditional paper logbooks. Elogs allow data to be received by AFMA in near real time, closer to actual fishing events. Elogs are currently available for use in the fishery.

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 boats operating inside, and periodically outside, the Australian Fishing Zone" (AFMA http://www.afma.gov.au/fisheries-services/observer-services/

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

- collect data on independent boat activity and catch data (not recorded in official logbooks);
- collect data and samples for research programs, supporting marine management and other issues relevant to environmental awareness and fisheries management and
- monitor compliance of the boat with its fishing concession.

There is no Observer Program for this fishery.

Other data

Data is annually obtained via Fishery dependent pre-season biomass surveys annually in the BSCZSF.

Legislative instruments and directions

- Bass Strait Central Zone Scallop Fishery (Total Allowable Catch) Determination 2022: https://www.afma.gov.au/sites/default/files/2023-02/bsczsf-tac-determination-2022.pdf
- Bass Strait Central Zone Scallop Fishery (Fishing Season) Determination 2022: https://www.afma.gov.au/sites/default/files/2023-02/bsczsf-fishing-season-determination-2022.pdf
- Fisheries Management (Bass Strait Central Zone Scallop Fishery) (Closures) Direction 2022: https://www.afma.gov.au/sites/default/files/2023-02/bsczsf-closure-direction-2022.pdf
- Bass Strait Central Zone Scallop Fishery Management Plan 2002: https://www.legislation.gov.au/Series/F2005B01047

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), 0 (CB)
Byproduct and bycatch species 1 (BP), 330 (BC)
Protected species 1
Habitats 26 (22 benthic, 4 pelagic)
Communities 21 (15 demersal, 6 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/

It is anticipated that these lists be validated and reviewed by AFMA and stakeholders.

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*

Table 2.8: Key commercial species (C1) and/or secondary commercial species (C2) and/or commercial bait species (CB) list for the Bass Strait Central Zone Scallop Fishery. LOG: refers to AFMA Logbook data. PSS: refers to pre-season surveys.

ERA Species ID	Role in Fishery	Taxa	Family Name	CAAB Code	Scientific Name	Common Name	Source(s)
1272	C1	Invertebrate	Pectinidae	23270007	*Pecten fumatus*	Commercial Scallop	LOG, PSS

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 2.9: Byproduct species list for the Bass Strait Central Zone Scallop Fishery. LOG: refers to AFMA Logbook data. PSS: refers to pre-season surveys.

ERA Species ID	Role in Fishery	Taxa	Family Name	CAAB Code	Scientific Name	Common Name	Source(s)
1271	BP	Invertebrate	Pectinidae	23270006	*Mimachlamys asperrima*	Doughboy Scallop	LOG, PSS

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 2.10: Bycatch species list for the Bass Strait Central Zone Scallop Fishery. ERA: Ecological Risk Assessment. LOG: refers to AFMA Logbook data. PSS: refers to pre-season surveys. It is anticipated that this list be validated and reviewed by AFMA and stakeholders.

ERA Species ID	Role in Fishery	Taxa	Family Name	CAAB Code	Scientific Name	Common Name	Source(s)
59	BC	Chondrichthyan	Hexanchidae	37005001	*Heptranchias perlo*	Sharpnose Sevengill Shark	expanded from 37005000, PSS
60	BC	Chondrichthyan	Hexanchidae	37005002	*Notorynchus cepedianus*	Broadnose Shark	expanded from 37005000, PSS
365	BC	Chondrichthyan	Hexanchidae	37005005	*Hexanchus griseus*	Bluntnose Sixgill Shark	expanded from 37005000, PSS
260	BC	Chondrichthyan	Heterodontidae	37007001	*Heterodontus portusjacksoni*	Port Jackson Shark	PSS
493	BC	Chondrichthyan	Scyliorhinidae	37015001	*Cephaloscyllium laticeps*	Draughtboard Shark	PSS, also in 37015000, PSS, also in 37015906, PSS
391	BC	Chondrichthyan	Scyliorhinidae	37015003	*Asymbolus vincenti*	Gulf Catshark	expanded from 37015000, PSS
932	BC	Chondrichthyan	Scyliorhinidae	37015009	*Figaro boardmani*	Australian Sawtail Catshark;Sawtail Catshark	expanded from 37015000, PSS
495	BC	Chondrichthyan	Scyliorhinidae	37015013	*Cephaloscyllium albipinnum*	Whitefin Swellshark	expanded from 37015000, 37015906, PSS
4821	BC	Chondrichthyan	Scyliorhinidae	37015024	*Asymbolus rubiginosus*	Orange Spotted Catshark	expanded from 37015000, PSS
460	BC	Chondrichthyan	Scyliorhinidae	37015027	*Asymbolus analis*	Australian Spotted Catshark	expanded from 37015000, PSS
656	BC	Chondrichthyan	Pristiophoridae	37023001	*Pristiophorus nudipinnis*	Southern Sawshark	PSS, also in 37023900, PSS

Table 2.10: *(continued)*

ERA Species ID	Role in Fishery	Taxa	Family Name	CAAB Code	Scientific Name	Common Name	Source(s)
1040	BC	Chondrichthyan	Pristiophoridae	37023002	*Pristiophorus cirratus*	Common Sawshark	expanded from 37023900, PSS
660	BC	Chondrichthyan	Squatinidae	37024001	*Squatina australis*	Australian Angel Shark	PSS, also in 37024900, PSS
505	BC	Chondrichthyan	Squatinidae	37024004	*Squatina albipunctata*	Eastern Angelshark	expanded from 37024900, PSS
687	BC	Chondrichthyan	Trygonorrhinidae	37027011	*Trygonorrhina dumerilii*	Southern Fiddler Ray	PSS
8446	BC	Chondrichthyan	Narcinidae	37028002	*Narcinops tasmaniensis*	Tasmanian Numbfish	PSS
812	BC	Chondrichthyan	Rajidae	37031003	*Dentiraja cerva*	Whitespotted Skate	PSS, also in 37031000, PSS
1063	BC	Chondrichthyan	Rajidae	37031005	*Dentiraja confusus*	Longnose Skate	PSS, also in 37031000, PSS
1065	BC	Chondrichthyan	Rajidae	37031006	*Spiniraja whitleyi*	Melbourne Skate	PSS, also in 37031000, PSS
760	BC	Chondrichthyan	Rajidae	37031007	*Dentiraja lemprieri*	Thornback Skate	PSS, also in 37031000, PSS
761	BC	Chondrichthyan	Arhynchobatidae	37031009	*Pavoraja nitida*	Peacock Skate	PSS, also in 37031000, PSS
1062	BC	Chondrichthyan	Rajidae	37031010	*Dipturus gudgeri*	Bight Skate	expanded from 37031000, PSS
763	BC	Chondrichthyan	Arhynchobatidae	37031018	*Notoraja azurea*	Blue Skate	expanded from 37031000, PSS
6317	BC	Chondrichthyan	Arhynchobatidae	37031023	*Pavoraja arenaria*	Sandy Skate	expanded from 37031000, PSS
1064	BC	Chondrichthyan	Rajidae	37031028	*Dipturus canutus*	Grey Skate	expanded from 37031000, PSS
356	BC	Chondrichthyan	Rajidae	37031034	*Dipturus wengi*	Weng's Skate	expanded from 37031000, PSS
65	BC	Chondrichthyan	Rajidae	37031035	*Dipturus acrobelus*	Deepwater Skate	expanded from 37031000, PSS
6173	BC	Chondrichthyan	Rajidae	37031040	*Rajella challengeri*	Challenger Skate	expanded from 37031000, PSS
6171	BC	Chondrichthyan	Rajidae	37031041	*Amblyraja hyperborea*	Arctic Skate	expanded from 37031000, PSS
764	BC	Chondrichthyan	Dasyatidae	37035001	*Bathytoshia brevicaudata*	Short-Tail Stingray	expanded from 37035000, PSS
767	BC	Chondrichthyan	Dasyatidae	37035002	*Bathytoshia lata*	Brown Stingray / Black Stingray	expanded from 37035000, PSS
816	BC	Chondrichthyan	Dasyatidae	37035010	*Pteroplatytrygon violacea*	Pelagic Stingray	expanded from 37035000, PSS
771	BC	Chondrichthyan	Urolophidae	37038001	*Urolophus bucculentus*	Sandyback Stingaree	PSS, also in 37038000, PSS

Table 2.10: *(continued)*

ERA Species ID	Role in Fishery	Taxa	Family Name	CAAB Code	Scientific Name	Common Name	Source(s)
772	BC	Chondrichthyan	Urolophidae	37038002	*Urolophus cruciatus*	Banded Stingaree	PSS, also in 37038000, PSS
22	BC	Chondrichthyan	Urolophidae	37038003	*Urolophus gigas*	Spotted Stingaree	expanded from 37038000, PSS
774	BC	Chondrichthyan	Urolophidae	37038004	*Urolophus paucimaculatus*	Sparsely-Spotted Stingaree	PSS, also in 37038000, PSS
23	BC	Chondrichthyan	Urolophidae	37038005	*Urolophus sufflavus*	Yellowback Stingaree	expanded from 37038000, PSS
775	BC	Chondrichthyan	Urolophidae	37038006	*Trygonoptera testacea*	Common Stingaree	expanded from 37038000, PSS
777	BC	Chondrichthyan	Urolophidae	37038007	*Urolophus viridis*	Greenback Stingaree	PSS, also in 37038000, PSS
6318	BC	Chondrichthyan	Urolophidae	37038014	*Trygonoptera imitata*	Shovelnose Stingaree	expanded from 37038000, PSS
8213	BC	Chondrichthyan	Urolophidae	37038024	*Urolophus sp. cf viridis [off Stanley]*	A Stingaree	expanded from 37038000, PSS
286	BC	Chondrichthyan	Callorhinchidae	37043001	*Callorhinchus milii*	Elephantfish	PSS
1265	BC	Invertebrate	Terebratellidae	19170001	*Magellania flavescens*	A Brachiopod	expanded from previous ERA
9539	BC	Invertebrate	Arcidae	23226001	*Anadara trapezia*	Sydney Cockle	expanded from 23226000, PSS
9540	BC	Invertebrate	Arcidae	23226006	*Barbatia parvivillosa*	An Ark Shell	expanded from 23226000, PSS
9541	BC	Invertebrate	Arcidae	23226019	*Barbatia pistachia*	An Ark Shell	expanded from 23226000, PSS
9542	BC	Invertebrate	Arcidae	23226044	*Bathyarca perversidens*	An Ark Shell	expanded from 23226000, PSS
9543	BC	Invertebrate	Limopsidae	23230001	*Limopsis penelevis*	A Dog Cockle	expanded from 23230000, PSS
9544	BC	Invertebrate	Limopsidae	23230003	*Limopsis tenisoni*	A Dog Cockle	expanded from 23230000, PSS
9545	BC	Invertebrate	Limopsidae	23230014	*Limopsis loringi*	A Dog Cockle	expanded from 23230000, PSS
9546	BC	Invertebrate	Limopsidae	23230025	*Limopsis bassi*	A Dog Cockle	expanded from 23230000, PSS
1267	BC	Invertebrate	Glycymerididae	23231001	*Glycymeris striatularis*	A Dog Cockle	expanded from previous ERA
1268	BC	Invertebrate	Glycymerididae	23231007	*Glycymeris grayana*	Shiny Dog Cockle	expanded from previous ERA
1800	BC	Invertebrate	Glycymerididae	23231010	*Tucetona flabellata*	A Dog Cockle	PSS
9549	BC	Invertebrate	Pinnidae	23245001	*Pinna dolabrata*	Razor Clam	PSS, also in 23245000, PSS
1269	BC	Invertebrate	Pinnidae	23245007	*Atrina tasmanica*	A Razor Clam	PSS, also in 23245000, PSS
1270	BC	Invertebrate	Ostreidae	23257002	*Ostrea angasi*	Native Oyster	expanded from 23257000, PSS

Table 2.10: *(continued)*

ERA Species ID	Role in Fishery	Taxa	Family Name	CAAB Code	Scientific Name	Common Name	Source(s)
7573	BC	Invertebrate	Pectinidae	23270005	*Equichlamys bifrons*	Queen Scallop	PSS
1273	BC	Invertebrate	Trigoniidae	23280002	*Neotrigonia margaritacea*	A Brooch Shell	expanded from previous ERA
1802	BC	Invertebrate	Carditidae	23325015	*Purpurocardia amabilis*	A Cockle	expanded from previous ERA
1274	BC	Invertebrate	Crassatellidae	23330004	*Eucrassatella kingicola*	A Cockle	PSS, also in 23330000, PSS
1275	BC	Invertebrate	Veneridae	23380001	*Dosinia caerulea*	Surf Clam	expanded from 23380000, PSS
9551	BC	Invertebrate	Veneridae	23380006	*Bassina pachyphylla*	A Venus Cockle	expanded from 23380000, 23380906, PSS
1515	BC	Invertebrate	Veneridae	23380040	*Circomphalus disjecta*	Wedding-Cake Cockle	expanded from 23380000, PSS
1276	BC	Invertebrate	Veneridae	23380041	*Placamen placidum*	A Venus Cockle	expanded from 23380000, PSS
1277	BC	Invertebrate	Veneridae	23380042	*Tawera gallinula*	A Venus Cockle	expanded from 23380000, PSS
1278	BC	Invertebrate	Veneridae	23380062	*Tawera lagopus*	A Venus Cockle	expanded from 23380000, PSS
1799	BC	Invertebrate	Corbulidae	23387001	*Corbula hydropica*	A Cockle	expanded from previous ERA
1801	BC	Invertebrate	Myochamidae	23422002	*Myochama anomoides*	A Bivalve	expanded from previous ERA
4637	BC	Invertebrate	Nautilidae	23600001	*Nautilus pompilius*	A Chambered Nautilus	expanded from 23600000, PSS
6306	BC	Invertebrate	Sepiidae	23607001	*Sepia apama*	Giant Cuttlefish	expanded from 23607000, PSS
7295	BC	Invertebrate	Sepiidae	23607002	*Sepia cultrata*	Cuttlefish	expanded from 23607000, PSS
7293	BC	Invertebrate	Sepiidae	23607014	*Sepia braggi*	Cuttlefish	expanded from 23607000, PSS
7294	BC	Invertebrate	Sepiidae	23607021	*Sepia hedleyi*	Cuttlefish	expanded from 23607000, PSS
1280	BC	Invertebrate	Loliginidae	23617005	*Sepioteuthis australis*	Southern Calamari	expanded from previous ERA
11	BC	Invertebrate	Ommastrephidae	23636004	*Nototodarus gouldi*	Gould's Squid	PSS
46	BC	Invertebrate	Ommastrephidae	23636011	*Todarodes filippovae*	Southern Ocean Arrow Squid	PSS
1285	BC	Invertebrate	Octopodidae	23659002	*Octopus berrima*	An Octopus	PSS, also in 23659000, PSS
9553	BC	Invertebrate	Octopodidae	23659003	*Macroctopus maorum*	Maori Octopus	PSS, also in 23659000, LOG, PSS
1286	BC	Invertebrate	Octopodidae	23659004	*Octopus pallidus*	Pale Octopus	PSS, also in 23659000, PSS

Table 2.10: *(continued)*

ERA Species ID	Role in Fishery	Taxa	Family Name	CAAB Code	Scientific Name	Common Name	Source(s)
762	BC	Invertebrate	Octopodidae	23659013	*Hapalochlaena maculosa*	Southern Blue-Ringed Octopus	PSS, also in 23659000, PSS
1288	BC	Invertebrate	Trochidae	24046137	*Clanculus undatus*	A Top Shell	expanded from previous ERA
1813	BC	Invertebrate	Calliostomatidae	24047003	*Astele subcarinata*	A Top Shell	expanded from previous ERA
1289	BC	Invertebrate	Turritellidae	24079001	*Maoricolpus roseus*	New Zealand Screw Shell	PSS
1815	BC	Invertebrate	Turritellidae	24079004	*Gazameda gunnii*	A Screw Shell	expanded from previous ERA
1290	BC	Invertebrate	Cypraeidae	24155005	*Notocypraea comptoni*	A Cowrie	expanded from 24155000, PSS
1816	BC	Invertebrate	Cypraeidae	24155023	*Umbilia hesitata hesitata*	A Cowrie	expanded from 24155000, PSS
1291	BC	Invertebrate	Cassidae	24171004	*Semicassis pyrum*	A Helmet Shell	expanded from 24171000, PSS
1811	BC	Invertebrate	Cassidae	24171027	*Semicassis semigranosa*	A Helmet Shell	expanded from 24171000, PSS
1292	BC	Invertebrate	Ranellidae	24176003	*Cabestana spengleri*	A Triton Shell	expanded from 24176922, PSS
1293	BC	Invertebrate	Ranellidae	24176006	*Monoplex parthenopeus*	A Triton Shell	expanded from 24176922, PSS
1294	BC	Invertebrate	Ranellidae	24176014	*Charonia lampas*	Red Triton Shell	expanded from 24176922, PSS
1295	BC	Invertebrate	Fasciolariidae	24202005	*Australaria australasia*	Tulip Shell	PSS, also in 24202000, PSS
9564	BC	Invertebrate	Nassariidae	24202006	*Nassarius (Alectrion) glans particeps*	Acorn Dog Whelk	expanded from 24202944, 24202000, PSS
9565	BC	Invertebrate	Nassariidae	24202007	*Nassarius (Niotha) pauperatus*	Impoverished Dog Whelk	expanded from 24202944, 24202000, PSS
9566	BC	Invertebrate	Nassariidae	24202008	*Tritia burchardi*	Burchard's Dog Whelk	expanded from 24202000, PSS
9567	BC	Invertebrate	Nassariidae	24202009	*Nassarius (Plicarcularia) jonasii*	Jonas's Dog Whelk	expanded from 24202944, 24202000, PSS
9568	BC	Invertebrate	Nassariidae	24202011	*Nassarius pyrrhus*	Banded Dog Whelk	expanded from 24202944, 24202000, PSS
2266	BC	Invertebrate	Buccinidae	24202026	*Penion maximus*	A Whelk	expanded from 24202000, PSS

Table 2.10: *(continued)*

ERA Species ID	Role in Fishery	Taxa	Family Name	CAAB Code	Scientific Name	Common Name	Source(s)
1296	BC	Invertebrate	Fasciolariidae	24202031	*Fusinus novaehollandiae*	A Spindle Shell	expanded from 24202000, PSS
9569	BC	Invertebrate	Nassariidae	24202127	*Nassarius (Alectrion) spiratus*	A Dog Whelk	expanded from 24202944, 24202000, PSS
9570	BC	Invertebrate	Nassariidae	24202128	*Tritia ephamilla*	A Dog Whelk	expanded from 24202000, PSS
9571	BC	Invertebrate	Nassariidae	24202129	*Nassarius (Hima) mobilis*	A Dog Whelk	expanded from 24202944, 24202000, PSS
9572	BC	Invertebrate	Nassariidae	24202130	*Reticunassa paupera*	Poor Dog Whelk	expanded from 24202000, PSS
9573	BC	Invertebrate	Nassariidae	24202144	*Nassarius (Niotha) nigellus*	Tasmanian Dog Whelk	expanded from 24202944, 24202000, PSS
9574	BC	Invertebrate	Nassariidae	24202157	*Nassarius (Plicarcularia) pullus*	Ribbed Dog Whelk	expanded from 24202944, 24202000, PSS
9575	BC	Invertebrate	Nassariidae	24202283	*Reticunassa compacta*	A Dog Whelk	expanded from 24202000, PSS
12	BC	Invertebrate	Volutidae	24207001	*Livonia mammilla*	False Bailer Shell	PSS, also in 24207000, PSS
1297	BC	Invertebrate	Volutidae	24207007	*Amoria undulata*	Wavy Volute	PSS, also in 24207000, PSS
1516	BC	Invertebrate	Volutidae	24207010	*Ericusa sowerbyi*	A Volute	expanded from 24207000, PSS
1518	BC	Invertebrate	Conidae	24222010	*Conus anemone*	A Cone Snail	expanded from previous ERA
1298	BC	Invertebrate	Chromodorididae	24432001	*Ceratosoma brevicaudatum*	A Nudibranch	expanded from 24420000 and previous ERA
1808	BC	Invertebrate	Luidiidae	25105001	*Luidia australiae*	A Seastar	PSS, also in 25102000, PSS
1299	BC	Invertebrate	Astropectinidae	25111017	*Bollonaster pectinatus*	A Seastar	expanded from 25102000, PSS
1300	BC	Invertebrate	Oreasteridae	25127039	*Nectria ocellata*	A Seastar	expanded from 25102000, PSS
1301	BC	Invertebrate	Echinasteridae	25143015	*Plectaster decanus*	A Seastar	expanded from 25102000, PSS
1302	BC	Invertebrate	Asteriidae	25154011	*Coscinasterias muricata*	Eleven-Arm Seastar	PSS, also in 25102000, PSS
1303	BC	Invertebrate	Ophiomyxidae	25166001	*Ophiomyxa australis*	A Brittlestar	expanded from 25160000, PSS
7569	BC	Invertebrate	Gorgonocephalidae	25171001	*Conocladus australis*	Southern Basketstar	expanded from 25160902, PSS

Table 2.10: *(continued)*

ERA Species ID	Role in Fishery	Taxa	Family Name	CAAB Code	Scientific Name	Common Name	Source(s)
9576	BC	Invertebrate	Gorgonocephalidae	25171002	*Astrothorax waitei*	A Basketstar	expanded from 25160902, PSS
9577	BC	Invertebrate	Gorgonocephalidae	25171017	*Astrosierra amblyconus*	A Basketstar	expanded from 25160902, PSS
9578	BC	Invertebrate	Gorgonocephalidae	25171020	*Astrothrombus rugosus*	A Basketstar	expanded from 25160902, PSS
9579	BC	Invertebrate	Gorgonocephalidae	25171023	*Gorgonocephalus pustulatum*	A Basketstar	expanded from 25160902, PSS
9580	BC	Invertebrate	Ophiuridae	25176004	*Ophiocten hastatum*	A Brittlestar	expanded from 25160000, PSS
9581	BC	Invertebrate	Astrophiuridae	25176005	*Ophiomisidium irene*	A Brittlestar	expanded from 25160000, PSS
9582	BC	Invertebrate	Ophiopyrgidae	25176006	*Ophioplinthus accomodata*	A Brittlestar	expanded from 25160000, PSS
9583	BC	Invertebrate	Ophiomusaidae	25176007	*Ophiomusium lymani*	A Brittlestar	expanded from 25160000, PSS
9584	BC	Invertebrate	Ophiopyrgidae	25176010	*Amphiophiura urbana*	A Brittlestar	expanded from 25160000, PSS
1803	BC	Invertebrate	Ophiuridae	25176016	*Ophiocrossota multispina*	A Brittlestar	expanded from 25160000, PSS
1519	BC	Invertebrate	Ophiolepididae	25176030	*Ophioplocus bispinosus*	A Brittlestar	expanded from 25160000, PSS
9585	BC	Invertebrate	Ophiopyrgidae	25176037	*Ophiura (Ophiura) kinbergi*	A Brittlestar	expanded from 25160000, PSS
9586	BC	Invertebrate	Ophiopyrgidae	25176040	*Ophiura (Ophiura) palliata*	A Brittlestar	expanded from 25160000, PSS
9587	BC	Invertebrate	Ophiopyrgidae	25176041	*Ophiura (Ophiuroglypha) rugosa*	A Brittlestar	expanded from 25160000, PSS
9588	BC	Invertebrate	Ophiopyrgidae	25176067	*Ophiopleura inermis*	A Brittlestar	expanded from 25160000, PSS
9589	BC	Invertebrate	Ophiosphalmidae	25176121	*Ophiosphalma armigerum*	A Brittlestar	expanded from 25160000, PSS
9590	BC	Invertebrate	Ophiopyrgidae	25176136	*Ophiura (Ophiuroglypha) irrorata*	A Brittlestar	expanded from 25160000, PSS

Table 2.10: *(continued)*

ERA Species ID	Role in Fishery	Taxa	Family Name	CAAB Code	Scientific Name	Common Name	Source(s)
1304	BC	Invertebrate	Ophionereididae	25179009	*Ophionereis schayeri*	A Brittlestar	expanded from 25160000, PSS
9591	BC	Invertebrate	Ophionereididae	25179016	*Ophioplax lamellosa*	A Brittlestar	expanded from 25160000, PSS
9592	BC	Invertebrate	Ophiodermatidae	25180001	*Bathypectinura heros*	A Brittlestar	expanded from 25160000, PSS
1305	BC	Invertebrate	Ophiodermatidae	25180013	*Ophiarachnella ramsayi*	A Brittlestar	expanded from 25160000, PSS
9593	BC	Invertebrate	Ophiopezidae	25180024	*Ophiopeza cylindrica*	A Brittlestar	expanded from 25160000, PSS
9594	BC	Invertebrate	Ophiocamacidae	25185009	*Ophiocamax applicatus*	A Brittlestar	expanded from 25160000, PSS
9595	BC	Invertebrate	Ophiacanthidae	25185011	*Ophiacantha alternata*	A Brittlestar	expanded from 25160000, PSS
9596	BC	Invertebrate	Ophiacanthidae	25185012	*Ophiacantha brachygnatha*	A Brittlestar	expanded from 25160000, PSS
9597	BC	Invertebrate	Ophiacanthidae	25185013	*Ophiacantha clavigera*	A Brittlestar	expanded from 25160000, PSS
9598	BC	Invertebrate	Ophiacanthidae	25185017	*Ophiacantha fidelis*	A Brittlestar	expanded from 25160000, PSS
9599	BC	Invertebrate	Ophiacanthidae	25185019	*Ophiacantha heterotyla*	A Brittlestar	expanded from 25160000, PSS
9600	BC	Invertebrate	Ophiacanthidae	25185023	*Ophiacantha sollicita*	A Brittlestar	expanded from 25160000, PSS
9601	BC	Invertebrate	Ophiacanthidae	25185029	*Ophiophthalmus relictus*	A Brittlestar	expanded from 25160000, PSS
9602	BC	Invertebrate	Ophiacanthidae	25185039	*Ophiolimna antarctica*	A Brittlestar	expanded from 25160000, PSS
9603	BC	Invertebrate	Ophiacanthidae	25185042	*Ophioplinthaca plicata*	A Brittlestar	expanded from 25160000, PSS
9604	BC	Invertebrate	Ophiacanthidae	25185045	*Ophiurothamnus clausa*	A Brittlestar	expanded from 25160000, PSS
9605	BC	Invertebrate	Ophiactidae	25190002	*Ophiactis abyssicola*	A Brittlestar	expanded from 25160000, PSS
9606	BC	Invertebrate	Ophiactidae	25190003	*Ophiactis hirta*	A Brittlestar	expanded from 25160000, PSS
9607	BC	Invertebrate	Ophiactidae	25190004	*Ophiactis amator*	A Brittlestar	expanded from 25160000, PSS
9608	BC	Invertebrate	Ophiactidae	25190013	*Ophiactis resiliens*	A Brittlestar	expanded from 25160000, PSS
9609	BC	Invertebrate	Ophiactidae	25190016	*Ophiactis tricolor*	A Brittlestar	expanded from 25160000, PSS
9610	BC	Invertebrate	Amphiuridae	25191015	*Amphipholis squamata*	A Brittlestar	expanded from 25160000, PSS

Table 2.10: *(continued)*

ERA Species ID	Role in Fishery	Taxa	Family Name	CAAB Code	Scientific Name	Common Name	Source(s)
9611	BC	Invertebrate	Amphiuridae	25191016	*Amphistigma minuta*	A Brittlestar	expanded from 25160000, PSS
9612	BC	Invertebrate	Amphiuridae	25191023	*Amphiura (Amphiura) constricta*	A Brittlestar	expanded from 25160000, PSS
9613	BC	Invertebrate	Amphiuridae	25191031	*Amphiura (Amphiura) magellanica*	A Brittlestar	expanded from 25160000, PSS
9614	BC	Invertebrate	Amphiuridae	25191039	*Amphiura (Amphiura) poecila*	A Brittlestar	expanded from 25160000, PSS
9615	BC	Invertebrate	Amphiuridae	25191054	*Ophiocentrus pilosus*	A Brittlestar	expanded from 25160000, PSS
9616	BC	Invertebrate	Ophiotrichidae	25192001	*Ophiothrix (Ophiothrix) aristulata*	A Brittlestar	expanded from 25160000, PSS
1306	BC	Invertebrate	Ophiotrichidae	25192002	*Ophiothrix caespitosa*	A Brittle-Star	expanded from 25160000, PSS
9619	BC	Invertebrate	Echinothuriidae	25205010	*Araeosoma thetidis*	A Sea Urchin	expanded from 25200000, PSS
9620	BC	Invertebrate	Echinothuriidae	25205011	*Hygrosoma hoplacantha*	A Sea Urchin	expanded from 25200000, PSS
1307	BC	Invertebrate	Temnopleuridae	25241005	*Amblypneustes ovum*	A Sea Urchin	expanded from 25200000, PSS
1520	BC	Invertebrate	Temnopleuridae	25241010	*Holopneustes inflatus*	A Sea Urchin	expanded from 25200000, PSS
1308	BC	Invertebrate	Echinometridae	25247001	*Heliocidaris erythrogramma*	Purple Sea Urchin	expanded from 25200000, PSS
1809	BC	Invertebrate	Laganidae	25266009	*Peronella peronii*	A Sand Dollar	expanded from previous ERA
9621	BC	Invertebrate	Thyonidae	25406038	*Thyone joshuai*	A Sea Cucumber	expanded from 25400000, 25400901, PSS
9622	BC	Invertebrate	Thyonidae	25406041	*Thyone tourvillei*	A Sea Cucumber	expanded from 25400000, 25400901, PSS
9623	BC	Invertebrate	Thyonidiidae	25408011	*Neoamphicyclus mutans*	A Sea Cucumber	expanded from 25400000, 25400901, PSS
1320	BC	Invertebrate	Stichopodidae	25417009	*Australostichopus mollis*	A Sea Cucumber	expanded from 25400000, 25400901, PSS
9625	BC	Invertebrate	Synallactidae	25418005	*Bathyplotes sulcatus*	A Sea Cucumber	expanded from 25400000, 25400901, PSS

Table 2.10: *(continued)*

ERA Species ID	Role in Fishery	Taxa	Family Name	CAAB Code	Scientific Name	Common Name	Source(s)
9626	BC	Invertebrate	Pseudostichopodidae	25418012	*Pseudostichopus hyalegerus*	A Sea Cucumber	expanded from 25400000, 25400901, PSS
9628	BC	Invertebrate	Synaptidae	25431002	*Leptosynapta dolabrifera*	A Sea Cucumber	PSS, also in 25400000, PSS, and 25400901, PSS
9629	BC	Invertebrate	Chiridotidae	25432005	*Scoliorhapis theeli*	A Sea Cucumber	expanded from 25400000, 25400901, PSS
9630	BC	Invertebrate	Chiridotidae	25432017	*Taeniogyrus papillis*	A Sea Cucumber	expanded from 25400000, 25400901, PSS
1823	BC	Invertebrate	Balanidae	27560004	*Balanus trigonus*	A Barnacle	expanded from previous ERA
7	BC	Invertebrate	Penaeidae	28711052	*Melicertus plebejus*	Eastern King Prawn	expanded from previous ERA
1339	BC	Invertebrate	Scyllaridae	28821001	*Ibacus alticrenatus*	Whitetail Bug	PSS, also in 28821904, PSS
1806	BC	Invertebrate	Scyllaridae	28821004	*Ibacus peronii*	Eastern Balmain Bug	PSS, also in 28821904, PSS
1341	BC	Invertebrate	Diogenidae	28827002	*Strigopagurus strigimanus*	Red Hermit Crab	expanded from 28825901, 28827000, PSS
2265	BC	Invertebrate	Diogenidae	28827087	*Areopaguristes tuberculatus*	Friendly Hermit Crab	expanded from 28825901, 28827000, PSS
1342	BC	Invertebrate	Dromiidae	28852002	*Lamarckdromia globosa*	Fringed Sponge Crab	expanded from previous ERA
1343	BC	Invertebrate	Dromiidae	28852004	*Metadromia wilsoni*	A Sponge Crab	expanded from previous ERA
1522	BC	Invertebrate	Dromiidae	28852010	*Stimdromia lateralis*	Ridged Sponge Crab	expanded from previous ERA
1344	BC	Invertebrate	Leucosiidae	28876003	*Bellidilia undecimspinosa*	Large Pebble Crab	expanded from previous ERA
1345	BC	Invertebrate	Majidae	28880008	*Notomithrax ursus*	A Decorator Crab	expanded from previous 28880000, PSS
1523	BC	Invertebrate	Majidae	28880010	*Leptomithrax gaimardii*	Great Spider Crab	expanded from previous 28880000, PSS
1348	BC	Invertebrate	Polybiidae	28911003	*Ovalipes australiensis*	Common Sand Crab	expanded from 28911901, 28708000, PSS
1349	BC	Invertebrate	Portunidae	28911004	*Nectocarcinus tuberculosus*	Velvet Crab	expanded from 28708000, PSS
9634	BC	Invertebrate	Carcinidae	28911009	*Carcinus maenas*	European Shore Crab	expanded from 28708000, PSS

Table 2.10: *(continued)*

ERA Species ID	Role in Fishery	Taxa	Family Name	CAAB Code	Scientific Name	Common Name	Source(s)
7583	BC	Invertebrate	Portunidae	28911010	*Nectocarcinus integrifrons*	Rough Rock Crab	expanded from 28708000, PSS
1350	BC	Invertebrate	Polybiidae	28911016	*Liocarcinus corrugatus*	Dwarf Swimmer Crab	expanded from 28708000, PSS
31	BC	Invertebrate	Polybiidae	28911020	*Ovalipes molleri*	A Swimmer Crab	PSS, also in 28911901, PSS
1351	BC	Invertebrate	Xanthidae	28920001	*Actaea peronii*	Thorn-Legged Crab	expanded from previous ERA
1353	BC	Invertebrate	Pilumnidae	28926057	*Pilumnus etheridgei*	A Hairy Crab	expanded from previous ERA
6685	BC	Teleost	Congridae	37067002	*Gnathophis longicauda*	Little Conger	expanded from 37067000, 37067922, PSS
554	BC	Teleost	Congridae	37067007	*Conger verreauxi*	Southern Conger	expanded from 37067000, 37067900, 37067922, PSS
811	BC	Teleost	Congridae	37067012	*Bassanago bulbiceps*	Swollenhead Conger	expanded from 37067000, 37067922, PSS
1477	BC	Teleost	Congridae	37067013	*Bassanago hirsutus*	Deepsea Conger	expanded from 37067000, 37067922, PSS
6323	BC	Teleost	Congridae	37067016	*Gnathophis umbrellabius*	Umbrella Conger	expanded from 37067000, 37067922, PSS
6324	BC	Teleost	Congridae	37067027	*Gnathophis macroporis*	Largepore Conger	expanded from 37067000, 37067922, PSS
928	BC	Teleost	Ophichthidae	37068001	*Ophisurus serpens*	Serpent Eel	expanded from previous ERA
929	BC	Teleost	Ophichthidae	37068003	*Scolecenchelys australis*	Shortfin Worm Eel	expanded from previous ERA
859	BC	Teleost	Aulopidae	37117001	*Latropiscis purpurissatus*	Sergeant Baker	PSS
867	BC	Teleost	Paraulopidae	37120001	*Paraulopus nigripinnis*	Blacktip Cucumberfish	expanded from 37120000, PSS
6336	BC	Teleost	Paraulopidae	37120008	*Paraulopus melanostomus*	Cucumberfish 1	expanded from 37120000, PSS
874	BC	Teleost	Gonorynchidae	37141001	*Gonorynchus greyi*	Beaked Salmon	PSS
6549	BC	Teleost	Brachionichthyidae	37209001	*Thymichthys verrucosus*	Warty Handfish	expanded from 37209000, PSS
6552	BC	Teleost	Brachionichthyidae	37209005	*Brachionichthys australis*	Australian Handfish	expanded from 37209000, PSS
8174	BC	Teleost	Brachionichthyidae	37209010	*Brachiopsilus dossenus*	A Handfish	expanded from 37209000, PSS

Table 2.10: *(continued)*

ERA Species ID	Role in Fishery	Taxa	Family Name	CAAB Code	Scientific Name	Common Name	Source(s)
8175	BC	Teleost	Brachionichthyidae	37209011	*Pezichthys amplispinus*	A Handfish	expanded from 37209000, PSS
8176	BC	Teleost	Brachionichthyidae	37209012	*Pezichthys compressus*	A Handfish	expanded from 37209000, PSS
8179	BC	Teleost	Brachionichthyidae	37209016	*Sympterichthys moultoni*	A Handfish	expanded from 37209000, PSS
906	BC	Teleost	Moridae	37224003	*Pseudophycis barbata*	Bearded Rock Cod	expanded from previous ERA
916	BC	Teleost	Moridae	37224006	*Pseudophycis bachus*	Red Cod	PSS
214	BC	Teleost	Cyttidae	37264002	*Cyttus australis*	Silver Dory	PSS
91	BC	Teleost	Centriscidae	37279001	*Centriscops humerosus*	Banded Bellowsfish	expanded from 37280000, PSS
90	BC	Teleost	Centriscidae	37279002	*Macroramphosus scolopax*	Common Bellowsfish	expanded from 37280000, PSS
92	BC	Teleost	Centriscidae	37279003	*Notopogon lilliei*	Crested Bellowsfish	expanded from 37280000, PSS
6358	BC	Teleost	Centriscidae	37279005	*Notopogon xenosoma*	Orange Bellowsfish	expanded from 37280000, PSS
941	BC	Teleost	Sebastidae	37287001	*Helicolenus percoides*	Reef Ocean Perch	PSS, also in 37287000, PSS
94	BC	Teleost	Neosebastidae	37287003	*Neosebastes pandus*	Bighead Gurnard Perch	PSS, also in 37287000, PSS
95	BC	Teleost	Neosebastidae	37287005	*Neosebastes scorpaenoides*	Common Gurnard Perch	PSS, also in 37287000, PSS
96	BC	Teleost	Neosebastidae	37287006	*Neosebastes thetidis*	Thetis Fish	expanded from 37287000, PSS
6416	BC	Teleost	Neosebastidae	37287007	*Maxillicosta scabriceps*	Little Gurnard Perch	expanded from 37287000, PSS
97	BC	Teleost	Scorpaenidae	37287008	*Scorpaena papillosa*	Southern Red Scorpionfish	PSS, also in 37287000, PSS
99	BC	Teleost	Tetrarogidae	37287018	*Gymnapistes marmoratus*	Soldier	expanded from 37287000, PSS
6651	BC	Teleost	Neosebastidae	37287019	*Neosebastes incisipinnis*	Incised Gurnard Perch	expanded from 37287000, PSS
100	BC	Teleost	Tetrarogidae	37287023	*Glyptauchen panduratus*	Goblinfish	expanded from 37287000, PSS

Table 2.10: *(continued)*

ERA Species ID	Role in Fishery	Taxa	Family Name	CAAB Code	Scientific Name	Common Name	Source(s)
101	BC	Teleost	Neosebastidae	37287045	*Maxillicosta whitleyi*	Whitley's Gurnard Perch	expanded from 37287000, PSS
102	BC	Teleost	Sebastidae	37287046	*Trachyscorpia eschmeyeri*	Deepsea Ocean Perch	expanded from 37287000, PSS
103	BC	Teleost	Tetrarogidae	37287048	*Centropogon australis*	Eastern Fortescue	expanded from 37287000, PSS
6653	BC	Teleost	Setarchidae	37287053	*Ectreposebastes niger*	Black Scorpionfish	expanded from 37287000, PSS
940	BC	Teleost	Sebastidae	37287093	*Helicolenus barathri*	Bigeye Ocean Perch	expanded from 37287000, PSS
2174	BC	Teleost	Sebastidae	37287103	*Trachyscorpia carnomagula*	Deepsea Scorpionfish	expanded from 37287000, PSS
6661	BC	Teleost	Neosebastidae	37287126	*Maxillicosta meridianus*	A Scorpionfish	expanded from 37287000, PSS
539	BC	Teleost	Triglidae	37288001	*Chelidonichthys kumu*	Red Gurnard	PSS, also in 37288000, PSS
104	BC	Teleost	Triglidae	37288002	*Lepidotrigla papilio*	Spiny Gurnard	expanded from 37288000, 37288801, PSS
106	BC	Teleost	Triglidae	37288003	*Lepidotrigla vanessa*	Butterfly Gurnard	PSS, also in 37288000, PSS
107	BC	Teleost	Peristediidae	37288004	*Peristedion picturatum*	Robust Amour Gurnard	expanded from 37288000, 37288902, PSS
108	BC	Teleost	Triglidae	37288005	*Pterygotrigla andertoni*	Painted Latchet	PSS, also in 37288000, PSS
109	BC	Teleost	Triglidae	37288006	*Pterygotrigla polyommata*	Latchet	PSS, also in 37288000, PSS
110	BC	Teleost	Triglidae	37288007	*Lepidotrigla modesta*	Cocky Gurnard	PSS, also in 37288000, PSS
111	BC	Teleost	Triglidae	37288008	*Lepidotrigla mulhalli*	Roundsnout Gurnard	PSS, also in 37288000, PSS
8300	BC	Teleost	Peristediidae	37288045	*Satyrichthys sp. W2*	An Armoured Gurnard	expanded from 37288000, 37288902, PSS
1037	BC	Teleost	Platycephalidae	37296001	*Platycephalus richardsoni*	Tiger Flathead	PSS, also in 37296000, PSS
113	BC	Teleost	Platycephalidae	37296002	*Platycephalus conatus*	Deepwater Flathead	expanded from 37296000, PSS
115	BC	Teleost	Platycephalidae	37296003	*Platycephalus bassensis*	Southern Sand Flathead	PSS, also in 37296000, PSS

Table 2.10: *(continued)*

ERA Species ID	Role in Fishery	Taxa	Family Name	CAAB Code	Scientific Name	Common Name	Source(s)
117	BC	Teleost	Platycephalidae	37296006	*Platycephalus laevigatus*	Rock Flathead	expanded from 37296000, PSS
2765	BC	Teleost	Platycephalidae	37296007	*Platycephalus caeruleopunctatus*	Bluespotted Flathead	expanded from 37296000, PSS
6214	BC	Teleost	Platycephalidae	37296011	*Ratabulus diversidens*	Orange-Freckled Flathead	expanded from 37296000, PSS
6	BC	Teleost	Platycephalidae	37296035	*Platycephalus aurimaculatus*	Toothy Flathead	expanded from 37296000, PSS
6401	BC	Teleost	Platycephalidae	37296036	*Platycephalus grandispinis*	Longspine Flathead	expanded from 37296000, PSS
118	BC	Teleost	Platycephalidae	37296037	*Platycephalus speculator*	Southern Bluespotted Flathead	expanded from 37296000, PSS
119	BC	Teleost	Platycephalidae	37296038	*Platycephalus marmoratus*	Marbled Flathead	expanded from 37296000, PSS
8304	BC	Teleost	Platycephalidae	37296045	*Thysanophrys cirronasus*	Tasselsnout Flathead	expanded from 37296000, PSS
122	BC	Teleost	Pegasidae	37309003	*Pegasus lancifer*	Sculptured Seamoth	expanded from previous ERA
123	BC	Teleost	Serranidae	37311001	*Lepidoperca pulchella*	Eastern Orange Perch	PSS
124	BC	Teleost	Serranidae	37311002	*Caesioperca lepidoptera*	Butterfly Perch	expanded from previous ERA
125	BC	Teleost	Serranidae	37311003	*Caesioperca rasor*	Barber Perch	PSS
930	BC	Teleost	Serranidae	37311036	*Hypoplectrodes maccullochi*	Halfbanded Seaperch	expanded from previous ERA
1822	BC	Teleost	Sillaginidae	37330002	*Sillago bassensis*	Southern School Whiting	expanded from previous ERA
1088	BC	Teleost	Carangidae	37337002	*Trachurus declivis*	Common Jack Mackerel	PSS

Table 2.10: *(continued)*

ERA Species ID	Role in Fishery	Taxa	Family Name	CAAB Code	Scientific Name	Common Name	Source(s)
156	BC	Teleost	Gerreidae	37349001	*Parequula melbournensis*	Silverbelly	PSS
1012	BC	Teleost	Latridae	37377003	*Nemadactylus macropterus*	Jackass Morwong	expanded from previous ERA
309	BC	Teleost	Labridae	37384018	*Dotalabrus aurantiacus*	Castelnau's Wrasse	expanded from previous ERA
188	BC	Teleost	Labridae	37384023	*Pseudolabrus rubicundus*	Rosy Wrasse	expanded from previous ERA
1824	BC	Teleost	Hemerocoetidae	37393008	*Enigmapercis reducta*	Broad Duckbill	expanded from previous ERA
192	BC	Teleost	Uranoscopidae	37400001	*Xenocephalus armatus*	Bulldog Stargazer	PSS
194	BC	Teleost	Uranoscopidae	37400003	*Kathetostoma laeve*	Common Stargazer	PSS
965	BC	Teleost	Uranoscopidae	37400018	*Kathetostoma canaster*	Speckled Stargazer	PSS
201	BC	Teleost	Callionymidae	37427001	*Foetorepus calauropomus*	Common Stinkfish	PSS
931	BC	Teleost	Callionymidae	37427014	*Eocallionymus papilio*	Painted Stinkfish	PSS
1087	BC	Teleost	Gempylidae	37439001	*Thyrsites atun*	Barracouta	PSS
1068	BC	Teleost	Centrolophidae	37445005	*Seriolella brama*	Blue Warehou	PSS
307	BC	Teleost	Bothidae	37460001	*Lophonectes gallus*	Crested Flounder	PSS, also in 37990009, PSS
8418	BC	Teleost	Bothidae	37460028	*Arnoglossus armstrongi*	Armstrong's Flounder	expanded from 37990009, PSS
7258	BC	Teleost	Bothidae	37460029	*Arnoglossus bassensis*	Bass Strait Flounder	expanded from 37990009, PSS
1821	BC	Teleost	Bothidae	37460030	*Arnoglossus muelleri*	Mueller's Flounder	expanded from 37990009, PSS
6298	BC	Teleost	Paralichthyidae	37460031	*Pseudorhombus tenuirastrum*	Slender Flounder	expanded from 37990009, PSS
222	BC	Teleost	Rhombosoleidae	37461001	*Ammotretis rostratus*	Longsnout Flounder	expanded from 37461916, 37990009, PSS
223	BC	Teleost	Rhombosoleidae	37461002	*Azygopus pinnifasciatus*	Banded-Fin Flounder	expanded from 37461916, 37990009, PSS
224	BC	Teleost	Rhombosoleidae	37461003	*Rhombosolea tapirina*	Greenback Flounder	PSS, also in 37461916, 37990009, PSS

Table 2.10: *(continued)*

ERA Species ID	Role in Fishery	Taxa	Family Name	CAAB Code	Scientific Name	Common Name	Source(s)
225	BC	Teleost	Rhombosoleidae	37461004	*Ammotretis lituratus*	Spotted Flounder	PSS, also in 37461916, 37990009, PSS
7265	BC	Teleost	Rhombosoleidae	37461011	*Taratretis derwentensis*	Derwent Flounder	expanded from 37461916, 37990009, PSS
8420	BC	Teleost	Rhombosoleidae	37461012	*Ammotretis macrolepis*	Largescale Flounder	expanded from 37461916, 37990009, PSS
26	BC	Teleost	Soleidae	37462010	*Zebrias scalaris*	Manyband Sole	expanded from 37462000, PSS
6414	BC	Teleost	Soleidae	37462017	*Brachirus nigra*	Black Sole	expanded from 37462000, PSS
311	BC	Teleost	Monacanthidae	37465002	*Acanthaluteres vittiger*	Toothbrush Leatherjacket	expanded from 37465000, 37465903, PSS
231	BC	Teleost	Monacanthidae	37465003	*Eubalichthys mosaicus*	Mosaic Leatherjacket	PSS, also in 37465000, 37465903, PSS
6819	BC	Teleost	Monacanthidae	37465004	*Meuschenia hippocrepis*	Horseshoe Leatherjacket	expanded from 37465000, 37465903, PSS
232	BC	Teleost	Monacanthidae	37465005	*Meuschenia scaber*	Velvet Leatherjacket	PSS, also in 37465000, 37465903, PSS
233	BC	Teleost	Monacanthidae	37465006	*Nelusetta ayraud*	Ocean Jacket	expanded from 37465000, 37465903, PSS
234	BC	Teleost	Monacanthidae	37465007	*Scobinichthys granulatus*	Rough Leatherjacket	expanded from 37465000, 37465903, PSS
235	BC	Teleost	Monacanthidae	37465008	*Meuschenia australis*	Brownstriped Leatherjacket	PSS, also in 37465000, 37465903, PSS
1178	BC	Teleost	Monacanthidae	37465009	*Monacanthus chinensis*	Fan-Bellied Leatherjacket	expanded from 37465000, 37465903, PSS
1400	BC	Teleost	Balistidae	37465011	*Abalistes stellatus*	Starry Triggerfish	expanded from 37465000, PSS
1182	BC	Teleost	Monacanthidae	37465024	*Paramonacanthus filicauda*	Threadfin Leatherjacket	expanded from 37465000, 37465903, PSS
6821	BC	Teleost	Monacanthidae	37465025	*Brachaluteres jacksonianus*	Southern Pygmy Leatherjacket	expanded from 37465000, 37465903, PSS
236	BC	Teleost	Monacanthidae	37465034	*Eubalichthys gunnii*	Gunn's Leatherjacket	PSS, also in 37465000, 37465903, PSS
6822	BC	Teleost	Monacanthidae	37465035	*Meuschenia flavolineata*	Yellowstriped Leatherjacket	expanded from 37465000, 37465903, PSS
237	BC	Teleost	Monacanthidae	37465036	*Meuschenia freycineti*	Sixspine Leatherjacket	expanded from 37465000, 37465903, PSS

Table 2.10: *(continued)*

ERA Species ID	Role in Fishery	Taxa	Family Name	CAAB Code	Scientific Name	Common Name	Source(s)
18	BC	Teleost	Monacanthidae	37465037	*Thamnaconus degeni*	Bluefin Leatherjacket	PSS, also in 37465000, 37465903, PSS
6438	BC	Teleost	Monacanthidae	37465039	*Eubalichthys bucephalus*	Black Reef Leatherjacket	expanded from 37465000, 37465903, PSS
7288	BC	Teleost	Monacanthidae	37465040	*Meuschenia galii*	Bluelined Leatherjacket	expanded from 37465000, 37465903, PSS
310	BC	Teleost	Monacanthidae	37465043	*Acanthaluteres spilomelanurus*	Bridled Leatherjacket	expanded from 37465000, 37465903, PSS
6828	BC	Teleost	Monacanthidae	37465060	*Meuschenia venusta*	Stars-And-Stripes Leatherjacket	expanded from 37465000, 37465903, PSS
239	BC	Teleost	Aracanidae	37466001	*Aracana ornata*	Ornate Cowfish	PSS
241	BC	Teleost	Aracanidae	37466003	*Aracana aurita*	Shaw's Cowfish	PSS
242	BC	Teleost	Tetraodontidae	37467001	*Contusus richei*	Barred Toadfish	expanded from 37467000, PSS
243	BC	Teleost	Tetraodontidae	37467002	*Omegophora armilla*	Ringed Toadfish	expanded from 37467000, PSS
244	BC	Teleost	Tetraodontidae	37467003	*Tetractenos glaber*	Smooth Toadfish	expanded from 37467000, PSS
245	BC	Teleost	Tetraodontidae	37467004	*Sphoeroides pachygaster*	Balloonfish	expanded from 37467000, PSS
246	BC	Teleost	Tetraodontidae	37467005	*Arothron firmamentum*	Starry Toadfish	expanded from 37467000, PSS
1256	BC	Teleost	Tetraodontidae	37467007	*Lagocephalus sceleratus*	Silver Toadfish	expanded from 37467000, PSS
2458	BC	Teleost	Tetraodontidae	37467008	*Lagocephalus inermis*	Smooth Golden Toadfish	expanded from 37467000, PSS
1258	BC	Teleost	Tetraodontidae	37467012	*Lagocephalus lunaris*	Rough Golden Toadfish	expanded from 37467000, PSS
1257	BC	Teleost	Tetraodontidae	37467017	*Lagocephalus spadiceus*	Brownback Toadfish	expanded from 37467000, PSS
4928	BC	Teleost	Tetraodontidae	37467023	*Lagocephalus lagocephalus*	Oceanic Puffer;Ocean Puffer	expanded from 37467000, PSS
248	BC	Teleost	Tetraodontidae	37467044	*Contusus brevicaudus*	Prickly Toadfish	PSS, also in 37467000, PSS

Table 2.10: *(continued)*

ERA Species ID	Role in Fishery	Taxa	Family Name	CAAB Code	Scientific Name	Common Name	Source(s)
6839	BC	Teleost	Tetraodontidae	37467050	*Reicheltia halsteadi*	Halstead's Toadfish	expanded from 37467000, PSS
6841	BC	Teleost	Tetraodontidae	37467056	*Torquigener altipinnis*	Highfin Toadfish	expanded from 37467000, PSS
6300	BC	Teleost	Triodontidae	37468001	*Triodon macropterus*	Threetooth Puffer	expanded from 37468000, PSS
249	BC	Teleost	Diodontidae	37469001	*Diodon nicthemerus*	Globefish	expanded from previous ERA
250	BC	Teleost	Diodontidae	37469002	*Allomycterus pilatus*	Australian Burrfish	PSS

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.

Protected species can be poorly listed by fisheries due to low frequency of direct interaction. Both direct (capture) and indirect (e.g., food source captured) interaction are considered in the ERAEF approach. A list of protected species has been generated for this fishery. In the absence of Observer coverage, annual pre-season BSCZSF surveys were used to generate this list. It is anticipated that this list be validated and reviewed by AFMA and stakeholders in a forthcoming RAG meeting.

Table 2.11: Protected species list for the Bass Strait Central Zone Scallop Fishery. PSS: refers to pre-season surveys.

ERA Species ID	Role in Fishery	Taxa	Family Name	CAAB Code	Scientific Name	Common Name	Source(s)
1073	PS	Teleost	Syngnathidae	37282029	*Solegnathus spinosissimus*	Spiny Pipehorse	PSS

[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).

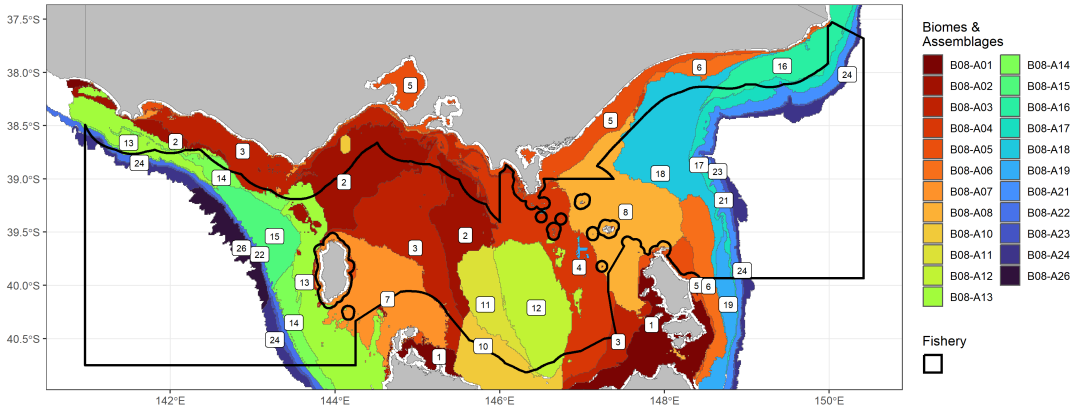


Figure 2.2: Map of the fishery region showing the biomes and assemblages derived by Pitcher et al. (2018). Please note that the map may contain biomes and assemblage numbers that do not overlap the fishery. Biomes: 08 = Southeast Australian shelf and slope region. For detailed descriptions of the biome and assemblage numbers, please refer to Table 2.12.

Since the previous assessments over a decade ago, there has been considerable research and habitat identification and modelling of demersal habitats around Australia and specifically in the SESSF region (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), a FRDC–funded project, which redefined much of the Australian seafloor based on mesoscale surrogates collated from data from biological surveys, environmental data, protected area/fishery closure data. Assemblages (=habitat) types were predicted, mapped (Figure 2.2) 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 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 22 habitat assemblages that overlap this fishery jurisdiction. Fishing occurred over benthic habitat assemblages 2, 3, 5, 6, 8, 11, 13, 15, 17, 18 and 21 corresponding to the Southeast Australian shelf and slope region Biome. Most effort occurred in assemblage 7, followed by 3, 6, 5 and 2 over the assessment period. Consequently, these assemblages were considered the most vulnerable assemblages in the Bass Strait Central Zone Scallop fishery.

Table 2.12: Benthic habitats that occur within the jurisdictional boundary of the Bass Strait Central Zone Scallop Fishery. Bold text denotes habitats where fishing effort has occurred (12 habitats).

Biome Number	Biome	ERAEF Assemblage Number	Habitat Type
08	**Southeast Australian shelf and slope region**	**2**	Shelf less than 100 m. Relatively diverse substrates ranging from sand, fine to course sediments, gravel, cobble, sedimentary rock or igneous rock outcrops (CSIRO image collection). Includes areas with encrusting mixed fauna (e.g., sponges, bryozoans, sea squirts, anemones and corals) and/or mixed sessile epifauna community (e.g., sponges, corals, sea squirts, brachypods and bivalves) (Passlow et al., (2006); Hobday et al. (2007b)).

Table 2.12: ***(continued)***

Biome Number	Biome	ERAEF Assemblage Number	Habitat Type
08	**Southeast Australian shelf and slope region**	**3**	Shelf less than 100 m. Relatively diverse substrates ranging from sand, fine to course sediments, gravel, cobble, sedimentary rock or igneous rock outcrops (CSIRO image collection). Includes areas with encrusting mixed fauna (e.g., sponges, bryozoans, sea squirts, anemones and corals) and/or mixed sessile epifauna community (e.g., sponges, corals, sea squirts, brachypods and bivalves) (Passlow et al., (2006); Hobday et al. (2007b)).
08	Southeast Australian shelf and slope region	4	Shelf less than 100 m. Relatively diverse substrates ranging from sand, fine to course sediments, gravel, cobble, sedimentary rock or igneous rock outcrops (CSIRO image collection). Includes areas with encrusting mixed fauna (e.g., sponges, bryozoans, sea squirts, anemones and corals) and/or mixed sessile epifauna community (e.g., sponges, corals, sea squirts, brachypods and bivalves) (Passlow et al., (2006); Hobday et al. (2007b)).
08	**Southeast Australian shelf and slope region**	**5**	Shelf less than 100 m. Relatively diverse substrates ranging from sand, fine to course sediments, gravel, cobble, sedimentary rock or igneous rock outcrops (CSIRO image collection). Includes areas with encrusting mixed fauna (e.g., sponges, bryozoans, sea squirts, anemones and corals) and/or mixed sessile epifauna community (e.g., sponges, corals, sea squirts, brachypods and bivalves) (Passlow et al., (2006); Hobday et al. (2007b)).
08	**Southeast Australian shelf and slope region**	**6**	Shelf less than 100 m. Relatively diverse substrates ranging from sand, fine to course sediments, gravel, cobble, sedimentary rock or igneous rock outcrops (CSIRO image collection). Includes areas with encrusting mixed fauna (e.g., sponges, bryozoans, sea squirts, anemones and corals) and/or mixed sessile epifauna community (e.g., sponges, corals, sea squirts, brachypods and bivalves) (Passlow et al., (2006); Hobday et al. (2007b)).
08	**Southeast Australian shelf and slope region**	**7**	Shelf less than 100 m. Relatively diverse substrates ranging from sand, fine to course sediments, gravel, cobble, sedimentary rock or igneous rock outcrops (CSIRO image collection). Includes areas with encrusting mixed fauna (e.g., sponges, bryozoans, sea squirts, anemones and corals) and/or mixed sessile epifauna community (e.g., sponges, corals, sea squirts, brachypods and bivalves) (Passlow et al., (2006); Hobday et al. (2007b)).
08	**Southeast Australian shelf and slope region**	**8**	Shelf less than 100 m. Relatively diverse substrates ranging from sand, fine to course sediments, gravel, cobble, sedimentary rock or igneous rock outcrops (CSIRO image collection). Includes areas with encrusting mixed fauna (e.g., sponges, bryozoans, sea squirts, anemones and corals) and/or mixed sessile epifauna community (e.g., sponges, corals, sea squirts, brachypods and bivalves) (Passlow et al., (2006); Hobday et al. (2007b)).

Table 2.12: ***(continued)***

Biome Number	Biome	ERAEF Assemblage Number	Habitat Type
08	Southeast Australian shelf and slope region	10	Shelf less than 100 m. Relatively diverse substrates ranging from sand, fine to course sediments, gravel, cobble or sedimentary rock or igneous rock outcrops (CSIRO image collection). Significant sponge communities present (Passlow et al., 2006). Includes areas with encrusting mixed fauna e.g., sponges, bryozoans, sea squirts, anemones and corals and/or mixed sessile epifauna community e.g., sponges, corals, sea squirts, brachypods, bivalves (Passlow et al., (2006); Hobday et al. (2007b)).
08	**Southeast Australian shelf and slope region**	**11**	Shelf less than 100 m. Relatively diverse substrates ranging from sand, fine to course sediments, gravel, cobble or sedimentary rock or igneous rock outcrops (CSIRO image collection). Significant sponge communities present (Passlow et al., 2006). Includes areas with encrusting mixed fauna e.g., sponges, bryozoans, sea squirts, anemones and corals and/or mixed sessile epifauna community e.g., sponges, corals, sea squirts, brachypods, bivalves (Passlow et al., (2006); Hobday et al. (2007b)).
08	Southeast Australian shelf and slope region	12	Shelf less than 100 m. Relatively diverse substrates ranging from sand, fine to course sediments, gravel, cobble or sedimentary rock or igneous rock outcrops (CSIRO image collection). Significant sponge communities present (Passlow et al., 2006). Includes areas with encrusting mixed fauna e.g., sponges, bryozoans, sea squirts, anemones and corals and/or mixed sessile epifauna community e.g., sponges, corals, sea squirts, brachypods, bivalves (Passlow et al., (2006); Hobday et al. (2007b)).
08	**Southeast Australian shelf and slope region**	**13**	Shelf less than 100 m. Relatively diverse substrates ranging from sand, fine to course sediments, gravel, cobble, sedimentary rock or igneous rock outcrops (CSIRO image collection). Includes areas with encrusting mixed fauna (e.g., sponges, bryozoans, sea squirts, anemones and corals) and/or mixed sessile epifauna community (e.g., sponges, corals, sea squirts, brachypods and bivalves) (Passlow et al., (2006); Hobday et al. (2007b)).
08	Southeast Australian shelf and slope region	14	Shelf less than 100 m. Relatively diverse substrates ranging from sand, fine to course sediments, gravel, cobble, sedimentary rock or igneous rock outcrops (CSIRO image collection). Includes areas with encrusting mixed fauna (e.g., sponges, bryozoans, sea squirts, anemones and corals) and/or mixed sessile epifauna community (e.g., sponges, corals, sea squirts, brachypods and bivalves) (Passlow et al., (2006); Hobday et al. (2007b)).

Table 2.12: ***(continued)***

Biome Number	Biome	ERAEF Assemblage Number	Habitat Type
08	**Southeast Australian shelf and slope region**	**15**	Shelf less than 100 m. Relatively diverse substrates ranging from sand, fine to course sediments, gravel, cobble, sedimentary rock or igneous rock outcrops (CSIRO image collection). Includes areas with encrusting mixed fauna (e.g., sponges, bryozoans, sea squirts, anemones and corals) and/or mixed sessile epifauna community (e.g., sponges, corals, sea squirts, brachypods and bivalves) (Passlow et al., (2006); Hobday et al. (2007b)).
08	Southeast Australian shelf and slope region	16	Shelf less than 100 m. Relatively diverse substrates ranging from sand, fine to course sediments, gravel, cobble, sedimentary rock or igneous rock outcrops (CSIRO image collection). Includes areas with encrusting mixed fauna (e.g., sponges, bryozoans, sea squirts, anemones and corals) and/or mixed sessile epifauna community (e.g., sponges, corals, sea squirts, brachypods and bivalves) (Passlow et al., (2006); Hobday et al. (2007b)).
08	**Southeast Australian shelf and slope region**	**17**	Relatively diverse substrates ranging from sand, fine to course sediments, gravel, cobble, sedimentary rock or igneous rock outcrops (CSIRO image collection). Includes areas with encrusting mixed fauna (e.g., sponges, bryozoans, sea squirts, anemones and corals) and/or mixed sessile epifauna community (e.g., sponges, corals, sea squirts, brachypods and bivalves) (Passlow et al., (2006); Hobday et al. (2007b)).
08	**Southeast Australian shelf and slope region**	**18**	Relatively diverse substrates ranging from sand, fine to course sediments, gravel, cobble, sedimentary rock or igneous rock outcrops (CSIRO image collection). Includes areas with encrusting mixed fauna (e.g., sponges, bryozoans, sea squirts, anemones and corals) and/or mixed sessile epifauna community (e.g., sponges, corals, sea squirts, brachypods and bivalves) (Passlow et al., (2006); Hobday et al. (2007b)).
08	Southeast Australian shelf and slope region	19	Relatively diverse substrates ranging from sand, fine to course sediments, gravel, cobble, sedimentary rock or igneous rock outcrops (CSIRO image collection). Includes areas with encrusting mixed fauna (e.g., sponges, bryozoans, sea squirts, anemones and corals) and/or mixed sessile epifauna community (e.g., sponges, corals, sea squirts, brachypods and bivalves) (Passlow et al., (2006); Hobday et al. (2007b)).
08	**Southeast Australian shelf and slope region**	**21**	Relatively diverse substrates ranging from sand, fine to course sediments, gravel, cobble, sedimentary rock or igneous rock outcrops (CSIRO image collection). Includes areas with encrusting mixed fauna (e.g., sponges, bryozoans, sea squirts, anemones and corals) and/or mixed sessile epifauna community (e.g., sponges, corals, sea squirts, brachypods and bivalves) (Passlow et al., (2006); Hobday et al. (2007b)).

Table 2.12: *(continued)*

Biome Number	Biome	ERAEF Assemblage Number	Habitat Type
08	Southeast Australian shelf and slope region	22	Diverse substrates and some canyons. Some areas with diverse encrusting mixed fauna (e.g., sponges, bryozoans, sea squirts, anemones and corals) and/or diverse sessile epifauna community (e.g., sponges, corals, sea squirts, brachypods, bivalves).
08	Southeast Australian shelf and slope region	23	Diverse substrates and some canyons. Some areas with diverse encrusting mixed fauna (e.g., sponges, bryozoans, sea squirts, anemones and corals) and/or diverse sessile epifauna community (e.g., sponges, corals, sea squirts, brachypods, bivalves).
08	Southeast Australian shelf and slope region	24	Relatively diverse substrates ranging from sand, fine to course sediments, gravel, cobble, sedimentary rock or igneous rock outcrops (CSIRO image collection). Includes areas with encrusting mixed fauna (e.g., sponges, bryozoans, sea squirts, anemones and corals) and/or mixed sessile epifauna community (e.g., sponges, corals, sea squirts, brachypods and bivalves) (Passlow et al., (2006); Hobday et al. (2007b)).
08	Southeast Australian shelf and slope region	26	Relatively diverse substrates ranging from sand, fine to course sediments, gravel, cobble, sedimentary rock or igneous rock outcrops (CSIRO image collection). Includes areas with encrusting mixed fauna (e.g., sponges, bryozoans, sea squirts, anemones and corals) and/or mixed sessile epifauna community (e.g., sponges, corals, sea squirts, brachypods and bivalves) (Passlow et al., (2006); Hobday et al. (2007b)).

Scoping Document S2B2. Pelagic Habitats

Table 2.13: Pelagic habitats for the Bass Strait Central Zone Scallop 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

Table 2.13: *(continued)*

ERAEF Pelagic Habitat No.	Pelagic Habitat type	Depth (m)	Comments	Source
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**
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 a 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

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. (2007a) and briefly outlined in the footnotes to the community Tables below.

Table 2.14: 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 Bass Strait Central Zone Scallop 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		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 2.14: ***(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
Seamount 0 – 110 m			■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Seamount 110 – 250 m			■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Seamount 250 – 565 m			■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Seamount 565 – 820 m			■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Seamount 820 – 1100 m			■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Seamount > 1100 m	■							■	■	■	■	■	■	■	■	■	■	■	■
Plateau 0 – 110 m	■			■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Plateau 110 – 250 m	■			■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Plateau 250 – 565 m	■			■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Plateau 565 – 820 m	■			■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Plateau 820 – 1100 m	■					■	■	■	■	■	■	■	■		■	■	■	■	■
Shelf (Territorial Seas) 0 – 100 m	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■		■
Shelf 0 – 250 m²	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	
Upper-Mid Slope 250 – 1100 m³	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■		■
Inner Heard Plateau 100 – 500 m⁴	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■		
Outer Heard Plateau 100 – 500 m⁴	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■		
Shell Bank 100 – 500 m⁴	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■		
Western Banks 200 – 500 m⁴	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■		
North Eastern Plateau 500 – 1000 m⁵	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■		
North Eastern Trough 500 – 1000 m⁵	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■		
South Eastern Trough 500 – 1000 m⁵	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■		

Table 2.14: ***(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 > 1100 m																			

Note:

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

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

At Heard/McDonald Islands: [4] outer and upper slope plateau communities combined to form four communities: Shell Bank, inner and outer Heard Plateau (100-500 m) and Western Banks (200-500 m), [5] mid and upper plateau communities combined into 3 trough, southern slope and North Eastern plateau communities (500-1000 m), and [6] 2 groups at Heard Is: Deep Shell Bank (>1000 m) 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 2.15: Pelagic communities in which fishing activity occurs in the Bass Strait Central Zone Scallop 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			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								
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 2.16.

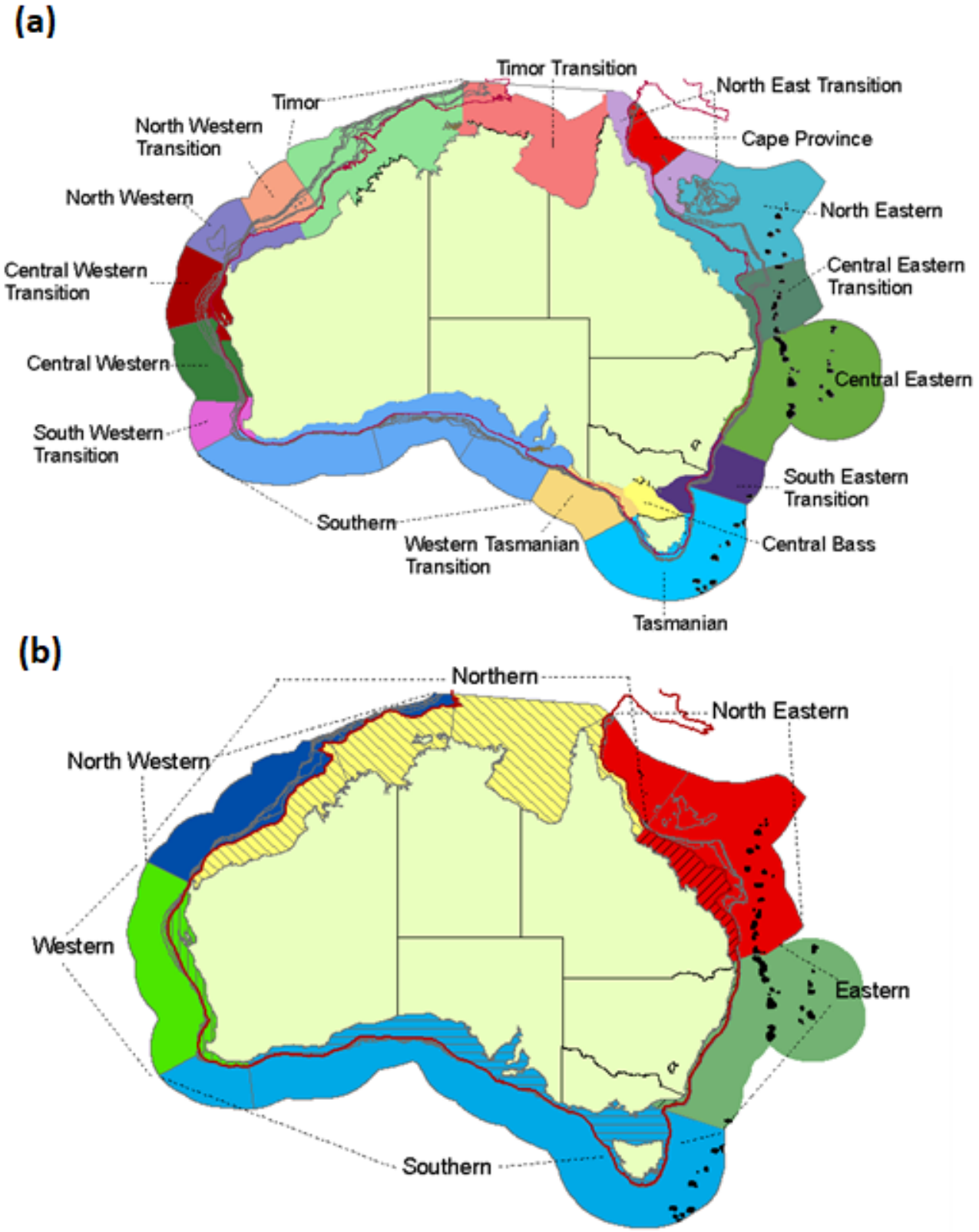


Figure 2.3: (a) Demersal communities around mainland Australia based on bioregionalisation schema. Some inshore (0-110 m) communities comprise more than one community e.g., Timor Transition comprises four distinct communities. (b) Australian pelagic provinces. Hatched areas indicate coastal epipelagic zones overlying the shelf. Offshore (oceanic) provinces comprise two or more overlaying pelagic zones as indicated in Table 2.15. Seamounts (black) and plateaux (light green) are illustrated in their demersal or pelagic provinces.

Table 2.16: 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. PSS: refers to pre-season surveys. LOG: refers to AFMA Logbook data.

Role in Fishery	Taxa	Family Name	CAAB Code	Scientific Name	Common Name	Rationale
BC	Chondrichthyan	Dasyatidae	37035000	Dasyatidae - undifferentiated	Stingrays	PSS, added 3 species to list (37035001, 37035002, 37035010)
BC	Chondrichthyan	Hexanchidae	37005000	Hexanchidae - undifferentiated	Cowsharks	PSS, added 3 species to list (37005001, 37005002, 37005005)
BC	Chondrichthyan	Pristiophoridae	37023900	*Pristiophorus* spp.	Sawshark	PSS, 1 existing species in list (37023001), added 2 species to list (37023002, 37023003)
BC	Chondrichthyan	Rajidae & Arhynchobatidae	37031000	Rajidae, Arhynchobatidae - undifferentiated	Skates	PSS, 5 existing species in list (37031003, 37031005, 37031006, 37031007, 37031009), added 8 species to list (37031010, 37031018, 37031023, 37031028, 37031034, 37031035, 37031040, 37031041)
BC	Chondrichthyan	Scyliorhinidae	37015000	Scyliorhinidae - undifferentiated	Catsharks	PSS, 1 existing species in list: 37015001, added 5 species to list (37015003, 37015009, 37015013, 37015024, 37015027)
BC	Chondrichthyan	Scyliorhinidae	37015906	*Cephaloscyllium* spp.	Cephaloscyllium (u)	PSS, 1 existing species in list (37015001), added 1 species to list: 37015013
BC	Chondrichthyan	Squatinidae	37024900	*Squatina* spp.	Angel shark	PSS, 1 existing species in list (37024001), added 1 species to list: 37024004
BC	Chondrichthyan	Urolophidae	37038904	Urolophidae - undifferentiated	Stingaree & giant stingaree (u)	PSS, 4 existing species in list (37038001, 37038002, 37038004, 37038007), added 5 species to list (37038003, 37038005, 37038006, 37038014, 37038024)
BC	Chondrichthyan				Shark egg (u)	PSS, insufficient taxonomic resolution
BC	Invertebrate	Acanthephyridae	28735000	Acanthephyridae - undifferentiated	Carid prawns	PSS, potential species depth distribution likely outside fishery depth range [28735005, 28735007]
BC	Invertebrate	Alcyoniidae	11176000	Alcyoniidae - undifferentiated	Soft corals	PSS, insufficient taxonomic resolution, part of benthos
BC	Invertebrate	Amphiuridae	25191000	Class Ophiuroidea - undifferentiated	Brittlestars	PSS, added 6 species to list (25191015, 25191016, 25191023, 25191031, 25191039, 25191054)

Table 2.16: *(continued)*

Role in Fishery	Taxa	Family Name	CAAB Code	Scientific Name	Common Name	Rationale
BC	Invertebrate	Arcidae	23226000	Arcidae	Limopsoidea	PSS, added 4 species to list (23226001, 23226006, 23226019, 23226044)
BC	Invertebrate	Astrophiuridae	25176954	Class Ophiuroidea - undifferentiated	Brittlestars	PSS, added 1 species to list: 25176005
BC	Invertebrate	Bathyteuthidae	23632000	Bathyteuthidae - undifferentiated	Deepsea squids	PSS, insufficient taxonomic resolution, possible mis-identification: outside fishery area
BC	Invertebrate	Buccinidae	24202904	Buccinidae - undifferentiated	Whelk 1	PSS, added 1 species to list: 24202026
BC	Invertebrate	Carcinidae	28911935	Carcinidae - undifferentiated	Swimmer Crab	PSS, added 1 species to list: 28911009
BC	Invertebrate	Cassidae	24171000	Cassidae - undifferentiated	Helmet shells	PSS, added 2 species to list (24171004, 24171027)
BC	Invertebrate	Charoniidae	24176923	Charoniidae - undifferentiated	Triton shells	PSS, insufficient taxonomic resolution, added 1 Charonia species to list: 24176014
BC	Invertebrate	Chiridotidae	25432000	Class Holothuroidea - undifferentiated	Holothurians	PSS, added 2 species to list (25432005, 25432017)
BC	Invertebrate	Crassatellidae	23330000	Crassatellidae	Crassatelloidea (u)	PSS, 1 existing species in list: 23330004
BC	Invertebrate	Cucumariidae	25408951	Class Holothuroidea - undifferentiated	Holothurians	PSS, this family unlikely in fishery area. Species from this class have been added from higher group codes (25432005, 25432017, 25418012, 25418005, 25417009, 25408011, 35406038, 25406041)
BC	Invertebrate	Cymatiidae	24176921	Cymatiidae undifferentiated	Triton shells	PSS, added 9 species to list (24176001, 24176003, 24176004, 24176012, 24176015, 24176016, 24176017, 24176049, 24176057)
BC	Invertebrate	Cypraeidae	24155000	Cypraeidae - undifferentiated	A cowry	PSS, added 2 species to list (24155005, 24155023)
BC	Invertebrate	Diogenidae	28827000	Diogenidae	Hermit Crab	PSS, added 2 species to list (28827002, 28827087)
BC	Invertebrate	Echinometridae	25247006	Heterocentrotus mamillatus	Slate pencil urchin	PSS, possible mis-identification: outside fishery area
BC	Invertebrate	Echinothuriidae	25205000	Echinothuriidae	Sea Urchin	PSS, added 2 species to list (5205010, 25205011)
BC	Invertebrate	Eunicidae	22024000	Eunicidae	Polychaete	PSS, insufficient taxonomic resolution, part of benthos
BC	Invertebrate	Gorgonocephalidae	25171000	Ophiuroids - undifferentiated	Brittlestars	PSS, added 5 species to list (25171001, 25171002, 25171017, 25171020, 25171023)
BC	Invertebrate	Hemieuryalidae	25186000	Class Ophiuroidea - undifferentiated	Brittlestars	PSS, added 1 species to list: 25186015

Table 2.16: *(continued)*

Role in Fishery	Taxa	Family Name	CAAB Code	Scientific Name	Common Name	Rationale
BC	Invertebrate	Limopsidae	23230000	Limopsidae - undifferentiated	Dog cockles	PSS, added 4 species to list (23230001, 23230003, 23230014, 23230025)
BC	Invertebrate	Merulinidae	11305002	*Dipsastraea amicorum*	A stony coral	PSS, insufficient taxonomic resolution, part of benthos
BC	Invertebrate	Mytilidae	23220001	*Mytilus galloprovincialis*	Blue Mussel	PSS, possible mis-identification: outside fishery area
BC	Invertebrate	Nassariidae	24202902	Nassariidae - undifferentiated	Whelk 2	PSS, added 12 species to list (24202006, 24202007, 24202008, 24202009, 24202011, 24202127, 24202128, 24202129, 24202130, 24202144, 24202157, 24202283)
BC	Invertebrate	Nassariidae	24202944	*Nassarius* spp.	Dog whelks	PSS, added 8 species to list (24202006, 24202007, 24202009, 24202011, 24202127, 24202129, 24202144, 24202157)
BC	Invertebrate	Nautilidae	23600000	Nautilidae - undifferentiated	Chambered nautiluses	PSS, added 1 species to list: 23600001
BC	Invertebrate	Octopodidae	23659000	Octopodidae - undifferentiated	Octopuses	LOG, 4 existing species in list (23659002, 23659003, 23659004, 23659013)
BC	Invertebrate	Octopodidae	23659921	Octopodidae	Octopus	PSS, 4 existing species in list (23659002, 23659003, 23659004, 23659013)
BC	Invertebrate	Ophiacanthidae	25185951	Class Ophiuroidea - undifferentiated	Brittlestars	PSS, added 10 species to list (25185011, 25185012, 25185013, 25185017, 25185019, 25185023, 25185029, 25185039, 25185042, 25185045)
BC	Invertebrate	Ophiactidae	25190000	Class Ophiuroidea - undifferentiated	Brittlestars	PSS, added 5 species to list (25190002, 25190003, 25190004, 25190013, 25190016)
BC	Invertebrate	Ophiocamacidae	25185962	Class Ophiuroidea - undifferentiated	Brittlestars	PSS, added 1 species to list: 25185009
BC	Invertebrate	Ophiodermatidae	25180921	Class Ophiuroidea - undifferentiated	Brittlestars	PSS, added 2 species to list (25180001, 25180013)
BC	Invertebrate	Ophiomusaidae	25176952	Class Ophiuroidea - undifferentiated	Brittlestars	PSS, added 1 species to list: 25176007
BC	Invertebrate	Ophiomyxidae	25166000	Class Ophiuroidea - undifferentiated	Brittlestars	PSS, added 1 species to list: 25166001
BC	Invertebrate	Ophionereididae	25179911	Class Ophiuroidea - undifferentiated	Brittlestars	PSS, added 2 species to list (25179009, 25179016)
BC	Invertebrate	Ophiopezidae	25180922	Class Ophiuroidea - undifferentiated	Brittlestars	PSS, added 1 species to list: 25180024
BC	Invertebrate	Ophiopyrgidae	25176955	Class Ophiuroidea - undifferentiated	Brittlestars	PSS, added 6 species to list (25176006, 25176010, 25176037, 25176041, 25176067, 25176136)

Table 2.16: *(continued)*

Role in Fishery	Taxa	Family Name	CAAB Code	Scientific Name	Common Name	Rationale
BC	Invertebrate	Ophiosphalmidae	25176953	Class Ophiuroidea - undifferentiated	Brittlestars	PSS, added 1 species to list: 25176121
BC	Invertebrate	Ophiotrichidae	25192000	Class Ophiuroidea - undifferentiated	Brittlestars	PSS, added 2 species to list (25192001, 25192002)
BC	Invertebrate	Ophiuridae	25176951	Class Ophiuroidea - undifferentiated	Brittlestars	PSS, added 3 species to list (25176004, 25176016, 25176040)
BC	Invertebrate	Ostreidae	23257000	Ostreidae - undifferentiated	Oyster	PSS, added 1 species to list: 23257002
BC	Invertebrate	Pennatulidae	11219000	Pennatulidae	Sea pen	PSS, insufficient taxonomic resolution, part of benthos
BC	Invertebrate	Pinnidae	23245000	Pinnidae - undifferentiated	razor clams	PSS, 2 existing species in list (23245001, 23245007)
BC	Invertebrate	Polybiidae	28911901	*Ovalipes* spp.	Sand Crabs	PSS, 1 existing species in list (28911020), added 1 species to list: 28911003
BC	Invertebrate	Polybiidae	28911932	Polybiidae - undifferentiated	Swimmer Crab	PSS, 1 existing species in list: 28911020, added 2 species to list (28911003, 28911016)
BC	Invertebrate	Portunidae	28911931	Portunidae - undifferentiated	Swimmer Crab	PSS, added 2 species to list (28911004, 28911010)
BC	Invertebrate	Pseudostichopodidae	25418913	Class Holothuroidea - undifferentiated	Holothurians	PSS, added 1 species to list (25418012)
BC	Invertebrate	Pyuridae	35032000	Pyuridae - undifferentiated	Ascidians	PSS, insufficient taxonomic resolution, likely part of benthos
BC	Invertebrate	Ranellidae	24176922	Ranellidae - undifferentiated	Ranellidae	PSS, added 2 species to list (24176006, 24176014)
BC	Invertebrate	Scyllaridae	28821903	*Thenus* spp.	Moreton Bay Bugs	PSS, possible mis-identification: outside fishery area
BC	Invertebrate	Scyllaridae	28821904	*Ibacus* spp. & *Thenus* spp.	Bugs	PSS, 2 existing Ibacus species in list (28821001, 28821004), Thenus spp. not known to fishery area
BC	Invertebrate	Sepiidae	23607000	Sepiidae - undifferentiated	Cuttlefish	PSS, 1 existing species in list: 23607001, added 3 species to list (23607002, 23607014, 23607021)
BC	Invertebrate	Stichopodidae	25417000	Class Holothuroidea - undifferentiated	Holothurians	PSS, added 1 species to list: 25417009
BC	Invertebrate	Synallactidae	25418911	Class Holothuroidea - undifferentiated	Holothurians	PSS, added 1 species to list: 25418005
BC	Invertebrate	Thyonidae	25406922	Class Holothuroidea - undifferentiated	Holothurians	PSS, added 2 species to list (25406038, 25406041)
BC	Invertebrate	Thyonidiidae	25408952	Class Holothuroidea - undifferentiated	Holothurians	PSS, added 1 species to list: 25408011
BC	Invertebrate	Veneridae	23380000	Veneridae - undifferentiated	Venus shells	PSS, added 6 species to list (23380001, 23380006, 23380040, 23380041, 23380042, 23380062)
BC	Invertebrate	Veneridae	23380906	Bassina spp.	A bivalve	PSS, added 1 species to list: 23380006

Table 2.16: *(continued)*

Role in Fishery	Taxa	Family Name	CAAB Code	Scientific Name	Common Name	Rationale
BC	Invertebrate	Volutidae	24207000	Volutidae - undifferentiated	Volutes	PSS, 2 existing species in list (24207001, 24207007), added 1 species to list: 24207010
BC	Invertebrate		11000000	Class Hydrozoa	Hydroids	PSS, insufficient taxonomic resolution
BC	Invertebrate		11120000	Class Scyphozoa - undifferentiated	Jellyfish	PSS, insufficient taxonomic resolution
BC	Invertebrate		11168000	Coral	Coral	PSS, insufficient taxonomic resolution, part of benthos
BC	Invertebrate		11208000	Order Pennatulacea - undifferentiated	Sea pens	PSS, insufficient taxonomic resolution, part of benthos
BC	Invertebrate		22000000	Class Polychaeta - undifferentiated	Polychaete worms	PSS, insufficient taxonomic resolution, part of benthos
BC	Invertebrate		23000000	Phylum Mollusca - undifferentiated	Mollusc	PSS, insufficient taxonomic resolution
BC	Invertebrate		23300000	Order Veneroidea - undifferentiated	Veneroidea (u)	PSS, insufficient taxonomic resolution
BC	Invertebrate		24000000	Class Gastropoda - undifferentiated	Gastropods	PSS, insufficient taxonomic resolution
BC	Invertebrate		24420000	Order Nudibranchia - undifferentiated	Nudibranchs	PSS, insufficient taxonomic resolution
BC	Invertebrate		25000000	Phylum Echinodermata	Echinoderms	PSS, insufficient taxonomic resolution
BC	Invertebrate		25001000	Class Crinoidea - undifferentiated	Crinoid	PSS, insufficient taxonomic resolution
BC	Invertebrate		25102000	Class Asteroidea	Seastar	PSS, 2 existing seastar species in list (25102001, 25154011), added 3 species to list (25111017, 25127039, 25143015)
BC	Invertebrate		28708000	Decapoda	Decapod	PSS, insufficient taxonomic resolution, added 5 swimmer crab species from three families existing in fishery area (28911931, 28911932, 28911935)
BC	Invertebrate		28850000	Infraorder Brachyura - undifferentiated	Crabs	PSS, insufficient taxonomic resolution
BC	Invertebrate		35000000	Class Ascidiacea - undifferentiated	Ascidian	PSS, insufficient taxonomic resolution, likely part of benthos
BC	Invertebrate				Cockle 1	PSS, insufficient taxonomic resolution
BC	Invertebrate				Mollusc shell	PSS, insufficient taxonomic resolution
BC	Invertebrate				Starfish	PSS, already expanded on from 25102000
BC	Invertebrate				Whelks - undifferentiated	PSS, insufficient taxonomic resolution, part of benthos
BC	Sponge	Corallistidae	10038000	Corallistidae - undifferentiated	Sponges	PSS, insufficient taxonomic resolution, part of benthos
BC	Sponge	Grantiidae	10216000	Grantiidae - undifferentiated	Sponges	PSS, insufficient taxonomic resolution, part of benthos

Table 2.16: *(continued)*

Role in Fishery	Taxa	Family Name	CAAB Code	Scientific Name	Common Name	Rationale
BC	Sponge	Polymastiidae	10025902	*Polymastia* spp.	A sponge	PSS, insufficient taxonomic resolution, part of benthos
BC	Teleost	Ariidae	37188010	*Neoarius midgleyi*	Silver cobbler	PSS, possible mis-identification: outside fishery area
BC	Teleost	Balistidae	37465900	Balistidae - undifferentiated	Triggerfishes	PSS, added 1 species to list: 37465011
BC	Teleost	Bathysauroididae	37120908	Bathysauroididae - undifferentiated	Cucumberfishes, greeneyes & flathead lizardfishes	PSS, possible mis-identification: outside fishery area and/or depth
BC	Teleost	Bathysauropsidae	37120909	Bathysauropsidae - undifferentiated	Cucumberfishes, greeneyes & flathead lizardfishes	PSS, possible mis-identification: outside fishery area and depth
BC	Teleost	Bothidae	37460922	Bothidae - undifferentiated	Flounder	PSS, 1 existing species in list: 37460001, added 3 species to list (37460028, 37460029, 37460030)
BC	Teleost	Brachionichthyidae	37209000	Brachionichthyidae - undifferentiated	Handfishes	PSS, added 6 species to list (37209001, 37209005, 37209010, 37209011, 37209012, 37209016)
BC	Teleost	Centriscidae: Macroramphosinae	37279000	Centriscidae - undifferentiated	Razorfishes	PSS, added 5 species to list (37279001, 37279002, 37279003, 37279005)
BC	Teleost	Colocongridae	37067923	Colocongridae - undifferentiated	Short-tail conger eels	PSS, insufficient taxonomic resolution, possible mis-identification: outside fishery area
BC	Teleost	Congridae	37067900	*Conger verreauxi* & *Conger wilsoni*	Conger eel	PSS, added 1 species to list (37067007), Conger wilsoni not known to occur in fishery area
BC	Teleost	Congridae	37067922	Congridae - undifferentiated	Conger eels	PSS, added 6 species to list (37067002, 37067007, 37067012, 37067013, 37067016, 37067027)
BC	Teleost	Labridae	37384099	*Cymolutes praetextatus*	Knife wrasse	PSS, possible mis-identification: outside fishery area
BC	Teleost	Monacanthidae	37465903	Monacanthidae - undifferentiated	Leatherjackets	PSS, 5 existing species in list (37465003, 37465005, 37465008, 37465034, 37465037), added 13 species to list (37465002, 37465004, 37465006, 37465007, 37465009, 37465024, 37465025, 37465035, 37465036, 37465039, 37465040, 37465043, 37465060)
BC	Teleost	Neosebastidae	37287947	Neosebastidae - undifferentiated	Scorpionfishes	PSS, 2 existing species in list (37287003, 37287005), added 5 species to list (37287006, 37287007, 37287019, 37287045, 37287126)

Table 2.16: *(continued)*

Role in Fishery	Taxa	Family Name	CAAB Code	Scientific Name	Common Name	Rationale
BC	Teleost	Paralichthyidae	37460924	Paralichthyidae - undifferentiated	Flounder	PSS, added 1 species to list: 37460031
BC	Teleost	Paraulopidae	37120907	Paraulopidae - undifferentiated	Cucumberfishes, greeneyes & flathead lizardfishes	PSS, added 2 species to list (37120001, 37120008)
BC	Teleost	Pataecidae	37292001	*Pataecus fronto*	Red Indian Fish	PSS, possible mis-identification: outside fishery area
BC	Teleost	Peristediidae	37288902	Peristediidae - undifferentiated	Armour gurnards	PSS, added 2 species to list (37288004, 37288045)
BC	Teleost	Platycephalidae	37296000	Platycephalidae - undifferentiated	Flatheads	PSS, 2 existing species in list (37296001, 37296003), added 9 species to list (37296002, 37296006, 37296007, 37296011, 37296035, 37296036, 37296037, 37296038, 37296045)
BC	Teleost	Pleuronectidae	37461916	Pleuronectidae	A right-eye flounder	PSS, 2 existing species in list (37461003, 37461004), added 4 species to list (37461001, 37461002, 37461011, 37461012)
BC	Teleost	Sebastidae	37287949	Sebastidae - undifferentiated	Scorpionfishes	PSS, added 3 species to list (37287046, 37287093, 37287103)
BC	Teleost	Setarchidae	37287950	Setarchidae - undifferentiated	Scorpionfishes	PSS, added 1 species to list: 37287053
BC	Teleost	Soleidae	37462000	Soleidae - undifferentiated	Soles	PSS, added 2 species to list (37462010, 37462017)
BC	Teleost	Tetraodontidae	37467000	Tetraodontidae - undifferentiated	Toadfishes	PSS, 1 existing species in list: 37467044, added 12 species to list (37467001, 37467002, 37467003, 37467004, 37467005, 37467007, 37467008, 37467012, 37467017, 37467023, 37467050, 37467056)
BC	Teleost	Tetrarogidae	37287952	Tetrarogidae - undifferentiated	Scorpionfishes	PSS, added 3 species to list (37287018, 37287023, 37287048)
BC	Teleost	Triglidae	37288000	Triglidae undifferentiated	Gurnard	PSS, 6 existing species in list (37288001, 37288003, 37288005, 37288006, 37288007, 37288008), added 1 species to list: 37288002
BC	Teleost	Triodontidae	37468000	Triodontidae - undifferentiated	Pufferfishes	PSS, added 1 species to list: 37468001
BC	Teleost	Uranoscopidae	37400904	*Uranoscopus* spp.	Stargazers - undifferentiated	PSS, insufficient taxonomic resolution, no species known to fishery area

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

Role in Fishery	Taxa	Family Name	CAAB Code	Scientific Name	Common Name	Rationale
BC	Teleost				Mixed fish	PSS, insufficient taxonomic resolution
BC	Teleost				Pisces	PSS, insufficient taxonomic resolution
BC					Sediment	PSS, part of benthos
Benthos	Invertebrate	Lobophylliidae	11307030	*Homophyllia australis*	A stony coral	PSS, insufficient taxonomic resolution, part of benthos
Benthos		Lessoniaceae	54079000	Lessoniaceae	Brown Algae	PSS, insufficient taxonomic resolution, part of benthos
Benthos		Lessoniaceae	54079903	*Ecklonia* spp.	Algae - Ecklonia	PSS, insufficient taxonomic resolution, part of benthos
Benthos		Seirococcaceae	54102902	*Phyllospora* spp.	Algae - Phyllospora	PSS, insufficient taxonomic resolution, part of benthos
Benthos					Substrate	PSS, insufficient taxonomic resolution, part of benthos
Benthos					Substrate - broken shell	PSS, insufficient taxonomic resolution, part of benthos
Benthos					Substrate - rock	PSS, insufficient taxonomic resolution, part of benthos
	Invertebrate				Clappers	PSS, insufficient taxonomic resolution
					Shell	PSS, 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 2.17: 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 Fishing down through the season is accepted.
	1.2 Maintain biomass above a specified level		1.2 To ensure that population at acceptable level by the assessment. Management is carried out through pre-season biomass surveys which is reviewed annually for key commercial species.
	1.3 Maintain catch at specified level		1.3 TAC levels are specified. Catch levels are desired above threshold levels for condition and economic efficiencies. Beds or areas are closed should the prescribed discard rate be exceeded, i.e., if 20% or more of Scallops are less than 85 mm.

Table 2.17: ***(continued)***

Sub-component	Example Operational Objectives	Example indicators	Rationale
	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 (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).
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. Changes in the distribution may change availability of the species to harvest. Capacity of the population to recover may change if range contracts or becomes patchier.
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 Beds in north-eastern Bass Strait are genetically distinct to adjacent Bass Strait beds and may not contribute to wider recruitment based on biophysical models of larval movement (Ovenden et al., 2016).
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. Changes in these characters are important if they impact on population processes. In general, these are currently difficult to understand for the key commercial species.
5. Reproductive capacity	5.1 Fecundity of the population does not change outside acceptable bounds (e.g., more than x% of reference population fecundity)	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. Closed areas are implemented each season to protect the reproductive capacity (i.e., to protect juvenile and adult spawning Scallops).
	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. If recruitment declines/is impaired, then sustainability may be impacted.
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., due to changes in dispersal patterns)	6.1. Changes to behaviour that are deleterious to the species and populations are to be avoided. No existing objective, but if animals change behaviour and move/disperse to beds that that are unharvestable, could affect the fishery economically.

Byproduct and Bycatch

Core objectives:

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

Table 2.18: 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. Management is carried via a TAC under the Harvest Strategy, which is reviewed annually for BP species (e.g., Doughboy Scallop).
	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 for bycatch species. 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): and 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 – all bycatch is required to be discarded at sea. Changes in these characters are important if they impact on population processes. In general, these are currently difficult to understand for these species.

Table 2.18: *(continued)*

Sub-component	Example Operational Objectives	Example indicators	Rationale
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 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.
	5.2 Recruitment to the population does not change outside acceptable bounds		Covered by 1.2 EMO and AMO. May be easier to monitor via changes in Age/size/sex structure in the fishery. If recruitment declines/is impaired, then sustainability may be impacted.
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	6.1 Dredging 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 2.19: 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.

Table 2.19: ***(continued)***

Sub-component	Example Operational Objectives	Example indicators	Rationale
	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.
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	6.1 Dredging 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.

Table 2.19: *(continued)*

Sub-component	Example Operational Objectives	Example indicators	Rationale
7. Interactions with fishery	7.1 Survival after interactions is maximised	Survival rate of species after interactions	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.
	7.2 Interactions do not affect the viability of the population or its ability to recover	Number of interactions, biomass or numbers in population	

Habitats

Core objectives:

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

Table 2.20: 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 Dredging activities may result in changes to the local habitat types on fishing grounds.

Table 2.20: *(continued)*

Sub-component	Example Operational Objectives	Example indicators	Rationale
5. Habitat structure and function	5.1 Size, shape and condition of habitat types does not vary outside acceptable bounds	Size structure, species composition and morphology of biotic habitats	5.1 Dredging activities may result in local disruption to benthic processes.

Communities

Core objectives:

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

Table 2.21: 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 Impacts on the benthos (i.e., on the fishing grounds) due to dredging has been investigated (e.g., Currie and Parry (1998)). Closed areas of the known habitat types from fishing disturbance help protect areas and hence the distribution of the community.

Table 2.21: *(continued)*

Sub-component	Example Operational Objectives	Example indicators	Rationale
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 Dredging activities for key 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 geo- checmical 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 Bass Strait Central Zone Scallop Fishery

Table 2.22: Hazard identification, score (i.e., presence/absence) and rationale(s) for the Bass Strait Central Zone Scallop Fishery.

Direct impact of Fishing	Fishing Activity	Presence (1) Absence (0)	Documentation of Rationale
Capture	Bait collection	0	Not required by this fishery method.

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

Direct impact of Fishing	Fishing Activity	Presence (1) Absence (0)	Documentation of Rationale
	Fishing	1	Actual fishing, i.e. capture of species resulting from deployment and retrieval of dredge, including key commercial, bycatch, byproduct, and protected species caught but not landed.
	Incidental behaviour	1	Assume that fishing using "recreational" gear can occur during the down time of the vessel, and that animals are captured.
Direct impact without capture	Bait collection	0	Not required for this fishery method.
	Fishing	1	Fishing is most likely to impact benthic habitats and animals as the gear contacts seafloor. Unknown mortality on fish arising from net escapement. Animals may be damaged by the fishing gear and not captured. These animals may later die.
	Incidental behaviour	1	Fishing using "recreational" gear can occur during the down time of the vessel, and that animals are sometimes hooked but not captured.
	Gear loss	1	Expect very low rates of gear loss. Dredges are lost on occasion. There is a very low chance of this occurring - most operators attach a surface buoy from the dredge, such that if the dredge wires break, the position of the dredge is marked which allows recovery of gear.
	Anchoring/ mooring	1	Assume that vessels anchor up at night or in bad weather.
	Navigation/ steaming	1	Steaming/navigation to and from fishing grounds occurs.
Addition/ movement of biological material	Translocation of species	1	Fishers are permit holders in several fisheries, and so will use different ports, which has a potential to translocate hull fouling animals, or through brine tanks used for ballast on the way to fishing grounds. Note that the brine tanks are not used for holding the catch in this fishery.
	On board processing	1	The processing of scallops on board a vessel is prohibited in the BSCZSF, except for the purpose of testing the quality of scallop meat.
	Discarding catch	1	Discarding is common. Undersize commercial species and bycatch species are discarded.
	Stock enhancement	0	Does not occur in this fishery. It is noted that some scallop fisheries elsewhere in the world are considering reseeding and stock enhancement.
	Provisioning	0	No bait is used to attract the target species.

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

Direct impact of Fishing	Fishing Activity	Presence (1) Absence (0)	Documentation of Rationale
	Organic waste disposal	1	If uncontaminated, food wastes 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	1	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, however rubbish could be accidentally discharged at sea.
	Chemical pollution	1	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. Little information on minor components loss. Dredges are recoverable.
	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.
	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	Dredging may disturb seabed sediments and structure.
	Boat launching	0	Not applicable. Vessels in fishery come from designated ports.
	Anchoring/ mooring	1	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.

Table 2.22: *(continued)*

Direct impact of Fishing	Fishing Activity	Presence (1) Absence (0)	Documentation of Rationale
External Hazards	Other capture fishery methods	1	Other fisheries that operate or occur in the BSS area: Small Pelagic Fishery (SPF), including the Purse Seine and midwater trawl subfisheries; Commonwealth Trawl Sector (CTS) otter trawl; Gillnet, Hook, and Trap (GHAT) fisheries: Gillnet, Scalefish Hook (demersal longline, auto-longline, dropline), and Shark Hook (demersal longline), trap; also overlapping with Southern Bluefin Tuna Fishery (SBTF), Eastern Skipjack Tuna Fishery (ESTF), and Eastern Tuna and Billfish Fishery (ETBF); Southern Squid Jig fishery; recreational, Indigenous, and state fisheries.
	Aquaculture	1	Not in Commonwealth waters, abalone at nearby Flinders Island. May change the water chemistry by depleting nutrients in local regions.
	Coastal development	1	Not in Commonwealth waters, but some agricultural runoff close to Flinders Island a possibility. 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). Decomissioning of oil and gas infrastructure and development of alternate energy infrastructure.
	Other non-extractive activities	1	Submarine cables (Basslink) occurs in the fishery jurisdiction. Shipping occurs particularly around and between major harbours, and around the mainland.
	Other anthropogenic activities	1	Tourism and dive charters around the Bass Strait Islands. Visits to the islands for tourism.

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/F2020C00225
- Fisheries Management (Bass Strait Central Zone Scallop Fishery) (Closures) Direction 2022: https://www.afma.gov.au/sites/default/files/2023-02/bsczsf-closure-direction-2022.pdf
- Bass Strait Central Zone Scallop Fishery (Fishing Season; TAC) Determination 2022:

https://www.afma.gov.au/sites/default/files/2023-02/bsczsf-fishing-season-determination-2022.pdf
- Management Regulations: https://www.legislation.gov.au/Series/F2019L00383
- Bass Strait Central Zone Scallop Fishery Management Arrangements Booklet 2022: https://www.afma.gov.au/sites/default/files/2023-02/bsczsf-management-arrangement-booklet-2022.pdf
- AFMA At a glance web page https://www.afma.gov.au/fisheries/bass-strait-central-zone-scallop-fishery
- Bycatch and Diacarding Workplan: https://www.afma.gov.au/sites/default/files/2023-02/Bass%20Strait%20Central%20Zone%20Scallop%20Fishery%20Bycatch%20and%20Discard%20Workplan.pdf
- Bass Strait Scallop Central Zone Scallop Fishery Harvest Strategy: https://www.afma.gov.au/sites/default/files/2023-02/Bass%20Strait%20Central%20Zone%20Scallop%20Fishery%20Harvest%20Strategy.pdf
- Ecological Risk Assessment and Management Reports

Other publications that provided information include:

- ABARES Fishery Status Reports: referenced in this report

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, 20 out of 26 possible internal activities were identified as occurring in this fishery. All six external activities were identified. Thus, a total of 26 activity-component scenarios will be considered at Level 1. This results in 130 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.

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. Commercial bait species are also included here.

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	4	4	Population size	Commercial Scallop (*Pecten fumatus*)		3			There are no key or secondary commercial species that are not assessed. No further action required for this activity.
	Incidental behaviour	1	4	4	Population size	Commercial Scallop (*Pecten fumatus*)	1.3	1	1	1	Fishing crew can line fish for fishing during their downtime when the vessel is anchored. Population size likely to be affected before major changes in other sub-components due to removal of individuals. The Commercial Scallop is the most likely species to be affected. Intensity: negligible, collection of the key commercial species by crew in their downtime probably very rare given their fishing gear with a remote likelihood of detection of impact on population size at any spatial or temporal scale. Consequence: negligible, impact on population size unlikely to be detectable at level of stock. Confidence: low, uncertainty about other fishing methods in this activity is high, but consequence is negligible as volumes of animals would not be captured.
Direct impact without capture	Bait collection	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
	Fishing	1	4	4	Population size	Commercial Scallop (*Pecten fumatus*)	1.3	3	2	1	The BSCZSF uses a harvester that is constructed of a heavy steel frame covered with steel mesh and open on the front side which is towed over the bottom. Population size likely to be affected before major changes in other sub-components due to damage (leading to death) of individuals which come in direct contact with this fishing gear yet are not captured. It is possible that damaged animals attract scavenging species to the area, which increase predation on damaged and intact animals. The Commercial Scallop is the most likely species to be affected as they suffer injury/ mortality as a result of passing through or getting in direct contact with the harvester. Intensity: moderate, Commercial Scallops may get damaged or die, which may occur over broad spatial scale. Consequence: minor, expected minimal impact on stock's population size. Confidence: low, lack of data on effect of dredge on beds with regard to damaged and non-captured animals.
	Incidental behaviour	1	4	4	Population size	Commercial Scallop (*Pecten fumatus*)	1.3	1	1	1	Fishing crew can line fish for fishing during their downtime when the vessel is anchored. Population size likely to be affected before major changes in other sub-components due to damage/ mortality suffered by individuals that are not captured. Intensity: negligible, damage/ mortality of the key commercial species by crew in their downtime probably very rare given their fishing gear with a remote likelihood of detection of impact on population size at any spatial or temporal scale. Consequence: negligible, impact on population size unlikely to be detectable at level of stock. Confidence: low, uncertainty about other fishing methods in this activity is high.

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	2	Population size	Commercial Scallop (*Pecten fumatus*)	1.3	1	1	2	Between 2017-21, fishing occurred on average about 140 days throughout the season of ~6 months (approximately from the end of June to 31 December) each year. The majority of effort occurred northeast of King Island and northeast of Flinders Island with gear loss being possible throughout that area. However, dredge loss is rare, and lost dredges can be recovered by fishers. Population size likely to be affected before major changes in other sub-components due to injury/ mortality of individuals due to contact with lost gear, however, dredges will not continue to fish. The Commercial Scallop is the most likely species to be affected. Intensity: negligible, lost gear considered to be rare with no loss of gear recorded for period of assessment. Consequence: negligible, impact considered unlikely to be measurable at the scale of this stock. Confidence: high, known that gear loss is rare and dredge does not ghost fish.
	Anchoring/ mooring	1	1	4	Population size	Commercial Scallop (*Pecten fumatus*)	1.3	1	1	2	Between 2017-21, fishing occurred on average about 140 days throughout the season of ~6 months (approximately from the end of June to 31 December) each year. The majority of effort occurred northeast of King Island and northeast of Flinders Island with anchoring/ mooring occurring throughout the area. Population size likely to be affected before major changes in other sub-components due to contact with the anchor. The Commercial Scallop is the most likely species to be affected. Intensity: negligible, anchoring has a very small footprint and its impact has a remote likelihood of detection at any spatial or temporal scale. Consequence: negligible, its impact on the population size of key commercial species was considered unlikely to be detectable at the scale of the stock. Confidence: high, logical considerations.

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	4	4	Population size	Commercial Scallop (*Pecten fumatus*)	1.3	1	1	2	Between 2017-21, fishing occurred on average about 140 days throughout the season of ~6 months (approximately from the end of June to 31 December) each year. The majority of effort occurred northeast of King Island and northeast of Flinders Island with navigation to and from fishing grounds and steaming between shots occurring throughout these areas with 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. The Commercial Scallop is the most likely species to be affected. Intensity: negligible, collisions between key commercial species and vessels unlikely and the likelihood of detection of this impact at any spatial or temporal scale to be remote. Consequence: negligible, any impact was considered unlikely to be detectable at the scale of their stock. Confidence: high, logical considerations.
Addition/ movement of biological material	Translocation of species	1	4	4	Population size	Commercial Scallop (*Pecten fumatus*)	1.3	3	3	1	BSS fishers are permit holders in several fisheries, and so will use different ports, which has a potential to translocate hull fouling animals, or through brine tanks used for ballast on the way to fishing grounds with the chance of introducing pests (such as North Pacific Seastar *Asterias amurensis*). Population size likely to be affected before major changes in other sub-components due to disease and death of individuals. The Commercial Scallop is the most likely species that could be adversely affected by the introduction of this type of pest to the scallop beds. Intensity: moderate, this activity can impact the population size of key commercial species due to its effect occurring over a broader spatial scale. Consequence: moderate, impact on population size could be long term but occurrence of the activity with this outcome is unusual. Confidence: low, difficult to trace occurrence of pest 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
	On board processing	1	4	4	Reproductive capacity	Commercial Scallop (*Pecten fumatus*)	5.1	1	1	2	Between 2017-21, fishing occurred on average about 140 days throughout the season of ~6 months (approximately from the end of June to 31 December) each year. The majority of effort occurred northeast of King Island and northeast of Flinders Island with onboard processing possible over this scale. Reproductive capacity likely to be affected before major changes in other sub-components due to extra food available at sea floor. The Commercial Scallop is the most likely species to be affected as key commercial species. Intensity: negligible, given its volume and that most will be consumed by scavengers before reaching the sea floor, a disposal event was not considered to have a detectable change on reproductive capacity of this species at any spatial or temporal scale. Consequence: negligible, impact considered unlikely to be detectable at the scale of the stock. Confidence: high, logical considerations.
	Discarding catch	1	4	4	Age/ size/ sex structure	Commercial Scallop (*Pecten fumatus*)	4.1	3	1	1	Between 2017-21, fishing occurred on average about 140 days throughout the season of ~6 months (approximately from the end June to 31 December) each year. The majority of effort occurred northeast of King Island and northeast of Flinders Island with discarding occurring throughout this area. Age-size structure likely to be affected before major changes in other sub-components due to discarding of undersized key commercial species potentially changing the size structure on the beds; juveniles will be proportionately more common. The Commercial Scallop is the most likely species to be affected as key commercial species. Intensity: moderate, discarding occurs on all days of fishery effort yet has a small footprint. Consequence: negligible, unlikely to detect its impact at the scale of their stock as general adults beds are targeted. Confidence: low, unknown whether beds are generally single-size class.
	Stock enhancement	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
	Provisioning	0									
	Organic waste disposal	1	4	4	Reproductive capacity	Commercial Scallop (*Pecten fumatus*)	5.1	1	1	2	Between 2017-21, fishing occurred on average about 140 days throughout the season of ~6 months (approximately from the end of June to 31 December) each year. The majority of effort occurred northeast of King Island and northeast of Flinders Island with organic, uncontaminated waste disposal possible over this scale. Reproductive capacity likely to be affected before major changes in other sub-components due to extra food available at sea floor. The Commercial Scallop is the most likely species to be affected as key commercial species. Intensity: negligible, given its volume and that most will be consumed by scavengers before reaching the sea floor, a disposal event was not considered to have a detectable change on reproductive output of this species at any spatial or temporal scale. Consequence: negligible, impact considered unlikely to be detectable at the scale of the stock. Confidence: high, logical considerations.

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	1	4	4	Population size	Commercial Scallop (*Pecten fumatus*)	1.3	1	1	2	Between 2017-21, fishing occurred on average about 140 days throughout the season of ~6 months (approximately from the end of June to 31 December) each year. The majority of effort occurred northeast of King Island and northeast of Flinders Island with accidental debris disposal possible throughout this area. Population size likely to be affected before major changes in other sub-components due to death by ingestion or damage due to contact. The Commercial Scallop is the most likely species to be affected. Intensity: negligible, disposal of debris is prohibited and the impact of incidental disposal considered to have a remote likelihood of detection at any spatial or temporal scale. Consequence: negligible, as this activity is rare its impact was considered unlikely to be detectable at the scale of the stock as key commercial species are mobile and filter feeders (thus can move and don't ingest materials). Confidence: high, logical considerations.

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
	Chemical pollution	1	4	4	Reproductive capacity	Commercial Scallop (*Pecten fumatus*)	5.1	1	1	2	Between 2017-21, fishing occurred on average about 140 days throughout the season of ~6 months (approximately from the end of June to 31 December) each year. The majority of effort occurred northeast of King Island and northeast of Flinders Island with occasional chemical pollution in normal course of operation possible throughout the area. Reproductive capacity likely to be affected before major changes in other sub-components due to chemical pollution potentially impacting the quantity or quality of gametes of the key commercial species. Intensity: negligible, as chemical pollution is prohibited and therefore rare, its impact was considered to have a remote likelihood of detection at any spatial or temporal scale. Consequence: negligible, this activity is rare, its impact was considered unlikely to be detectable at the scale of the stock. Confidence: high, chemical pollution is prohibited, however, the impact of potential chemical pollution on the key commercial species is unknown.

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
	Exhaust	1	4	4	Reproductive capacity	Commercial Scallop (*Pecten fumatus*)	5.1	2	1	2	Between 2017-21, fishing occurred on average about 140 days throughout the season of ~6 months (approximately from the end of June to 31 December) each year. The majority of effort occurred northeast of King Island and northeast of Flinders Island with exhaust emissions possible over this scale. Reproductive capacity likely to be affected before major changes in other sub-components due to dissolved gasses and particulates in water. Intensity: minor, because although the hazard could occur over a large range/ scale, exhaust wouldn't cause a detectable change on Reproductive output. Consequence: negligible, the impact of exhaust emissions is unlikely to be detectable at stock scale as most exhaust fumes enter the atmosphere or the water immediately below the engines and dissolved gases and particulates unlikely to affect demersal key commercial species. Confidence: high, logical considerations.
	Gear loss	1	1	2	Population size	Commercial Scallop (*Pecten fumatus*)	1.3	1	1	2	Between 2017-21, fishing occurred on average about 140 days throughout the season of ~6 months (approximately from the end of June to 31 December) each year. The majority of effort occurred northeast of King Island and northeast of Flinders Island with gear loss being possible throughout that area. However, dredge loss is rare, and lost dredges can be recovered by fishers. If gear loss would occur, population size likely to be affected before major changes in other sub-components as lost gear becomes unnatural habitat. Intensity: negligible, gear loss is rare and its impact was considered to have a remote likelihood of detection at any spatial or temporal scale. Consequence: negligible, unlikely to detect impact on the population size of key commercial species. Confidence: high, logical considerations and all major gear loss is required to be recorded.

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	4	4	Age/ size/ sex structure	Commercial Scallop (*Pecten fumatus*)	4.1	2	1	1	Between 2017-21, fishing occurred on average about 140 days throughout the season of ~6 months (approximately from the end of June to 31 December) each year. The majority of effort occurred northeast of King Island and northeast of Flinders Island with navigation to and from fishing grounds and steaming between shots occurring throughout these areas introducing noise and visual stimuli into the environment. Age-size structure likely to be affected before major changes in other sub-components as it might scare some of the size classes of key commercial species such that size structure changes on the fishing ground through different movements. Intensity: minor, these stimuli occur in restricted areas in proximity of the vessels and detectability of impact even at this scale is rare. Consequence: negligible, introduction of noise and light not considered to be a threat for benthic key commercial species, like scallops, and thus impact unlikely to be detectable at the scale of the stock. Confidence: low, impact of this activity for the age-size structure of key commercial species is unlikely yet unknown.

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
	Activity/ presence on water	1	4	4	Behaviour/ Movement	Commercial Scallop (*Pecten fumatus*)	6.1	2	1	2	Between 2017-21, fishing occurred on average about 140 days throughout the season of ~6 months (approximately from the end of June to 31 December) each year. The majority of effort occurred northeast of King Island and northeast of Flinders Island introducing 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 on the key commercial species. Intensity: minor, these stimuli occur in restricted areas in proximity of the vessels and detectability of impact even at this scale is rare. Consequence: negligible, impact on behaviour/ movement of key commercial species unlikely to be detectable at the scale of the stock. Confidence: high, logical considerations.
Disturb physical processes	Bait collection	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
	Fishing	1	4	4	Behaviour/ Movement	Commercial Scallop (*Pecten fumatus*)	6.1	3	2	1	Between 2017-21, fishing occurred on average about 140 days throughout the season of ~6 months (approximately from the end of June to 31 December) each year. The majority of effort occurred northeast of King Island and northeast of Flinders Island, with the action of direct disturbance of the sea floor. Behaviour/ movement of key commercial species likely to be affected before major changes in other sub-components due to degradation of habitat. Intensity: moderate, these disturbance occurs locally in proximity of the fishing activity yet can be severe. Consequence: minor, it was considered that the disturbance of the sea bottom is short-lived and scallops may move temporarily with only a minimal impact on their behaviour/ movement. Confidence: low, long-term effects of sea floor disturbance on scallop behaviour/ movement unknown.
	Boat launching	0									
	Anchoring/ mooring	1	1	4	Population size	Commercial Scallop (*Pecten fumatus*)	1.3	1	1	2	Between 2017-21, fishing occurred on average about 140 days throughout the season of ~6 months (approximately from the end of June to 31 December) each year. The majority of effort occurred northeast of King Island and northeast of Flinders Island with anchoring/ mooring occurring throughout the area. Effects on any subcomponent hard to envisage for the key commercial species. Intensity: negligible, anchoring has a very small footprint and its impact has a remote likelihood of detection at any spatial or temporal scale. Consequence: negligible, its impact on the population size of the key commercial species was considered unlikely to be detectable at the scale of the stock. Confidence: high, logical considerations.

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	4	4	Population size	Commercial Scallop (*Pecten fumatus*)	1.3	1	1	2	Between 2017-21, fishing occurred on average about 140 days throughout the season of ~6 months (approximately from the end of June to 31 December) each year. The majority of effort occurred northeast of King Island and northeast of Flinders Island with navigation to and from fishing grounds and steaming between shots occurring throughout these areas causing turbulence in the water column due to action of the propellers. Effects on any subcomponent hard to envisage for the key commercial species. Intensity: negligible, impact of this activity has a remote likelihood of detection at any spatial or temporal scale. Consequence: negligible, its impact on the population size of the key commercial species was considered unlikely to be detectable at the scale of the stock. Confidence: high, logical considerations.
External Impacts	Other fisheries	1	4	6	Population size	Commercial Scallop (*Pecten fumatus*)	1.3	3	2	2	Fishing occurs throughout the year by several other fisheries in the BSCZSF area, including the Commonwealth Trawl Sector (CTS) of the Southern and Eastern Scalefish and Shark Fishery (SESSF). Population size likely to be affected before major changes in other sub-components due to removal of individuals of the key commercial species. Intensity: moderate, impact moderate over a large spatial scale over which there can be daily fishing activity. Consequence: minor, individuals taken by other fisheries considered to have a minimal impact on stock. Confidence: high, this species is being assessed (based on pre-season surveys) and catch by other fisheries recorded.

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	3	6	Population size	Commercial Scallop (*Pecten fumatus*)	1.3	3	1	1	Abalone aquaculture occurs at Flinders Island with the possibility to change the water chemistry and may remove some of the coastal production. Population size of key commercial species likely to be affected before major changes in other sub-components due to nutrient depletion. Intensity: moderate, potential moderate impact at broader spatial scale. Consequence: negligible, impact on population size of key commercial species was considered unlikely due to small overlap of scallop beds and aquaculture affected areas. Confidence: low, insufficient data on how aquaculture affects key commercial species.
	Coastal development	1	4	6	Population size	Commercial Scallop (*Pecten fumatus*)	1.3	3	2	1	Coastal development occurs on Flinders Island, with the possibility of sewage discharge, agricultural runoff, and pollution from ports and coastal towns impacting coastal waters. Population size of key commercial species likely to be affected before major changes in other sub-components due to change of habitat quality. Intensity: moderate, moderate both broad coastal development and localised centres. Consequence: minor, activity could have impact on key commercial species' beds close to the coast yet as the impact of this activity was unlikely to extend to entire shelf area it was considered that it would have a minimal impact on the stock. Confidence: low, insufficient data available on how aquaculture affects 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
	Other extractive activities	1	5	6	Population size	Commercial Scallop (*Pecten fumatus*)	1.3	3	2	1	Oil and gas pipelines, oil and gas exploration and extraction drilling, and seismic survey for further oil and gas exploration occurs across the Bass Strait adding structures to the sea and introducing noise and visual stimuli into the environment. Population size of key commercial species likely to be affected before major changes in other sub-components due to general disturbance habitat and adding structures in the sea. Intensity: moderate, local effects may be severe but also many extractive activities over broader spatial scale. Consequence: minor, impacts on population size of key commercial species were considered minimal at scale of the stock. Confidence: low, insufficient data on how this activity affects key commercial species, conservative score with regard to consequence used.
	Other non extractive activities	1	6	6	Population size	Commercial Scallop (*Pecten fumatus*)	1.3	3	2	1	Submarine cables (Basslink) and shipping occurs daily in the fishery jurisdiction introducing structures and visual and noise stimuli into the environment. Population size of key commercial species likely to be affected before major changes in other subcomponents due to general degradation habitat. Intensity: moderate, activity occurs throughout the BSS area with shipping being concentrated near major harbours and around the mainland. Consequence: minor, this activity was considered to have minimal impact on the stock. Confidence: low, the impact and extent of non-extractive activities on the (long-term) key commercial species is unknown, conservative score with regard to consequence used.

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 anthropogenic activities	1	5	5	Behaviour/ Movement	Commercial Scallop (*Pecten fumatus*)	6.1	2	2	1	Tourism and dive charters occur around the Bass Strait Islands causing disturbance due to introducing visual and noise stimuli into the environment. Behaviour/ movement of key commercial species likely to be affected before major changes in other subcomponents due to long-term avoidance or attraction reaction (e.g., avoidance of locations with regular anchoring activity and substrate disturbance). Intensity: minor, impact occurs in few restricted areas due to destination of this activity with detectability even at these scales being rare. Consequence: minor, this activity was considered to have minimal impact on the stock. Confidence: low, given the diverse potential effect of this activity the overall impact and its extent remains undefined.

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	4	4	Population size	Longnose Skate (*Dentiraja confusus*); Greenback Stingaree (*Urolophus viridis*); Pale Octopus (*Octopus pallidus*)	1.4	3	3	1	Between 2017-21, fishing occurred on average about 140 days throughout the season of ~6 months (from the end of June to 31 December) each year. The majority of effort occurred northeast of King Island and northeast of Flinders Island. Population size likely to be affected before major changes in other sub-components due to removal of individuals. Longnose Skate and Greenback Stingaree are the most likely chondrichthyan species to be affected as 1) it has been shown that stingaree species experience stress and post-capture mortality which increase with tow duration and air exposure (Heard et al., 2014) and rajids experience injury and post-capture mortality which increase with tow duration (Knotek et al., 2018); 2) they have slow reproduction rate due to life-history traits; 3) are endemic to south-eastern Australia within the BSCZSF area covering a large part of the limited range of occurrence and habitat is where fishing activity is focussed on (sand and mud bottoms); 4) being a viviparous chondrichthyan species, the Greenback Stingaree frequently abort pups due to stress from capture and handling (Adams et al., 2018); 5) they show a current population decline (Kyne and Sherman, (2016); Kyne et al., (2019)); 6) Longnose Skate is listed as critically endangered (Kyne & Sherman, 2016) and Greenback Stingaree as vulnerable by the IUCN (Kyne et al., 2019). The Pale Octopus is also likely affected and in northern Tasmania its stock is classified as depleting (Krueck et al., (2021)). The species lives on sand and mud substrates and therefore its habitat overlaps with fishing areas and is endemic to south-eastern Australia. Intensity: moderate, impact occurs over a broader spatial scale. Consequence: moderate. Confidence: low, fishery estimates within this assessment period are unavailable. However, it is known that the primary threat to these species are likely to be fisheries (Kyne and Shermen (2016); Kyne et al., (2019); Krueck et al.,(2021)).

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
	Incidental behaviour	1	4	4	Behaviour/ movement	Draughtboarc Shark (*Cephaloscyl-lium laticeps*)	6.1	1	1	1	Fishing crew can line fish for fishing during their downtime when the vessel is anchored and on way to and from grounds (trolling). Behaviour and movement of the Draughtboard Shark is likely to be affected before major changes in other sub-components due to bait attracting sharks and scavengers. The Draughtboard Shark 1) is endemic to temperate waters of southern Australia (White & Bray, 2023), 2) has a relative limited distribution, 3) represents by weight the largest shark bycatch recorded during the preseason survey, 4) has slow reproduction rate due to life history traits, 5) forms a significant part of the bycatch in the southern gillnet fishery (White & Bray, 2023). Intensity: negligible, effect of occasional fishing by crew on sharks' stock unlikely to be detectable at any spatial or temporal scale. Consequence: negligible, interactions with sharks unlikely to contribute to detectable change at the scale of the stock. Confidence: low, insufficient data available on how this activity affects the species' stock.
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	4	4	Population size	Longnose Skate (*Dentiraja confusus*); Greenback Stingaree (*Urolophus viridis*); Pale Octopus (*Octopus pallidus*)	1.4	3	2	1	The BSCZSF uses a single towed scallop harvester (dredge) that is constructed of a heavy steel frame covered with steel mesh and open on the front side which is towed over the bottom at a depth range of 30-100 m. Population size likely to be affected before major changes in other sub-components due to damage (leading to death) of individuals which come in direct contact with this fishing gear yet are not captured. Longnose Skate and Greenback Stingaree are the most likely elasmobranch species to be affected as: 1) it has been shown that stingaree species experience stress and post-capture mortality which increase with tow duration and air exposure (Heard et al., 2014) and rajids experience injury and post-capture mortality which increase with tow duration (Knotek et al., 2018); 2) they have slow reproduction rate due to life-history traits; 3) are endemic to south-eastern Australia within the BSCZSF area covering a large part of the limited range of occurrence and habitat is where fishing activity is focussed on (sand and mud bottoms); 4) being a viviparous chondrichthyan species, the Greenback Stingaree frequently abort pups due to stress from capture and handling (Adams et al., 2018); 5) they show a current population decline (Kyne and Sherman, (2016); Adams et al., (2018)); 6) Longnose Skate is listed as critically endangered (Kyne & Sherman, 2016) and Greenback Stingaree as vulnerable by the IUCN (Kyne et al., 2019). The Pale Octopus is also likely affected and in northern Tasmania its stock is classified as depleting (Krueck et al., (2021)). The species lives on sand and mud substrates and therefore its habitat overlaps with fishing areas and is endemic to south-eastern Australia. Intensity: moderate, impact occurs over a broader spatial scale. Consequence: minor, injury or death of individuals through contact with fishing gear considered to have minimal impact on population size. Confidence:
	Fishing (continued)										low, lack of data on the discard mortality of these species or in contact with harvester, plus species interaction rates seen in the preseason biomass survey are not directly indicative of commercial fishing practices (as a range of environments are targeted in the survey) and estimates within this assessment period are unavailable.

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
	Incidental behaviour	1	4	4	Behaviour/ movement	Draughtboarc Shark (*Cephaloscyl-lium laticeps*)	6.1	1	1	1	Fishing crew can line fish for fishing during their downtime when the vessel is anchored. Behaviour and movement likely to be affected before major changes in other sub-components due to foraging for food. The Draughtboard Shark is the most likely species to be affected as this activity can attract sharks affecting their behaviour. Intensity: negligible - effect of occasional fishing by crew on sharks' behaviour unlikely to be detectable at any spatial or temporal scale. Consequence: negligible, interactions with this species is rare and is unlikely to contribute to detectable movement/ behaviour change at the scale of the stock. Confidence: low, insufficient data available on how this activity affects shark behaviour and movement plus species interaction rates seen in the preseason biomass survey are not directly indicative of commercial fishing practices, as a range of environments are targeted in the survey.

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
	Gear loss	1	1	2	Population size	Longnose Skate (*Dentiraja confusus*); Greenback Stingaree (*Urolophus viridis*); Pale Octopus (*Octopus pallidus*)	1.4	1	1	2	Between 2017-21, fishing occurred on average about 140 days throughout the season of ~6 months (from the end of June to 31 December) each year. The majority of effort occurred northeast of King Island and northeast of Flinders Island with gear loss being possible throughout that area. However, dredge loss is rare, and lost dredges can be recovered by fishers. Population size likely to be affected before major changes in other sub-components due to injuring individuals which die after being damaged due to contact with gear. Longnose Skate and Greenback Stingaree are the most likely elasmobranch species to be affected as: 1) latter is mostly caught Chondrichthyan species by weight in preseason survey; 2) they have slow reproduction rate due to life-history traits; 3) are endemic to south-eastern Australia with the BSCZSF area covering a large part of the limited range of occurrence and habitat is where fishing activity is focussed on (sand and mud bottoms) and therefore higher chance of getting in contact with lost gear; 4) being a viviparous chondrichthyan species, the Greenback Stingaree frequently abort pups due to stress from capture and handling (Adams et al., 2018); 5) they show a current population decline (Kyne and Sherman, (2016); Adams et al., (2018)); 6) Longnose Skate is listed as critically endangered (Kyne & Sherman, 2016) and Greenback Stingaree as vulnerable by the IUCN (Kyne et al., 2019); and 7) there are no conservation actions in place (Heupel et al., (2018); Kyne et al., (2019)). The Pale Octopus is also likely affected as 1) they show a high bycatch in weight and, as it often occurs on sand and mud substrates, its habitat overlaps with fishing areas; 2) in northern Tasmania its stock is classified as depleting (Krueck et al., 2021), and 3) is endemic to south-eastern Australia. Intensity: negligible - gear loss is rare and if gear was lost, its impact would have a remote likelihood of detection at any spatial or temporal scale. Consequence:
	Gear loss (continued)										negligible - it is unlikely that species get injured due to lost gear and therefore considered unlikely that impact of lost gear is detectable at the scale of their stock. Confidence: high - all gear loss is required to be recorded and none occurred during the assessment period.

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
	Anchoring/ mooring	1	1	4	Population size	Longnose Skate (*Dentiraja confusus*); Greenback Stingaree (*Urolophus viridis*); Pale Octopus (*Octopus pallidus*)	1.4	1	1	1	Between 2017-21, fishing occurred on average about 140 days throughout the season of ~6 months (from the end of June to 31 December) each year. The majority of effort occurred northeast of King Island and northeast of Flinders Island with anchoring/ mooring occurring throughout the area. Population size likely to be affected before major changes in other sub-components due to injury or death from contact with the anchor. Longnose Skate and Greenback Stingaree are the most likely elasmobranch species to be affected as: 1) latter is mostly caught Chondrichthyan species by weight in preseason survey and therefore assumably high overlap with fishery area; 2) they have slow reproduction rate due to life-history traits; 3) are endemic to south-eastern Australia with the BSCZSF area covering a large part of the limited range of occurrence and habitat is where fishing activity is focussed on (sand and mud bottoms) and therefore higher chance of getting in contact with an anchor; 4) being a viviparous chondrichthyan species, the Greenback Stingaree frequently abort pups due to stress from capture and handling (Adams et al., 2018); 5) they show a current population decline (Kyne and Sherman, (2016); Adams et al., (2018)); 6) Longnose Skate is listed as critically endangered (Kyne & Sherman, 2016) and Greenback Stingaree as vulnerable by the IUCN (Kyne et al., 2019); and 7) there are no conservation actions in place (Heupel et al., (2018); Adams et al.,(2018); Kyne et al., (2019)). The Pale Octopus is also likely affected as 1) they show a high bycatch in weight and therefore assumably high interaction rate, 2) in northern Tasmania its stock is classified as depleting (Krueck et al., 2021), 3) lives on sand and mud substrates and therefore its habitat overlaps with fishing areas, and 4) is endemic to south-eastern Australia. Intensity: negligible, anchoring has a very small footprint and its impact has a remote likelihood of detection at any spatial or temporal scale.
	Anchoring/ mooring (continued)										Consequence: negligible, its impact on the population size of these species was considered unlikely to be detectable at the scale of the stock. Confidence: low, it is unknown how often anchors come in contact with these species.

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	4	4	Population size	Draughtboard Shark (*Cephaloscyl-lium laticeps*)	1.2	1	1	1	Between 2017-21, fishing occurred on average about 140 days throughout the season of ~6 months (from the end of June to 31 December) each year. The majority of effort occurred northeast of King Island and northeast of Flinders Island with navigation to and from fishing grounds and steaming between shots occurring throughout these areas with 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. The Draughtboard Shark is the most likely species to be affected as this species 1) is endemic to temperate waters of southern Australia (White & Bray, 2023), 2) has a relative limited distribution (White & Bray, 2023), 3) represents by weight the largest shark bycatch recorded during the preseason survey, 4) has slow reproduction rate due to life history traits (White & Bray, 2023), 5) forms a significant part of the bycatch in the southern gillnet fishery (White & Bray, 2023), and 6) can collide with vessel when swimming at the surface. Intensity: negligible, it was considered that collisions between this species and vessels are rare and the likelihood of detection of this impact at any spatial or temporal scale to be remote. Consequence: negligible, any impact was considered unlikely to be detectable at the scale of their stock. Confidence: low, it is unknown how often the species collide with vessels.

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
Addition/ movement of biological material	Translocation of species	1	4	4	Population size	Australian Handfish (*Brachionichthys australis*); A Handfish (*Brachiopsilus dossenus*)	1.2	3	2	1	BSCZSF fishers are permit holders in several state and commonwealth fisheries, and so will use different ports in Tasmania and Victoria, even further afield, thus there is a chance for introducing species (such as North Pacific Seastar *Asterias amurensis*, and other marine species e.g., European Green Crab *Carcinus maenas*) being translocated on vessels, ballast, and brine tanks. Population size likely to be affected before major changes in other sub-components, by introducing a foreign competitor or through transmission of disease. These species (including other handfish species that occur within this fishery) are the likely to be the most vulnerable as it could easily be out-competed by introduced bivalves for food and habitat. Intensity: moderate, at present. Consequence: minor, although there is the potential for impacts to significantly alter population size. Confidence: low, unknown if any pests have been observed and to what extent this fishery contributes to the spread of pest species.
	On board processing	1	4	4	Behaviour/ movement	Draughtboard Shark (*Cephaloscyllium laticeps*)	6.1	1	1	1	Between 2017-21, fishing occurred on average about 140 days throughout the season of ~6 months (from the end of June to 31 December) each year. The majority of effort occurred northeast of King Island and northeast of Flinders Island with onboard processing possible throughout this area. Behaviour and movement likely to be affected before major changes in other sub-components if scavengers and predators (e.g., sharks and trevallies) are attracted due to the addition of discards. The Draughtboard Shark are the most likely species to be affected as they can be attracted by discards for feeding. Intensity: negligible, given its volume and the footprint of disposal after onboard processing this activity was not considered to have a detectable change on behaviour/ movement of sharks at any spatial or temporal scale. Consequence: negligible, unlikely to detect its short-lived effect on the behaviour/ movement of sharks at the scale of their stock. Confidence: low, long-lasting effects of discarding on shark behaviour/ movement not well known.

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	4	4	Behaviour/ movement	Draughtboarc Shark (*Cephaloscyl-lium laticeps*)	6.1	3	1	1	Between 2017-21, fishing occurred on average during about 140 days throughout the season of ~6 months (from the end of June to 31 December) each year. The majority of effort occurred northeast of King Island and northeast of Flinders Island with discarding occurring throughout this area. Behaviour and movement likely to be affected before major changes in other sub-components if scavengers and predators (e.g., sharks and trevallies) are attracted due to the addition of discards. The Draughtboard Shark is the most likely species to be affected as they will likely be attracted by discards for feeding. Intensity: moderate, discarding occurs on all days of fishery effort yet has a small footprint. Consequence: negligible, unlikely to detect its short-lived effect on the behaviour/ movement of sharks at the scale of their stock. Confidence: low, long-lasting effects of discarding on shark behaviour/ movement not well known.
	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	4	4	Behaviour/ movement	Draughtboard Shark (*Cephaloscyllium laticeps*)	6.1	1	1	2	Between 2017-21, fishing occurred on average about 140 days throughout the season of ~6 months (from the end of June to 31 December) each year. The majority of effort occurred northeast of King Island and northeast of Flinders Island with organic waste disposal possible over this scale. Behaviour/ movement likely to be affected before major changes in other sub-components due to the attraction (e.g., food scraps) or repulsion (e.g., raw sewage) by the organic waste. The Draughtboard Shark is the most likely species to be affected as they may change their behaviour due to organic waste disposal. Intensity: negligible, given its volume, a disposal event was not considered to have a detectable change on shark behaviour/ movement at any spatial or temporal scale. Consequence: negligible, temporary change in behaviour/ movements was considered unlikely to be detectable at the scale of the stock. Confidence: high, logical considerations.
Addition of non-biological material	Debris	1	4	4	Population size	Longnose Skate (*Dentiraja confusus*); Greenback Stingaree (*Urolophus viridis*); Pale Octopus (*Octopus pallidus*)	1.4	1	1	2	Between 2017-21, fishing occurred on average about 140 days throughout the season of ~6 months (from the end of June to 31 December) each year. The majority of effort occurred northeast of King Island and northeast of Flinders Island with accidental debris disposal possible throughout this area. Population size likely to be affected before major changes in other sub-components due to injury/ death from contact with, entanglement in, or ingestion of debris. These species are the most likely species to be affected as they may be attracted by the debris (either directly or indirectly due to aggregating prey) and get injured by, entangled in or swallow the debris. Intensity: negligible, disposal of debris is prohibited and the impact of incidental disposal considered to have a remote likelihood of detection at any spatial or temporal scale. Consequence: negligible, as this activity is rare its impact was considered unlikely to be detectable at the scale of the stock. Confidence: high, debris disposal is prohibited.

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
	Chemical pollution	1	4	4	Behaviour/ movement	Longnose Skate (*Dentiraja confusus*); Greenback Stingaree (*Urolophus viridis*); Pale Octopus (*Octopus pallidus*)	6.1	1	1	2	Between 2017-21, fishing occurred on average about 140 days throughout the season of ~6 months (from the end of June to 31 December) each year. The majority of effort occurred northeast of King Island and northeast of Flinders Island with occasional chemical pollution in normal course of operation possible throughout the area. Behaviour/ movement likely to be affected before major changes in other sub-components due to the repulsive nature of the chemical pollution. These species are the most likely species to be affected as they may be repulsed by the pollution directly or indirectly by change in movement of their prey. Intensity: negligible, as chemical pollution is prohibited and therefore rare, its impact was considered to have a remote likelihood of detection at any spatial or temporal scale. Consequence: negligible, this activity is rare, its impact was considered unlikely to be detectable at the scale of the stock. Confidence: high, chemical pollution is prohibited.
	Exhaust	1	4	4	Behaviour/ movement	Draughtboarc Shark (*Cephaloscyl-lium laticeps*)	6.1	2	1	2	Between 2017-21, fishing occurred on average about 140 days throughout the season of ~6 months (from the end of June to 31 December) each year. The majority of effort occurred northeast of King Island and northeast of Flinders Island with exhaust emissions 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. The Draughtboard Shark is the most likely species to be affected. Intensity: minor, because 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 at stock scale. Confidence: high, logical considerations.

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
	Gear loss	1	1	2	Behaviour/ movement	Australian Handfish (*Brachionichthys australis*); A Handfish (*Brachiopsilus dossenus*)	6.1	1	1	2	The majority of effort occurred northeast of King Island and northeast of Flinders Island with gear loss being possible throughout that area. However, dredge loss is rare, and lost dredges can be recovered by fishers. If gear loss would occur, behaviour/ movement likely to be affected before major changes in other sub-components due to this species being attracted around the abandoned structure over time. These species (including other handfish species that occur within this fishery) are the most likely species to be affected as they can be attracted. Intensity: negligible, gear loss is rare and its impact was considered to have a remote likelihood of detection at any spatial or temporal scale. Consequence: negligible, unlikely to detect impact on the species behaviour/ movement at stock level. Confidence: high, logical considerations and all major gear loss is required to be recorded.
	Navigation/ steaming	1	4	4	Behaviour/ movement	Draughtboarc Shark (*Cephaloscyllium laticeps*)	6.1	2	1	1	Between 2017-21, fishing occurred on average about 140 days throughout the season of ~6 months (from the end of June to 31 December) each year. The majority of effort occurred northeast of King Island and northeast of Flinders Island with navigation to and from fishing grounds and steaming between shots occurring throughout these areas introducing 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. The Draughtboard Shark is the most likely species to be affected by the stimuli. Intensity: minor, these stimuli occur in restricted areas in proximity of the vessels and detectability of impact even at this scale is rare. Consequence: negligible, sharks are mobile and, although they can respond to the stimuli, the impact was considered to be short-lived and unlikely to be detectable at the scale of the stock. Confidence: low, long-term effects of navigation/ steaming on shark behaviour/ movement 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
	Activity/ presence on water	1	4	4	Behaviour/ movement	Draughtboard Shark (*Cephaloscyl-lium laticeps*)	6.1	2	1	1	Between 2017-21, fishing occurred on average about 140 days throughout the season of ~6 months (from the end of June to 31 December) each year. The majority of effort occurred northeast of King Island and northeast of Flinders Island introducing 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. The Draughtboard Shark is the most likely species to be affected by these stimuli. Intensity: minor, these stimuli occur in restricted areas in proximity of the vessels and detectability of impact even at this scale is rare. Consequence: negligible, sharks are mobile and, although they can respond to the stimuli, the impact was considered to be short-lived an unlikely to be detectable at the scale of the stock. Confidence: low, long-term effects of activity/ presence on water on shark behaviour/ movement unknown.
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	4	4	Behaviour/ movement	Australian Handfish (*Brachionichthys australis*); A Handfish (*Brachiopsilus dossenus*)	6.1	3	2	1	Dredging activities result in localised shifts in turbidity, water and sediment quality. These impacts can potentially cause population declines in handfish as they are small and have narrow distribution ranges (Stuart-Smith et al., 2020). These species (including other handfish species that occur within this fishery) are the most likely species to be affected as they occur at or near sand and mud bottom and therefore overlap with fishery activity. Intensity: moderate, physical disturbance such as increased turbidity due to dredging can be severe yet it is localised and will reside over a short-time period (within a day). Consequence: minor, this species is mobile and, although they can respond to the stimuli, it was assumed that they would move out of the area of the fishing activity and return to natural behaviour with the impact being minimal on the scale of the stock. Confidence: low, long-term effects of sea floor disturbance on the species behaviour/ movement unknown.
	Boat launching	0									
	Anchoring/ mooring	1	1	4	Behaviour/ movement	Australian Handfish (*Brachionichthys australis*); A Handfish (*Brachiopsilus dossenus*)	6.1	1	1	2	The majority of effort occurred northeast of King Island and northeast of Flinders Island with anchoring/ mooring occurring throughout the area. Behaviour and movement likely to be affected before major changes in other sub-components due to the disturbance of physical processes from anchoring. These species (including other handfish species that occur within this fishery) are the most likely species to be affected as they will try to move away from an anchor and/ or can be disrupted. Intensity: negligible, anchoring has a very small footprint and its impact has a remote likelihood of detection at any spatial or temporal scale. Consequence: negligible, its impact on the behaviour/ movement of these species was considered unlikely to be detectable at the scale of the stock. Confidence: high, logical considerations.

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	4	4	Behaviour/ movement	Draughtboarc Shark (*Cephaloscyl-lium laticeps*)	6.1	1	1	1	Between 2017-21, fishing occurred on average about 140 days throughout the season of ~6 months (from the end of June to 31 December) each year. The majority of effort occurred northeast of King Island and northeast of Flinders Island with navigation to and from fishing grounds and steaming between shots occurring throughout these areas causing turbulence in the water column due to action of the propellers. Behaviour and movement likely to be affected before major changes in other sub-components due to the repellent nature of this turbulence. The Draughtboard Shark is the most likely species to be affected as they likely change their behaviour/ movement to get away from turbulence caused by vessels. Intensity: negligible, sharks are mobile and can move away from vessels due to which the impact of this activity was considered to have a remote likelihood of detection at any spatial or temporal scale. Consequence: negligible, any impact is unlikely to be detectable at the scale of the stock. Confidence: low, the long-term effect of turbulence due to vessels on shark behaviour/ movement is 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
External Impacts	Other fisheries	1	4	6	Population size	Longnose Skate (*Dentiraja confusus*); Greenback Stingaree (*Urolophus viridis*); Pale Octopus (*Octopus pallidus*)	1.4	3	3	1	Fishing occurs throughout the year by several other fisheries in the BSCZSF area. Population size likely to be affected before major changes in other sub-components due to removal of individuals. Longnose Skate and Greenback Stingaree are the most likely species to be affected as they are susceptible to exploitation and population decline based on their typically long life spans, late age at maturity, and low fecundity (Heupel et al., 2018). The Greenback Stingaree is also a bycatch of otter trawlers and Danish seiners in the Southern and Eastern Scalefish and Shark Fishery (SESSF). The Longnose Skate is caught as byproduct and bycatch by otter trawlers in the Commonwealth Trawl Sector (CTS) of the Southern and Eastern Scalefish and Shark Fishery (SESSF) and by Danish seine in the SESSF, and deepwater longlines in the Gillnet, Hook and Trap Fishery sector (GHATF). Pale Octopus are also likely to be affected due to exploitation by several fisheries active in the Bass Strait; it is targeted by the Tasmanian Octopus Fishery (TOF), bycatch/ byproduct in the GHATF, and targeted by a new, standalone commercial Octopus Fishery commenced in 2020 harvesting predominantly Pale Octopus in Eastern Victoria. Evidence of localised and total biomass depletion in traditionally fished areas indicates that current levels of fishing are unlikely to be sustainable (Krueck et al., 2021). Intensity: moderate. Consequence: moderate. Confidence: low, there are no current accepted quantitative assessments for these species.
	Aquaculture	1	3	6	Behaviour/ movement	Longnose Skate (*Dentiraja confusus*); Greenback Stingaree (*Urolophus viridis*)	6.1	3	2	1	Abalone aquaculture occurs at Flinders Island with the possibility to change the water chemistry by depleting nutrients. Behaviour and movement likely to be affected before major changes in other sub-components due to change in habitat and its species, including prey. These species are the most likely species to be affected as they may adjust their behaviour/ movement due to this change in habitat and prey. Intensity: moderate, local effects may be severe. Consequence: minor, impacts on behaviour/ movement of these species were considered minimal at scale of their stock. Confidence: low, insufficient data on how aquaculture affects behaviour/ movement of these species.

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
	Coastal development	1	4	6	Behaviour/ movement; Reproductive capacity	Longnose Skate (*Dentiraja confusus*); Greenback Stingaree (*Urolophus viridis*)	6.1; 5.1	3	2	1	Coastal development occurs on Flinders Island, with the possibility of sewage discharge, agricultural runoff, and pollution from ports and coastal towns impacting habitat quality, including breeding grounds and nursery areas of species. Behaviour/ movement and Reproductive capacity likely to be affected before major changes in other sub-components due to the repelling or attracting nature of this activity. These species are the most likely species to be affected as they may adjust their behaviour/ movement due to this change in habitat and prey, but may also experience endocrine disruption of reproduction due to pollution (Heupel et al., 2018). Intensity: moderate, both broad coastal development and localised centres. Consequence: minor, it was considered that it would have a minimal impact on the stocks. Confidence: low, insufficient data available on how coastal development affects the species' behaviour/ movement.
	Other extractive activities	1	5	6	Behaviour/ movement	Longnose Skate (*Dentiraja confusus*); Greenback Stingaree (*Urolophus viridis*)	6.1	3	2	1	Oil and gas pipelines, oil and gas exploration and extraction drilling, and seismic survey for further oil and gas exploration occurs across the Bass Strait adding structures to the sea and introducing noise and visual stimuli into the environment. Behaviour and movement likely to be affected before major changes in other sub-components due to the repelling nature of this activity. These species are the most likely species to be affected due to the repellent nature of this activity. Intensity: moderate, local effects may be severe. Consequence: minor, impacts on behaviour/ movement of these species were considered minimal at scale of the stock. Confidence: low, insufficient data on how these activities affect behaviour/ movement of the species.

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 non extractive activities	1	6	6	Behaviour/ movement	Longnose Skate (*Dentiraja confusus*); Greenback Stingaree (*Urolophus viridis*)	6.1	3	2	1	Submarine cables (Basslink) and shipping occurs daily in the fishery jurisdiction introducing visual and noise stimuli into the environment. Behaviour and movement likely to be affected before major changes in other subcomponents due to an avoidance reaction. These species are the most likely species to be affected as they may experience stress and show avoidance behaviour when they are in proximity of this activity. Intensity: moderate, activity occurs throughout the BSCZSF area with shipping being concentrated near major harbours and around the mainland. Consequence: minor, this activity was considered to have minimal impact on the stock. Confidence: low, it is unknown to what extent non-extractive activities have impact on the (long-term) behaviour/ movement of these species.
	Other anthropogenic activities	1	5	5	Behaviour/ movement	Longnose Skate (*Dentiraja confusus*); Greenback Stingaree (*Urolophus viridis*)	6.1	2	2	1	Tourism and dive charters occur around the Bass Strait Islands causing disturbance due to introducing visual and noise stimuli into the environment. Behaviour and movement likely to be affected before major changes in other subcomponents due to an avoidance or attraction reaction in response to recreational vessels and divers. These species are the most likely species to be affected as they may experience stress and show avoidance behaviour towards a disturbance. Intensity: minor, impact occurs in few restricted areas due to destination of this activity and concerns smaller vessels and therefore it was considered that detectability even at these scales is rare. Consequence: minor, this activity was considered to have minimal impact on stock level. Confidence: low, it is unknown to what extent these activities have impact on the (long-term) behaviour/ movement of these species.

3.10.3 Protected Species Component

Table 3.8: Level 1 (SICA) Document L1.3 - Protected Species Component.

Direct impact of fishing	Fishing Activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
Capture	Bait collection	0									
	Fishing	1	4	4	Population size	Spiny Pipehorse (*Solegnathus spinosissimus*)	1.1	3	2	1	Between 2017-21, fishing occurred on average about 140 days throughout the season of ~6 months (from the end of June to 31 December) each year. The majority of effort occurred northeast of King Island and northeast of Flinders Island. Population size likely to be affected before major changes in other sub-components due to removal of individuals. The Spiny Pipehorse is the most likely species to be affected as it is listed under the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) and listed as protected under the New South Wales, Victorian and Tasmanian Fisheries Management Acts (Bray, 2022). Intensity: moderate, impact local but severe. Consequence: minor, the number of individuals potentially interacted with the fishery and the likely impact on population size is assumed to be low. Confidence: low, lack of data and protected species interaction rates seen in the preseason biomass surveys are not directly indicative of commercial fishing practices, as a range of environments are targeted in the survey.

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	1	4	4	Population size	Spiny Pipehorse (*Solegnathus spinosissimus*)	1.1	1	1	2	Fishing crew can line fish for fishing during their downtime when the vessel is anchored. Population size likely to be affected before major changes in other sub-components due to attraction of sharks and other scavengers. The Spiny Pipehorse is the most likely species to be affected as it is listed under the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) and listed as protected under the New South Wales, Victorian and Tasmanian Fisheries Management Acts (Bray, 2022) and this activity can attract predators. Intensity: negligible, effect of occasional fishing by crew on stock unlikely to be detectable at any spatial or temporal scale. Consequence: negligible, interactions with Spiny Pipehorse unlikely to contribute to detectable change in population size of the stock. Confidence: high, logical considerations.
Direct impact without capture	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	4	4	Population size	Spiny Pipehorse (*Solegnathus spinosissimus*)	1.1	3	2	1	The BSCZSF uses a harvester that is constructed of a heavy steel frame covered with steel mesh and open on the front side which is towed over the bottom. Population size likely to be affected before major changes in other sub-components due to damage (leading to death) of individuals which come in direct contact with this fishing gear yet are not captured. The Spiny Pipehorse is the most likely species to be affected as it is listed under the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) and listed as protected under the New South Wales, Victorian and Tasmanian Fisheries Management Acts (Bray, 2022). Intensity: moderate, Spiny Pipehorses can be encountered at a broader spatial scale regarding fishery effort. Consequence: minor, impact on stock assumed to be minor. Confidence: low, lack of data and protected species interaction rates seen in the preseason biomass survey are not directly indicative of commercial fishing practices, as a range of environments are targeted in the survey. As such, the interaction between this protected species and this fishery remains unclear.

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	1	4	4	Population size	Spiny Pipehorse (*Solegnathus spinosissimus*)	1.1	1	1	1	Fishing crew can line fish for fishing during their downtime when the vessel is anchored. Behaviour and movement likely to be affected before major changes in other sub-components due to foraging for food. The Spiny Pipehorse is the most likely species to be affected. Population size likely to be affected before major changes in other sub-components due to damage/ mortality suffered by individuals that are not captured. Intensity: negligible, damage/ mortality of the species by crew in their downtime probably very rare given their fishing gear with a remote likelihood of detection of impact on population size at any spatial or temporal scale. Consequence: negligible, impact on population size unlikely to be detectable at level of stock. Confidence: low, uncertainty about other fishing methods in this activity is high.

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
	Gear loss	1	1	2	Population size	Spiny Pipehorse (*Solegnathus spinosissimus*)	1.1	1	1	2	Between 2017-21, fishing occurred on about during 140 days throughout the season of ~6 months (from the end of June to 31 December) each year. The majority of effort occurred northeast of King Island and northeast of Flinders Island with gear loss being possible throughout that area. However, dredge loss is rare, and lost dredges can be recovered by fishers. Population size likely to be affected before major changes in other sub-components due to killing individuals or injuring individuals which die after being damaged due to contact with lost gear. The Spiny Pipehorse is the most likely species to be affected as it is listed under the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) and listed as protected under the New South Wales, Victorian and Tasmanian Fisheries Management Acts (Bray, 2022)and they can potentially die from or get injured by lost gear. Intensity: negligible, gear loss is rare and if gear was lost, its impact would have a remote likelihood of detection at any spatial or temporal scale. Consequence: negligible, unlikely that species get injured due to the lost gear and therefore unlikely that its impact is detectable at the scale of the stock. Confidence: high, all gear loss is required to be recorded and none occurred during the assessment period.

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
	Anchoring/ mooring	1	1	4	Behaviour/ Movement	Spiny Pipehorse (*Solegnathus spinosissimus*)	6.1	1	1	1	Between 2017-21, fishing occurred on average about 140 days throughout the season of ~6 months (from the end of June to 31 December) each year. The majority of effort occurred northeast of King Island and northeast of Flinders Island with anchoring/ mooring occurring throughout the area. The behaviour/ movement of the species is likely to be affected before major changes in other sub-components due to contact with the anchor. The Spiny Pipehorse is the most likely species to be affected as they may be disturbed or displaced by anchoring the vessel. Intensity: negligible, anchoring has a very small footprint and its impact has a remote likelihood of detection at any spatial or temporal scale. Consequence: negligible, its impact on the behaviour/ movement of this species was considered unlikely to be detectable at the scale of the stock. Confidence: low, it is unknown how often anchors come in contact with this species.

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	4	4	Population size	Spiny Pipehorse (*Solegnathus spinosissimus*)	1.1	1	1	2	Between 2017-21, fishing occurred on average about 140 days throughout the season of ~6 months (from the end of June to 31 December) each year. The majority of effort occurred northeast of King Island and northeast of Flinders Island with navigation to and from fishing grounds and steaming between shots occurring throughout these areas with 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. The Spiny Pipehorse is the most likely species to be affected. Intensity: negligible, collisions between species and vessels unlikely and the likelihood of detection of this impact at any spatial or temporal scale to be remote. Consequence: negligible, any impact was considered unlikely to be detectable at the scale of their stock. Confidence: high, logical considerations.
Addition/ movement of biological material	Translocation of species	1	4	4	Behaviour/ Movement	Spiny Pipehorse (*Solegnathus spinosissimus*)	6.1	3	2	1	BSCZSF fishers are permit holders in several fisheries, and so will use different ports, which has a potential to translocate hull fouling animals, or through brine tanks used for ballast on the way to fishing grounds. Translocation of species such as habitat-modifying invasive species may affect habitat-dependent species such as the Spiny Pipehorse. Behaviour/ movement likely to be affected before major changes in other sub-components. The Spiny Pipehorse is the most likely species to be affected as they may move relatively short distances in sediments. Intensity: moderate, this activity can impact the behaviour/ movement due to its effect occurring over a broader spatial scale. Consequence: minor, it was considered to have a minimal impact on the stock. Confidence: low, unknown how this activity would affect the behaviour/ movement of this species.

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
	On board processing	1	4	4	Population size	Spiny Pipehorse (*Solegnathus spinosissimus*)	1.1	1	1	2	Between 2017-21, fishing occurred on average about 140 days throughout the season of ~6 months (from the end of June to 31 December) each year. The majority of effort occurred northeast of King Island and northeast of Flinders Island with onboard processing possible throughout this area. Population size likely to be affected before major changes in other sub-components due to attraction of scavengers and predators (e.g., sharks and trevallies). The Spiny Pipehorse is the most likely species to be affected as it is listed under the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) and listed as protected under the New South Wales, Victorian and Tasmanian Fisheries Management Acts (Bray, 2022) and this activity can attract predators. Intensity: negligible, given its volume and the footprint of disposal after onboard processing this activity was not considered to have a detectable change on population size of the species at any spatial or temporal scale. Confidence: high, logical considerations.

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
	Discarding catch	1	4	4	Population size	Spiny Pipehorse (*Solegnathus spinosissimus*)	1.1	3	1	2	Between 2017-21, fishing occurred on average about 140 days throughout the season of ~6 months (from the end of June to 31 December) each year. The majority of effort occurred northeast of King Island and northeast of Flinders Island with discarding occurring throughout this area. Population size likely to be affected before major changes in other sub-components due to attraction of scavengers and predators (e.g., sharks and trevallies). The Spiny Pipehorse is the most likely species to be affected as it is listed under the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) and listed as protected under the New South Wales, Victorian and Tasmanian Fisheries Management Acts (Bray, 2022) and this activity can attract predators. Intensity: negligible, given its volume and the footprint of disposal after onboard processing this activity was not considered to have a detectable change on population size of the species at any spatial or temporal scale. Confidence: high, logical considerations.
	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	4	4	Behaviour/ Movement	Spiny Pipehorse (*Solegnathus spinosissimus*)	6.1	1	1	2	Between 2017-21, fishing occurred on average about 140 days throughout the season of ~6 months (from the end of June to 31 December) each year. The majority of effort occurred northeast of King Island and northeast of Flinders Island with organic waste disposal possible over this scale. Behaviour/ movement likely to be affected before major changes in other sub-components due to the attraction (e.g., food scraps) or repulsion (e.g., raw sewage) by the organic waste. The Spiny Pipehorse is the most likely species to be affected as they may change their behaviour due to organic waste disposal. Intensity: negligible, given its volume, a disposal event was not considered to have a detectable change on the species' behaviour/ movement at any spatial or temporal scale. Consequence: negligible, temporary change in behaviour/ movements was considered unlikely to be detectable at the scale of the stock. Confidence: high, logical considerations.

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 of non-biological material	Debris	1	4	4	Population size	Spiny Pipehorse (*Solegnathus spinosissimus*)	1.1	1	1	2	Between 2017-21, fishing occurred on average about 140 days throughout the season of ~6 months (from the end of June to 31 December) each year. The majority of effort occurred northeast of King Island and northeast of Flinders Island with accidental debris disposal possible throughout this area. Population size likely to be affected before major changes in other sub-components due to injury/ death from contact with, entanglement in, or ingestion of debris. The Spiny Pipehorse is the most likely species to be affected as it is listed under the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) and listed as protected under the New South Wales, Victorian and Tasmanian Fisheries Management Acts (Bray, 2022). They may be attracted by the debris (either directly or indirectly due to aggregating species) and get injured by, entangled in or swallow the debris. Intensity: negligible, disposal of debris is prohibited and the impact of incidental disposal considered to have a remote likelihood of detection at any spatial or temporal scale. Consequence: negligible, as this activity is rare its impact was considered unlikely to be detectable at the scale of the stock. Confidence: high, debris disposal is prohibited.

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
	Chemical pollution	1	4	4	Behaviour/ Movement	Spiny Pipehorse (*Solegnathus spinosissimus*)	6.1	1	1	2	Between 2017-21, fishing occurred on average about 140 days throughout the season of ~6 months (from the end of June to 31 December) each year. The majority of effort occurred northeast of King Island and northeast of Flinders Island with occasional chemical pollution in normal course of operation possible throughout the area. Behaviour/ movement likely to be affected before major changes in other sub-components due to the repulsive nature of the chemical pollution. The Spiny Pipehorse is the most likely species to be affected as they may be repulsed by the pollution directly or indirectly by change in movement of their food sources. Intensity: negligible, as chemical pollution is prohibited and therefore rare, its impact was considered to have a remote likelihood of detection at any spatial or temporal scale. Consequence: negligible, this activity is rare, its impact was considered unlikely to be detectable at the scale of the stock. Confidence: high, chemical pollution is prohibited.
	Exhaust	1	4	4	Behaviour/ Movement	Spiny Pipehorse (*Solegnathus spinosissimus*)	6.1	2	1	2	Between 2017-21, fishing occurred on average about 140 days throughout the season of ~6 months (from the end of June to 31 December) each year. The majority of effort occurred northeast of King Island and northeast of Flinders Island with exhaust emissions 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. The Spiny Pipehorse is the most likely species to be affected. Intensity: minor, because 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 at stock scale. Confidence: high, logical considerations.

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
	Gear loss	1	1	2	Behaviour/ Movement	Spiny Pipehorse (*Solegnathus spinosissimus*)	6.1	1	1	2	Between 2017-21, fishing occurred on average about 140 days throughout the season of ~6 months (from the end of June to 31 December) each year. The majority of effort occurred northeast of King Island and northeast of Flinders Island with gear loss being possible throughout that area. However, dredge loss is rare, and lost dredges can be recovered by fishers. If gear loss would occur, behaviour/ movement likely to be affected before major changes in other sub-components due to being attracted to the structure over time. This species is the most likely species to be affected as they can be attracted to abandoned gear. Intensity: negligible, gear loss is rare and its impact was considered to have a remote likelihood of detection at any spatial or temporal scale. Consequence: negligible, unlikely to detect impact on the behaviour/ movement of this species. Confidence: high, logical considerations and all major gear loss is required to be recorded.

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	4	4	Behaviour/ Movement	Spiny Pipehorse (*Solegnathus spinosissimus*)	6.1	2	1	2	Between 2017-21, fishing occurred on average about 140 days throughout the season of ~6 months (from the end of June to 31 December) each year. The majority of effort occurred northeast of King Island and northeast of Flinders Island with navigation to and from fishing grounds and steaming between shots occurring throughout these areas introducing 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. The Spiny Pipehorse is the most likely species to be affected as they can be exposed to these stimuli. Intensity: minor, these stimuli occur in restricted areas in proximity of the vessels and detectability of impact even at this scale is rare. Consequence: negligible, although they can respond to the stimuli, the impact was considered to be short-lived an unlikely to be detectable at the scale of the stock. Confidence: high, logical considerations.

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
	Activity/ presence on water	1	4	4	Behaviour/ Movement	Spiny Pipehorse (*Solegnathus spinosissimus*)	6.1	2	1	2	Between 2017-21, fishing occurred on average about 140 days throughout the season of ~6 months (from the end of June to 31 December) each year. The majority of effort occurred northeast of King Island and northeast of Flinders Island introducing 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. The Spiny Pipehorse is the most likely species to be affected as they can be in proximity of vessels. Intensity: minor, these stimuli occur in restricted areas in proximity of the vessels and detectability of impact even at this scale is rare. Consequence: negligible, although they can respond to the stimuli, the impact was considered to be short-lived an unlikely to be detectable at the scale of the stock. Confidence: high, logical considerations.
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	4	4	Behaviour/ Movement	Spiny Pipehorse (*Solegnathus spinosissimus*)	6.1	3	2	1	Between 2017-21, fishing occurred on average about 140 days throughout the season of ~6 months (from the end of June to 31 December) each year. The majority of effort occurred northeast of King Island and northeast of Flinders Island. Fishing may disrupt benthic structures and processes. Behaviour and movement likely to be affected before major changes in other sub-components. This species is the most likely species to be affected as they occur over the fishery footprint and could be disturbed or displaced. Intensity: moderate, these stimuli occur locally in proximity of the fishing activity yet can be severe. Consequence: minor, it was assumed that they would move out of the area of the fishing activity and return to natural behaviour. It is unlikely that to detect the variation in distribution. Confidence: low, long-term effects of sea floor disturbance on behaviour/ movement unknown.
	Boat launching	0									
	Anchoring/ mooring	1	1	4	Behaviour/ Movement	Spiny Pipehorse (*Solegnathus spinosissimus*)	6.1	1	1	2	The majority of effort occurred northeast of King Island and northeast of Flinders Island with anchoring/ mooring occurring throughout the area. Behaviour and movement likely to be affected before major changes in other sub-components. This species is the most likely species to be affected as it may anchoring may alter critical habitat, e.g., pipefishes may be displaced if site-specific habitat is altered. Intensity: negligible, anchoring has a very small footprint and its impact has a remote likelihood of detection at any spatial or temporal scale. Consequence: negligible, its impact on the behaviour/ movement of this species was considered unlikely to be detectable at the scale of the stock. Confidence: high, logical considerations.

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	4	4	Behaviour/ Movement	Spiny Pipehorse (*Solegnathus spinosissimus*)	6.1	1	1	2	Between 2017-21, fishing occurred on average about 140 days throughout the season of ~6 months (from the end of June to 31 December) each year. The majority of effort occurred northeast of King Island and northeast of Flinders Island with navigation to and from fishing grounds and steaming between shots occurring throughout these areas causing turbulence in the water column due to action of the propellers. Behaviour and movement likely to be affected before major changes in other sub-components due to the repellent nature of this turbulence. The Spiny Pipehorse is the most likely species to be affected. Intensity: negligible, the impact of this activity was considered to have a remote likelihood of detection at any spatial or temporal scale. Consequence: negligible, any impact is unlikely to be detectable at the scale of the stock. Confidence: high, logical considerations.

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	4	6	Population size	Spiny Pipehorse (*Solegnathus spinosissimus*)	1.1	3	3	1	Fishing occurs throughout the year by several other fisheries in the BSCZSF area. Population size likely to be affected before major changes in other sub-components due to removal of individuals. The Spiny Pipehorse is the most likely species to be affected as it is listed under the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) and listed as protected under the New South Wales, Victorian and Tasmanian Fisheries Management Acts (Bray, 2022). The species is taken as incidental bycatch in dredges, trawls (e.g., the Southern and eastern Scalefish and Shark Trawl Fishery (SESSF) - trawl sector), seines and in crayfish pots (Bray, 2022). Intensity: moderate, impact moderate over a broader spatial scale. Consequence: major. Confidence: low, being a protected species, all interactions with fisheries must be recorded and data shows the species is caught in numerous fisheries, however the species IUCN status is data deficient due to a general lack of data on the species stock.
	Aquaculture	1	3	6	Behaviour/ Movement	Spiny Pipehorse (*Solegnathus spinosissimus*)	6.1	3	2	1	Abalone aquaculture occurs at Flinders Island with the possibility to change the water chemistry by depleting nutrients. Behaviour and movement likely to be affected before major changes in other sub-components due to the change of habitat and species. The Spiny Pipehorse is the most likely species to be affected as they may adjust their behaviour/ movement due to this change in habitat and prey. Intensity: moderate, local effects may be severe. Consequence: minor, impacts on behaviour/ movement of the species were considered minimal at scale of the stock. Confidence: low, insufficient data on how aquaculture affects behaviour/ movement of species.

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
	Coastal development	1	4	6	Behaviour/ Movement	Spiny Pipehorse (*Solegnathus spinosissimus*)	6.1	3	2	1	Coastal development occurs on Flinders Island, with the possibility of sewage discharge, agricultural runoff, and pollution from ports and coastal towns impacting breeding grounds and nursery areas for some of the species in the fishery. Behaviour and movement likely to be affected before major changes in other sub-components due to the repelling or attracting nature of this activity. The Spiny Pipehorse is the most likely species to be affected as they may adjust their behaviour/ movement due to this change in habitat and prey. Intensity: moderate - both broad coastal development and localised centres. Consequence: minor - as the impact of this activity was unlikely to extend to entire shelf area it was considered that it would have a minimal impact on the stock. Confidence: low - insufficient data available on how coastal development affects the species behaviour/ movement.
	Other extractive activities	1	5	6	Behaviour/ Movement	Spiny Pipehorse (*Solegnathus spinosissimus*)	6.1	3	2	1	Oil and gas pipelines, oil and gas exploration and extraction drilling, and seismic survey for further oil and gas exploration occurs across the Bass Strait adding structures to the sea and introducing noise and visual stimuli into the environment. Behaviour and movement likely to be affected before major changes in other sub-components due to the repelling nature of this activity. The Spiny Pipehorse is the most likely species to be affected due to the repellent nature of this activity. Intensity: moderate, local effects may be severe. Consequence: minor, impacts on behaviour/ movement of the species were considered minimal at scale of the stock. Confidence: low, insufficient data on how these activities affect behaviour/ movement of the species.

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 non extractive activities	1	6	6	Behaviour/ Movement	Spiny Pipehorse (*Solegnathus spinosissimus*)	6.1	3	2	1	Submarine cables (Basslink) and shipping occurs daily in the fishery jurisdiction introducing visual and noise stimuli into the environment. Behaviour and movement likely to be affected before major changes in other subcomponents due to an avoidance reaction. The Spiny Pipehorse is the most likely species to be affected as they may experience stress and show avoidance behaviour when occurring in proximity of this activity. Intensity: moderate, activity occurs throughout the BSCZSF area with shipping being concentrated near major harbours and around the mainland. Consequence: minor, this activity was considered to have minimal impact on the stock. Confidence: low, it is unknown to what extent non-extractive activities have impact on the (long-term) behaviour/ movement of the species.
	Other anthropogenic activities	1	5	5	Behaviour/ Movement	Spiny Pipehorse (*Solegnathus spinosissimus*)	6.1	2	2	1	Tourism and dive charters occur around the Bass Strait Islands causing disturbance due to introducing visual and noise stimuli into the environment. Behaviour and movement likely to be affected before major changes in other subcomponents due to an avoidance or attraction reaction in response to recreational vessels and divers. The Spiny Pipehorse is the most likely species to be affected as they may experience stress and show avoidance behaviour towards a disturbance. Intensity: minor, impact occurs in few restricted areas due to destination of this activity and concerns smaller vessels and therefore it was considered that detectability even at these scales is rare. Consequence: minor, this activity was considered to have minimal impact on the stock. Confidence: low, the overall impact of this activity and its extent remains undefined.

3.10.4 Habitats Component

Table 3.9: 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									

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	4	4	Habitat structure and function	Southeast shelf and slope (assessmblage 7, Shelf < 100 m)	5.1	3	3	1	Most effort over the assessment period occurred in assemblage 7 within the Southeast shelf and slope biome in shelf habitat less than 100m and is thus considered the most vulnerable assemblages in the fishery. The fishery uses single towed scallop harvester (dredge) that occurs at a depth range of approximately 30-100 m, within a defined area of Bass Strait that supports dense scallop beds. Key commercial species are typically found in coarse sediments in highly dynamic current zones. Dredging activities may result in significant localized disturbance on and in the substratum to a depth of ~50 mm (Craven et al., 2013). When dredged, all habitat on the surface (encrusting mixed fauna and epifauna e.g., sponges, corals, bryozoans, sea squirts, anemones, brachypods, and bivalves) will be impacted. During 2021 surveys, Old Single Shell (26%), other Brocken Shell (18%) and Sponge (8%) comprised the largest other components of the catch (Koopman et al., 2021). Mortality to taxa can be expected to be high, even if returned to the sea after haul and surface time. Intentional 'skimming off' of sediments to get to target species in furrows causes sediment resuspension, translocation in currents and particle size sorting, which alters substrate and result in reduced habitat complexity, habitat fragmentation, loss of biodiversity and reduced ecosystem functioning of marine seabed habitats (Bloor et al., 2021). Changes occur in a way that the benthic habitat requires years to at least a decade to recover (Hiddink et al., 2017). Intensity: moderate with highly localised severe impact to benthic habitat. Consequence: moderate, high localised severe impacts to fished habitat. Confidence: low to moderate with some survey data reporting bycatch although not focused on how fishing affects habitat sustainability.

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
	Incidental behaviour	1	4	4	Habitat structure and function	Southern Pelagic Province - Coastal 0 - 200 m	5.1	1	1	1	Fishing using recreational gear (mainly trolling) on way to and from grounds may occur in addition to line fishing by fishers during their downtime when the vessel is anchored. Recreational fishing is most likely to affect the habitat structure and function of coastal pelagic habitats due to removal of fish affecting species composition. Intensity: negligible. Consequence: negligible. Confidence: low, lack of information.
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	4	4	Habitat structure and function	Southeast shelf and slope (assemblage 7, Shelf < 100 m)	5.1	3	3	1	Most effort over the assessment period occurred in assemblage 7 within the Southeast shelf and slope biome in shelf habitat less than 100m and is thus considered the most vulnerable assemblages in the fishery. Benthic infaunal habitat types (within the substrate) are most at risk of direct impact from the fishery without capture from the dredge gear due to scraping (or ploughing), sediment re-suspension, physical destruction of bedforms, and the removal or scattering of non-target benthic organisms (Craven et al., 2013). Bioturbators are unlikely to be identified in bycatch; however habitat architecture will be destroyed in the act of fishing. Time for recovery of substrate post trawling has been estimated to be between 1.9 to 6.4 years depending on fisheries and environmental context (Hiddink et al., 2017). Sessile infauna likely to be months to years, providing recruitment possible (requires longer cycles of disturbance). Intensity: moderate, at with highly localised severe impact to benthic habitat types. Consequence: moderate, sustainable level of impact on the benthic infaunal habitat across the broader fishing area. Confidence: low, due to lack of information on substratum infaunal processes in this region and that effects of dredging disturbance on post encounter status of fauna and habitat is largely unquantified.
	Incidental behaviour	1	4	4	Habitat structure and function	Southern Pelagic Province - Coastal 0 - 200 m	5.1	1	1	1	Fishing using recreational gear (mainly trolling) on way to and from grounds may occur which is not likely to affect benthic habitats. Further to this, fishing crew can line fish for fishes during their downtime when the vessel is anchored. Intensity: negligible. Consequence: negligible. Confidence: low, lack of information.

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
	Gear loss	1	1	2	Habitat structure and function	Southeast shelf and slope (assemblage 7, Shelf < 100 m)	5.1	1	1	2	Fishing occurs mostly in the inner shelf of the Southeast shelf and slope biome typically in waters less than 100 m. Reports of gear loss is rare and all efforts to retrieve gear are made. Where gear is lost it could impact the structure and function of benthic habitats in the Southeast shelf and slope biome through direct contact on the substrate which may squash or displace benthic invertebrates in the short term. Minor gear components such as buoys, could be lost, which could also interact with species in the pelagic habitat, but less likely than impact on benthic habitats. Intensity: minor, gear loss is rare. Consequence: negligible, unlikely to detect impact. Confidence: high, all major gear loss is required to be recorded.
	Anchoring/ mooring	1	1	4	Habitat structure and function	Southeast shelf and slope (assemblage 7, Shelf < 100 m)	5.1	1	1	2	Anchoring/ mooring occurs throughout the Southeast shelf and slope biome typically in shallow inshore areas. Sessile benthic fauna may be damaged by physical contact with anchor, during anchoring and retrieval which is mostly likely to impact benthic habitat structure and function. Intensity: negligible as activity is infrequent and within a season (~6 months). Consequence: negligible, unlikely to be detectable at scale of habitat. Impact of the anchor is localized and negligible for large sponge habitat and other benthic habitat over the scale of possible anchoring sites. Confidence: high, logical considerations.
	Navigation/ steaming	1	4	4	Water quality	Southern Pelagic Province - Coastal 0 - 200 m	1.1	1	1	2	Navigation/ steaming to fishing grounds may result in disruption of water quality from introduction of pollutants or chemicals, noise, light and changes to water chemistry or turbidity. Intensity: low, broad spatial scale. Consequence: negligible, considered unlikely that there would be detectable impacts. Confidence: high, because negative interactions between navigation/ steaming and pelagic habitat were considered unlikely to be detectable.

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/ movement of biological material	Translocation of species	1	4	4	Habitat structure and function	Southeast shelf and slope (assemblage 7, Shelf < 100 m)	5.1	3	3	1	The fishery likely has an impact on the ecology and distribution of the introduced New Zealand screw shell and the European shore crab (*Carcinus maenas*) which occurs in the fished area in shelf waters less than 100 m. Translocated species most likely to affect compromised habitats in terms of structure and function, by altering pelagic and sediment processes, and displacing species. Intensity: moderate, impact considered to be highly localised though mechanism driving translocation not understood but translocation through dredging cannot be discounted. Consequence: moderate, this introduced species is a suspension feeder that forms dense beds of up to several hundred squared metres. It can impact biodiversity through competition with commercial and native species for food (suspended nutrients and plankton), displacement, or habitat modification, e.g., dead shells create additional habitat for hermit crabs (Bax et al., 2003). Confidence: low, considerable uncertainty about changes in habitat function as introduced species proliferate, and relationship to fishing.
	On board processing	1	4	4	Habitat structure and function	Southeast shelf and slope (assemblage 7, Shelf < 100 m)	5.1	1	1	1	Onboard processing can take place only to test for the quality of scallop meat, otherwise it is not permitted. Discarded shells and other material left after removing the adductor muscle for quality testing is most likely to affect the benthic habitat structure and function due to disturbance and settling of material. Intensity: minor, as processing is rare. Consequence: minor, as processing rarely occurs. Confidence: low, lack of information.

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	4	4	Sediment quality	Southeast shelf and slope (assemblage 7, Shelf < 100 m)	3.1	3	3	1	Bycatch discarding is high with the mortality status of benthic fauna variable and taxa dependent. Hard bodied discards may settle on the substrate, possibly in localised accumulations which impact the substrate quality. Bioturbated fine sediments may become anoxic (lowest oxygen content below the surface compared with other habitat types) particularly in areas of slower flushing times typical within areas of Bass Strait. Scavenging animals will process material in time, and discarding may be dispersed if vessel underway, which would reduce the concentration of the discards. Intensity: moderate, severe but local but with some uncertainty of spatial scale. Consequence: moderate, due to scale of operation being highly localised. Confidence: low, volumes of discards unknown and there is limited information about discards and benthic community composition.
	Stock enhancement	0									
	Provisioning	0									
	Organic waste disposal	1	4	4	Water quality	Southern Pelagic Province - Coastal 0 - 200 m	1.1	1	2	1	Discharge of organic waste (e.g. uncontaminated food waste) likely to occur daily although relatively small amounts. Excess waste could accumulate and affect water quality in quiescent periods but is unlikely as dispersal could be expected to be relatively rapid in this region of strong currents and wave/ swell action. Intensity: negligible, unlikely to detect at any scale. Consequence: minor, generally undetectable though the level of organic waste could be expected to be minimal, however may be highly localised due to the spatial scale of the effort within this fishery. Confidence: low, no information available.

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	1	4	4	Water quality	Southern Pelagic Province - Coastal 0 - 200 m	1.1	1	2	1	MARPOL regulations apply. Assumed that accidental loss occurs, and that debris will generally sink, where it will eventually form habitat where breakdown times are long. Some will float, drifting about until washed ashore, otherwise impact the pelagic habitat and species dwelling within it, e.g., small scraps of plastic may be ingested. Sinking debris may not be buried easily, and may accumulate, although uncertain in dynamic wave and storm swell environments. Intensity: minor, occurs rarely. Consequence: minor, minimal impact on pelagic or benthic habitats. Confidence: low, lack of information on type and quantity of debris.
	Chemical pollution	1	4	4	Water quality	Southern Pelagic Province - Coastal 0 - 200 m	1.1	1	1	2	Chemical spills (inadvertent) and operation of vessel, affects pelagic water quality. Intensity: negligible, volumes of material expected to be quickly dispersed. Consequence: negligible. Confidence: high, logical considerations.
	Exhaust	1	4	4	Air quality	Southern Pelagic Province - Coastal 0 - 200 m	2.1	2	1	2	Exhaust from running engines may impact the air quality within the fishery. Intensity: negligible, because although the hazard occurs over a larger range/ scale, impact area is only within metres of the vessel. Consequence: negligible, due to rapid dispersal of pollutants in winds, and likely to be physically undetectable over very short time frames. Confidence: high, because effect of exhaust was considered to be very localised.

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
	Gear loss	1	1	2	Habitat structure and function	Southeast shelf and slope (assemblage 7, Shelf < 100 m)	5.1	1	2	1	Fishing occurs mostly in the inner shelf of the Southeast shelf and slope biome typically in waters less than 100 m. Amount of gear lost is considered low and was reported as not occurring during the season. Intensity: minor, dredges can be lost, however uncommon and only have highly localised impact. Consequence: minor, some detectability will exist where gear remains on bottom, to eventually become a new substrate/ habitat, if not buried. Confidence: low, due to lack of information.
	Navigation/ steaming	1	4	4	Water quality	Southern Pelagic Province - Coastal 0 - 200 m	1.1	2	1	2	Steaming/ navigation to fishing grounds may result in disruption of water quality from introduction noise, light and changes to water chemistry or turbidity or of pollutants or chemicals (unlikely). Intensity: minor, as soon as activity ceases, no evidence of remaining activity. Consequence: negligible, because it was considered unlikely that there would be detectable impacts. Confidence: high, logical considerations.
	Activity/ presence on water	1	4	4	Water quality	Southern Pelagic Province - Coastal 0 - 200 m	1.1	2	1	2	The noise and visual stimuli related to the presence of vessels impact the pelagic habitat for as long as the fishing activity occurs. As soon as activity ceases, no evidence in terms of air and water quality remains. Intensity: minor, minimal impact on pelagic habitats. Consequences: negligible. 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	4	4	Sediment quality	Southeast shelf and slope (assemblage 7, Shelf < 100 m)	3.1	3	3	1	Dredging disturbs benthic sediments to an approximate depth of 50 mm and thus benthic habitats. The resulting suspension of sediments will temporarily increase water turbidity, the extent is influenced by sediment type (greater in fine sands and mud), and the strength of currents present. The major commercial beds of Bass Strait are characterised by coarse sediments, which are unlikely to remain suspended for long, however during resettlement may smother sessile fauna, resorted sediments alter substrate architecture, and change the mineralization of settled organic material within the substrate. Intensity: moderate, locally severe. Consequence: moderate, reflect that raking of the substrate alters infaunal and epifaunal habitat structure, both locally severely and in the immediate surrounds, to a lesser degree. Confidence: low to moderate, as limited data but there has been scientific studies into the effects of dredging and trawling on the benthos.
	Boat launching	0									
	Anchoring/ mooring	1	1	4	Habitat structure and function	Southeast shelf and slope (assemblage 7, Shelf < 100 m)	5.1	1	1	2	Where anchoring does occur, it is likely to be in shallow inshore areas where the impact of the anchor on sediment processes is localized and negligible compared with the regular mixing and disturbance due to physical processes. Intensity: negligible. Consequence: negligible. 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
	Navigation/ steaming	1	4	4	Water quality	Southern Pelagic Province - Coastal 0 - 200 m	1.1	1	1	2	Navigation/ steaming occur throughout fishing season over a small area of the fishery. Mixing of the water column is unlikely to have more than a negligible intensity and negligible consequence on water quality, structure of the water column, or pelagic productivity. Intensity: negligible. Consequence: negligible. Confidence: high, logical consideration.
External Impacts	Other fisheries	1	4	6	Habitat type, structure and function	Southeast shelf and slope (assemblage 7, Shelf < 100 m), Southern Pelagic Province - Coastal 0 - 200 m	4.1, 5.1	3	3	1	Commonwealth fisheries that operate in the same area as the BSCZSF include the Commonwealth South East Trawl Sector, the Gillnet Hook and Trap Sector, the Eastern Tuna and Billfish Fishery, the Small Pelagic Fishery and the Southern Squid Jig Fishery. State jurisdictions for Victoria and Tasmania are also directly adjacent to the BSCZSF, both of which have scallop fisheries in Bass Strait. Due to the targeted nature of scallop fishing in the BSCZSF, there is little direct interaction with other fisheries, apart from a geographic overlap in fishery jurisdiction. Fishing is most likely to impact both benthic and pelagic habitat type and habitat structure and function in the fished area due to the use of fishing gear (trawling, gill nets, and dredging) removing biomass and impacting benthic and pelagic processes. Intensity: moderate, at broader spatial scale. Consequence: moderate, as frequency of disturbance affects recovery of habitat. Confidence: low, need data on frequency of overlap of fisheries operations.

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	3	6	Water quality, sediment quality	Southeast shelf and slope (assemblage 7, Shelf < 100 m), Southern Pelagic Province - Coastal 0 - 200 m	3.1	3	2	2	Aquaculture occurs at sites throughout the Southeast shelf and slope and Southern Pelagic Province biomes typically in harbours, bays and estuaries (State waters) adjacent to inner shelf habitats. Mollusc aquaculture more frequent on mainland coast and can affect nutrient depletion and water and substrate quality. Intensity: moderate, operates throughout the year. Consequence: minor, as current scale of impact unlikely to detect differences against natural variability except where seagrass habitat important to different life stages of a variety species, for which there is no evidence. Confidence: high, studies on nutrient inputs into estuaries are quickly dispersed but impacts if any are difficult to measure against other anthropogenic sources (Wild-Allen & Andrewartha, 2016).
	Coastal development	1	4	6	Water quality, sediment quality	Southeast shelf and slope (assemblage 7, Shelf < 100 m), Southern Pelagic Province - Coastal 0 - 200 m	1.1, 3.1	3	2	1	Coastal development can affect inner shelf habitats in addition to water and sediment quality. Intensity: moderate, range of activities likely to have local affects such as removal or degradation of inshore habitats. Consequence: minor, greatest impacts likely to be inshore including waters less than 25 m (not within fishery boundary) but detection further out onto the inner shelf is unknown. Confidence: low, little data on the cumulative affects.

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	5	6	Habitat structure and function	Southeast shelf and slope assemblage 13, 18	5.1	3	3	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 assemblage 13 and assemblage 18). Infrastructure impacts seafloor locally but oil leaks/ spills may impact water and substrate quality in immediate area. There is limited evidence that scallop mortality is attributable to seismic survey, although sub-lethal effects cannot be excluded (Przeslawski et al., 2018). Intensity: moderate, some localised pollution and disturbance from existing infrastructure likely. Consequence: moderate, localised impacts on benthic habitats. Confidence: low, little information on effects of pipelines on surrounding habitats although modelling suggests very contracted impact area.
	Other non extractive activities	1	6	6	Habitat structure and function	Southeast shelf and slope (assemblage 7, Shelf < 100 m)	5.1	3	2	2	Submerged cables (Basslink, Telstra, Duke Energy) either adds substrate in terms of anchors, cable, rubble to bury, or materials dug to make a channel, including activities surrounding ongoing maintenance. Intensity: moderate, at a local scale. Consequence: minor, as occurs in locations away from current fishery grounds (central zone) and at very localised impacts. Confidence: high, location of cables known.

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 anthropogenic activities	1	5	5	Water quality, air quality, sediment quality, habitat types, habitat structure and function	Southeast shelf and slope (assemblage 7, Shelf < 100 m)	1.1, 2.1, 3.1, 4.1, 5.1	2	2	1	Tourism and recreational boating/ fishing/ diving activities occur throughout the year in the southeast shelf and slope biome and could increase noise and pollutants into the pelagic habitat within the fished area. Greatest threat to water quality, substrate quality, air quality, habitat types and habitat structure and function as it includes boat launching, recreational fishing, diving, etc., that has effect from the water surface to the seafloor. Intensity: minor, although difficult to assess cumulative effects. Consequence: minor, restricted area rare event short term effects although no information to assess cumulative effects. Confidence: low, limited information.

3.10.5 Communities Component

Table 3.10: 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	4	4	Species composition	Central Bass inner shelf 0 - 110 m	1.1	3	3	1	Most fishing effort occurs north east of Flinders Island, corresponding to the area of the Central Bass Province. Dredging directly impacts benthic fauna and habitats with delayed effects to species communities through removal of the target species and through post-fishing mortality or injury of non-target organisms. Fishing removes the filter feeding sessile and mobile (scallop) members of benthic communities for which all non-target members and smaller targeted members are discarded. Mortality to taxa can be expected to be high, even if returned to the sea after haul and surface time. Average post-trawl recovery times for towed (scallop) tows is estimated between 1.9 to 6.4 years, depending on the fishery and environmental context (Hiddink et al., 2017). State Victorian and Tasmanian scallop fisheries also operate in the same fishery area and the same stock is fished. However direct fishing impacts of these state managed fisheries are not assessed, but they can potentially impact scallops and the benthic community. Intensity: moderate, as fishing is likely to alter community production, trophic structure and function of communities at a localised scale. Consequence: moderate, impact at the community scale. Confidence: low, due to lack of information on community structure in the fished area, including state fishery data.

Table 3.10: *(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	1	4	4	Species composition	Southern Coastal pelagic 0 - 200 m	1.1	1	1	2	Recreational gear including trolling and fishing lines may be used by the fishery to capture larger members of the inshore community, such as fish. Intensity: negligible, as trolling expected to have minimal impact on community. Consequence: negligible, limited impact on community. Confidence: high, due to scale of activity and logical consideration.
Direct impact without capture	Bait collection	0									
	Fishing	1	4	4	Species composition	Central Bass inner shelf 0 - 110 m	1.1	3	3	1	Most fishing effort occurs northeast of Flinders Island, corresponding to the area of the Central Bass Province. Damage and disturbance to habitat structures as a result of dredging affects benthic communities in the short term through species becoming buried in the sediment and long-term through changes in community productivity, trophic structure and function (Hiddink et al., 2017). Only those larger infauna, occurring deeper than approximately 60 mm in the substrate will be unaffected. Intensity: moderate, at localised scales. Consequence: moderate, impact on community. Confidence: low, due to lack of data on community effects of scallop dredging.
	Incidental behaviour	1	4	4	Species composition	Southern Coastal pelagic 0 - 200 m	1.1	1	1	2	Recreational fishing including trolling and fishing lines may be used by the fishery to capture larger members of the inshore community, such as fish. Intensity: negligible, as trolling expected to have minimal impact on community. Consequence: negligible, limited impact on community. Confidence: high, due to scale of activity and logical consideration.

Table 3.10: *(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	2	Species composition	Central Bass inner shelf 0 - 110 m	1.1	1	1	2	Loss of dredge gear could damage benthic habitat and thus affect demersal communities. Gear loss in this fishery is rare and all efforts to retrieve gear are made. Minor gear components may be lost, but would not impact with benthic communities and impact to pelagic communities are considered to be minimal. Intensity: minor, as gear loss is rare and all efforts of recovery are made. Consequence: negligible, impact on community, as gear is seldom lost, and unlikely to be detectable at scale of community. Confidence: high, all major gear loss is required to be recorded.
	Anchoring/ mooring	1	1	4	Species composition	Central Bass inner shelf 0 - 110 m	1.1	1	1	2	Anchoring/ mooring occurs throughout the area typically in shallow inshore areas. When/ where it occurs it is most likely to affect the species composition and distribution of the community through direct mortality and displacement of megabenthos. Intensity: minor, occurs in a few restricted locations and detectability would be rare. Consequence: negligible, impact as activity is not detectable at scale of community. Confidence: high, due to logical consideration.
	Navigation/ steaming	1	4	4	Distribution of the community	Central Bass inner shelf 0 - 110 m	3.1	1	1	2	Navigation/ steaming occurs during the approximately 6 month fishing season mostly in the Central Bass inner shelf area where there is the greatest fishing effort. The most likely affect is on the distribution of pelagic species (marine mammals, seabirds, and sharks) in the community which is considered to be temporarily and minimal. Intensity: minor due to small spatial overlap of fishing with communities in the Central Bass inner Shelf (0-110 m). Consequence: negligible, as activity is unlikely to be detectable at scale of community. Confidence: high, logical consideration, but more data required.

Table 3.10: ***(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	1	4	4	Species composition	Central Bass inner shelf 0 - 110 m	1.1	3	3	1	BSCZSF fishers are permit holders in several state and Commonwealth fisheries, and so will use different ports in Tasmania and Victoria, thus there is a chance for introducing pests (e.g. Northern Pacific Seastar (*Asterias amurensis*), New Zealand Screwshell (*Maoricolpus roseus*), Seballa Worm (*Sabella spallanzanii*)) being translocated on vessels, ballast, and brine tanks. Addition of a new species may change the species composition, and impact the community that may be dependent on the species. Fishing activity, through picking up in dredges and after capture discard, may spread the potential range of these pests, and hence contribute to a major change to the species composition of the community. Intensity: moderate, at broader spatial scale. Consequence: moderate, impact on community. Confidence: low, due to lack of information on the impact and translocation of pest species.
	On board processing	1	4	4	Species composition	Central Bass inner shelf 0 - 110 m	1.1	1	1	1	Onboard processing can take place only to test for the quality of scallop meat, otherwise it is not permitted. Discarded shells and other material left after removing the adductor muscle for quality testing is most likely to affect the species composition of the benthic community due to disturbance and settling of material. Intensity: minor, as processing is rare. Consequence: minor, as processing rarely occurs. Confidence: low, lack of information.

Table 3.10: ***(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	4	4	Species composition	South eastern Transition inner shelf 0 - 110 m	1.1	3	2	1	All bycatch and smaller sized targeted species are discarded upon capture with handling times minimised to increases survival chance. Those is the community particularly vulnerable include crabs which are often crashed or severely damaged with high mortality associated with the number of appendages removed and unsealed wounds (Ondes et al., 2016). Mortality rates of skate species, whilst variable between species, is likely to be high according to previous studies (Knotek et al., 2018). Post-capture survival for fishes, octopus and other demersal taxa may also be moderate. All discards are likely to be more vulnerable to predation as they could be taken up quickly by opportunistic species or sink to the benthos and scavenged by benthic species. These affects will most likely impact species composition of the community within the fished area. Intensity: moderate, as severe at localised scale and due to the potential impact on particular taxa groups. Consequence: minor, unlikely to affect the species composition of community. Confidence: low, due to lack of verified observer data regarding discards or information on post-capture survival of most invertebrates.
	Stock enhancement	0									
	Provisioning	0									

Table 3.10: ***(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	4	4	Distribution of the community	Southern Coastal pelagic 0 - 200 m	3.1	1	1	1	Most fishing effort occurred northeast of Flinders Island and northeast of King Island, across throughout the season of ~6 months (approximately from the end of June to 31 December) each year, so organic waste disposal is possible over this scale. Vessels are subject to MARPOL rules. Disposal of organic waste poses greatest potential risk for distribution of the pelagic community in the fished area resulting in either attraction (e.g., food scraps) or repulsion (e.g., raw sewage). Intensity: negligible, unlikely to detect at the community scale provided MARPOL rules are adhered to. Consequence: negligible, because organic waste likely to be scavenged or break down quickly, so unlikely persistent effect of distribution of the community. Confidence: low, due to lack of verified observer data.
Addition of non-biological material	Debris	1	4	4	Species composition	Central Bass inner shelf 0 - 110 m	1.1	1	1	1	Plastic debris may be an issue with the possibility of entanglement and ingestion by a range of species in the fished area. This is most likely to impact the species composition of the community due to removal or physiological stress impacting survival. Otherwise if debris sinks to the benthos it can provide further refuge or hinder benthic species. Vessels subject to MARPOL. Intensity: negligible, at the scale of the community if MARPOL rules followed. Consequence: negligible, as debris by this fishery is expected to be accidental and not routine. Confidence: low, due to lack of verified observer data.

Table 3.10: ***(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
	Chemical pollution	1	4	4	Species composition	Central Bass inner shelf 0 - 110 m	1.1	1	1	1	Chemicals used during fishing activities may be an issue, but unlikely as vessels are out at sea for usually a day at a time. Community unlikely to be affected unless a major spill occurs. Boats subject to MARPOL rules. Intensity: negligible, if MARPOL rules followed. Consequence: negligible, because chemical pollution impacts expected to be minimal and therefore unlikely to be detectable at the scale of the community. Confidence: low, due to lack of verified observer data.
	Exhaust	1	4	4	Bio- and geo-chemical cycles	Central Bass inner shelf 0 - 110 m	6.1	2	1	2	There were 10-12 active vessels operating within the fishery over the assessment period. Exhaust emissions form fishing vessels are likely to affect the bio- and geo- chemical cycles of waters within the fished area. Intensity: negligible, because exhaust considered low impact to community. Consequence: negligible, because impact on community unlikely to be detected. Confidence: high, because exhaust unlikely to impact community.
	Gear loss	1	1	2	Distribution of the community	Central Bass inner shelf 0 - 110 m	3.1	1	1	2	Gear loss in this fishery is rare and is retrieved where possible. Lost dredges would smothers part of the substrate, or allow build up of sand, that would likely affect the distribution of the local community. Intensity: minor, for this fishery direct impact expected to be minimal and affects unlikely to be detectable. Consequence: negligible, since the scale and intensity of direct impacts is perceived to be low and unlikely to impact distribution of the community. Confidence: high, because risk of interaction is unlikely.

Table 3.10: ***(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	4	4	Distribution of the community	Central Bass inner shelf 0 - 110 m	3.1	2	1	1	There were 10-12 active vessels operating within a given season (approximately 6 months) in the fishery over the assessment period. Navigation/ steaming introduces noise from vessel engines and is expected to pose greatest potential risk to the distribution of the community members such as marine mammals. Intensity: minor, occurs rarely and is unlikely to have measurable/ detectable impact on distribution of community (e.g., seabirds and/ or marine mammals). Consequence: negligible, because interactions remote, and impact on community unlikely. Confidence: high, because it was considered unlikely for there to be strong interactions between navigation/ steaming and community.
	Activity/ presence on water	1	4	4	Distribution of the community	Central Bass inner shelf 0 - 110 m	3.1	2	1	2	The environment will be impacted by noise and visual stimuli which could temporarily affect the distribution of the community. Intensity: minor, unlikely to have measurable/ detectable impact on community. Consequence: negligible, because type of impact on community. Confidence: high, because it was considered unlikely for there to be strong impacts between activity and presence and community.
Disturb physical processes	Bait collection	0									

Table 3.10: ***(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	4	4	Distribution of the community	Central Bass inner shelf 0 - 110 m	3.1	3	2	1	Dredging occurs throughout fishing season over a small area of the fishery. Dredging may stir sediments and therefore increase turbidity and sedimentation affecting the distribution of the mostly benthic community members. Intensity: moderate, with likely detectable effect on the physical processes important to the demersal community. Consequence: minor, impact on community structure given scale of disturbance. Confidence: low, due to lack of data.
	Boat launching	0									
	Anchoring/ mooring	1	1	4	Distribution of the community	Central Bass inner shelf 0 - 110 m	3.1	1	1	2	Disturbance due to anchoring/ mooring may disrupt the sediments causing immediate disruption to distribution of animals and further bacterial decomposition in the substrates, liberating the particulate organic matter before it becomes dissolved organic matter. Vessels rarely anchor or moor. Intensity: negligible, given scale of disturbance relative to natural cycles. Consequence: negligible, because scale and intensity of physical processes expected to recover after disturbance. Confidence: high, logical consideration given scale of some other natural processes.
	Navigation/ steaming	1	4	4	Distribution of the community	Central Bass inner shelf 0 - 110 m	3.1	1	1	2	Navigation/ steaming occurs throughout the approximate 6 month fishing season mostly northeast of King Island and northeast of Flinders Island. Noise and wake from vessels would mostly impact the distribution of community members such as marine mammals and seabirds. Intensity: negligible, unlikely to impact at the scale of the community. Consequence: negligible, at the community scale. Confidence: high, because it was considered unlikely for there to be strong interactions between navigation/ steaming and community.

Table 3.10: ***(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	4	6	Species composition	Central Bass inner shelf 0 - 110 m	1.1	3	3	2	Fishery covers a large spatial area in which many other state and Commonwealth fisheries operate, using a wide range targeting methods and catch species. These fisheries target predators (including Flathead, Pink Ling, Blue Grenadier, Gummy Shark and Blue-eye Trevalla), and remove the larger animals that would release the predation and competition pressure of lower trophic groups (e.g., octopus, crabs and seastars) known to feed on Commercial Scallop. The South East Trawl and the Gillnet, Hook and Trap sectors of the SESSF have low rates of interaction including incidental bycatch (demersal trawl) and touching seabed (gillnets and seines). Intensity: moderate, could have measurable direct or indirect impact on communities once predator-prey linkages fully understood. Consequence: moderate, at the scale of the community. Confidence: high, catch data from other fisheries recorded.
	Aquaculture	1	3	6	Bio- and geo-chemical cycles	Central Bass inner shelf 0 - 110 m	6.1	3	2	1	Aquaculture sites are generally located adjacent to Tasmanian coast. Changes in bio- and geo-chemical cycles due to discharges or additional feed through the water column not believed to have large impact on this community. Intensity: moderate, operating throughout the year. Consequence: minor, as any effect on this community unlikely to be measurable. Confidence: low, due to lack of data.

Table 3.10: ***(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
	Coastal development	1	4	6	Species composition	South Eastern Transition inner shelf 0 - 110 m, Central Bass inner shelf 0 - 100 m, Western Tasmania Transition inner shelf 0 - 100 m	1.1	3	3	1	Coastal developments occur on the Victorian and Tasmania coastlines that could impact the environment of the fished area in the South Eastern Transition, Central Bass, and Western Tasmania Transition inner shelf 0 - 100 m. Sewage from major settlements, eutrophication and algal blooms may occur and is most likely to impact species composition of demersal communities in coastal and inner shelf areas. Scallop juvenile survival could be compromised by sedimentation and nutrient pollution resulting from coastal developments and usage. Also, changes to bio- and geo-chemical cycles may be measurable. Intensity: moderate, both direct and indirect impact on community. It may be different around a major population centre, but linkages need to be better understood. Consequence: moderate, cumulative effects could be moderate and may impact community. Confidence: low, due to lack of information.

Table 3.10: ***(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	5	6	Distribution of the community	Central Bass inner shelf 0 - 110 m, Southern 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 southern Australia (notably within the Bass Strait). The most likely risk is to the distribution of demersal and pelagic communities as sounds from seismic surveys is thought to affect the behaviour of vertebrate species (fish, mammals, sharks) possibly causing them to migrate out of fishing grounds. There is limited evidence that scallop mortality is attributable to seismic survey, although sub-lethal effects cannot be excluded (Przeslawski et al., 2018). Intensity: moderate, as local effects are potentially severe but confined to small area. Consequence: minor, as any long-term effect on communities expected to be minimal, if detectable at all. Confidence: low, as effects are unknown.
	Other non extractive activities	1	6	6	Distribution of the community	Southern Coastal pelagic 0 - 200 m	3.1	3	2	1	Commercial shipping occurs throughout the area daily and would have the greatest affect on the distribution of pelagic communities through noise and traffic disturbance particularly on marine mammals as a result of avoidance reaction. Intensity: moderate, as local effects but temporary. Consequence: minor, as long-term effects on communities undetectable. Confidence: low, because of a lack of information on shipping - animal interactions.

Table 3.10: ***(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	5	Distribution of the community	Central Bass inner shelf 0 - 110 m, Southern Coastal pelagic 0 - 200 m	3.1	2	2	1	Tourism and recreational boating/ fishing/ diving activities occur throughout the year in the fished area. The distribution of demersal and pelagic communities may be disturbed by charter boats associated with general recreational activities, and tourism. Intensity: minor, unlikely to detect direct and indirect impacts on pelagic or demersal communities. Consequence: minor, minimal impact to communities. Confidence: low, no available information on the effect of this activity on communities.

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 3.11.

Table 3.11: Level 1 (SICA) Document L1.6.
Summary table of consequence scores for all activity/component combinations. Internal activities that scored 3 or more are coloured light blue and bold if high confidence. * existing stock assessment for all species within component. Therefore, assessment not required. Note: external hazards are not considered at Level 2.

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

Figure 3.1 to Figure 3.5 show the frequency distribution of consequence scores for all components that were assessed.

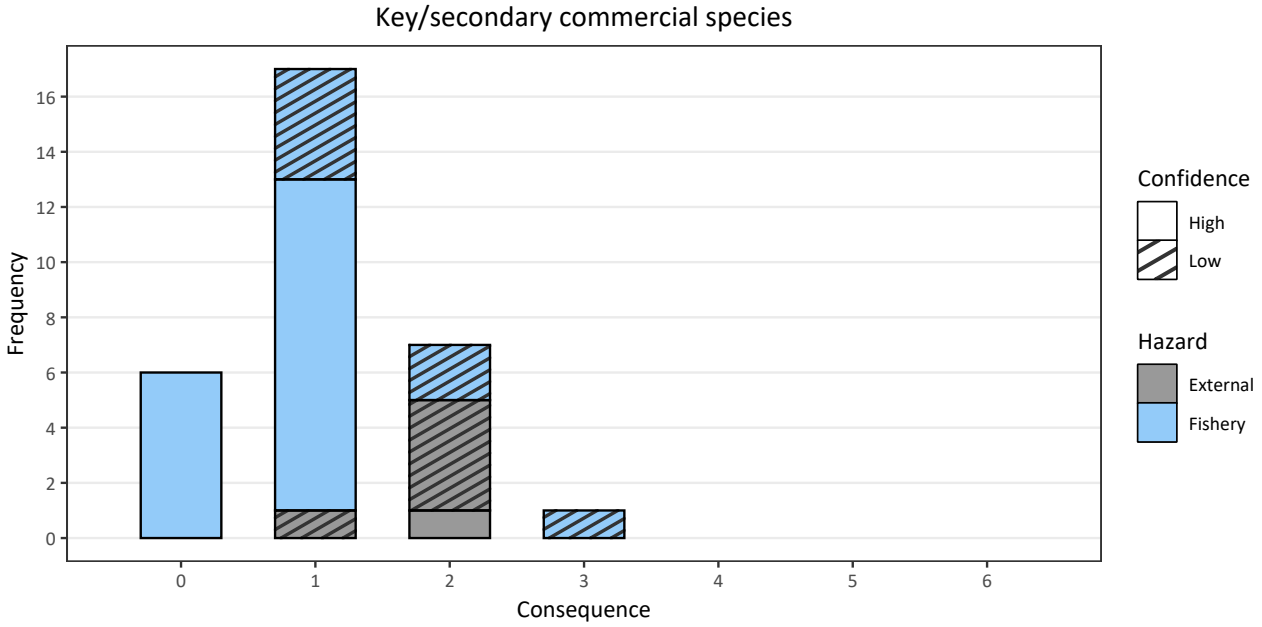


Figure 3.1: Key/secondary commercial species component: Frequency of consequence score by high and low confidence.

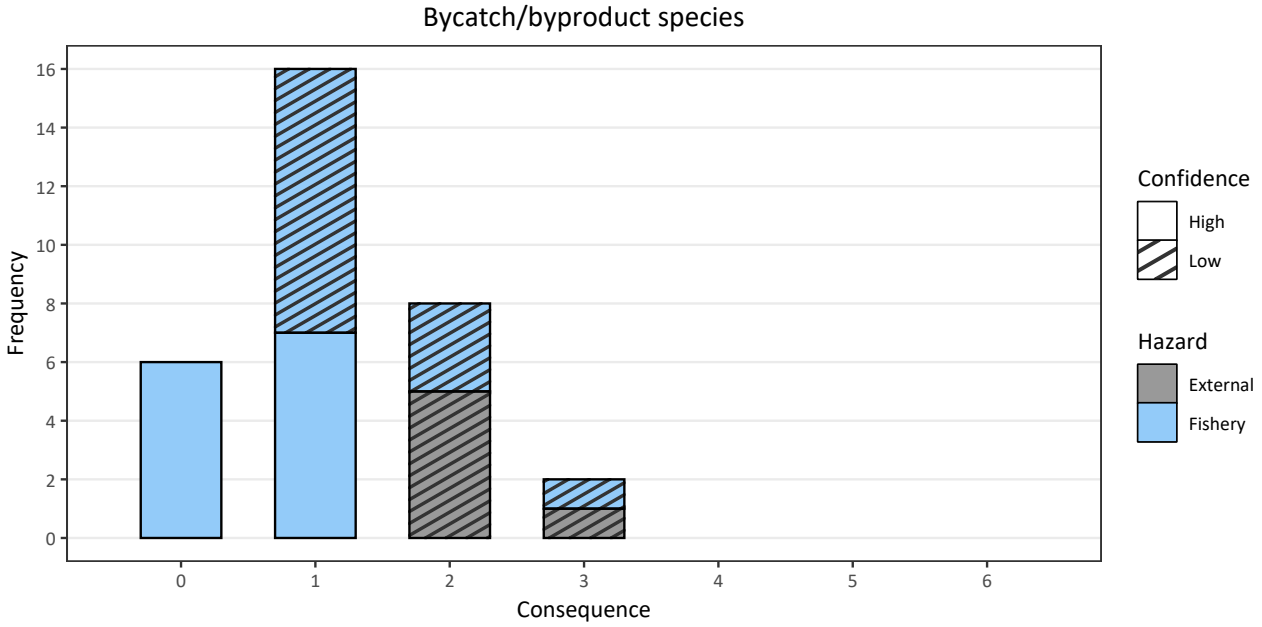


Figure 3.2: Bycatch/byproduct species component: Frequency of consequence score by high and low confidence.

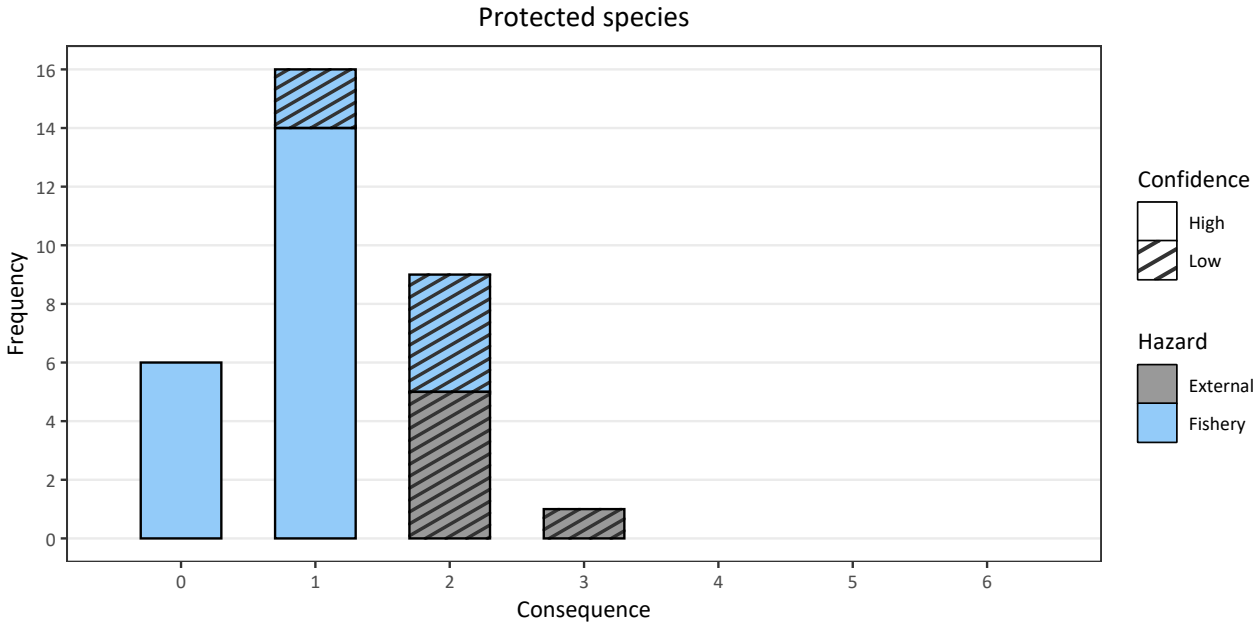


Figure 3.3: Protected species component: Frequency of consequence score by high and low confidence.

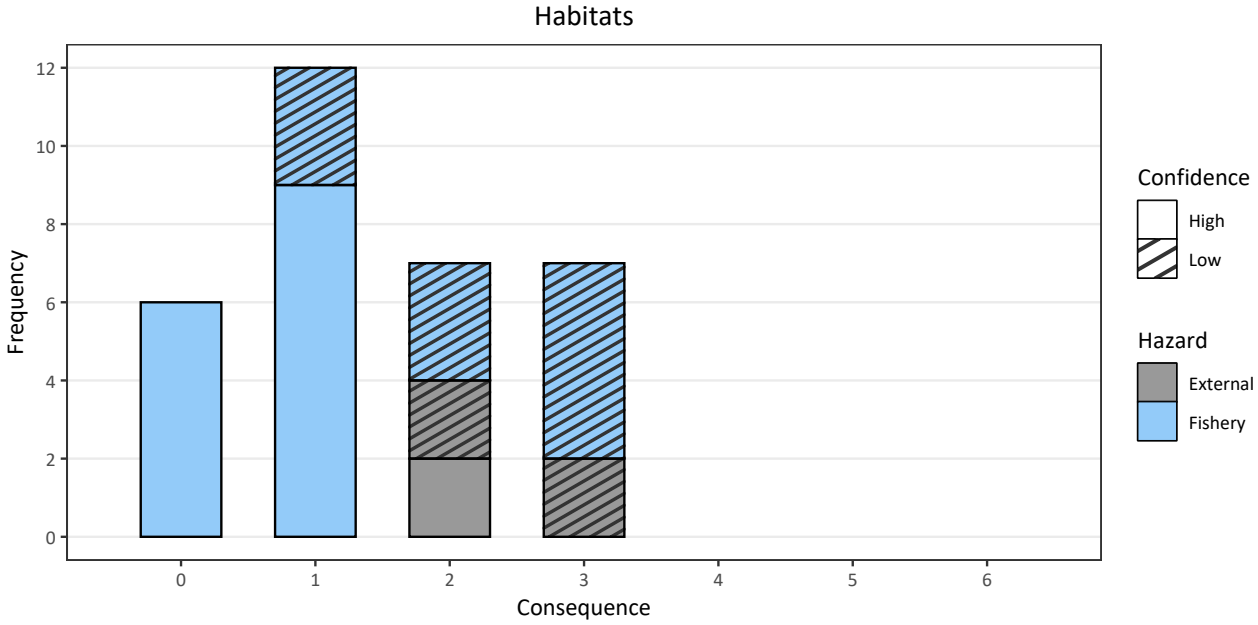


Figure 3.4: Habitats component: Frequency of consequence score by high and low confidence.

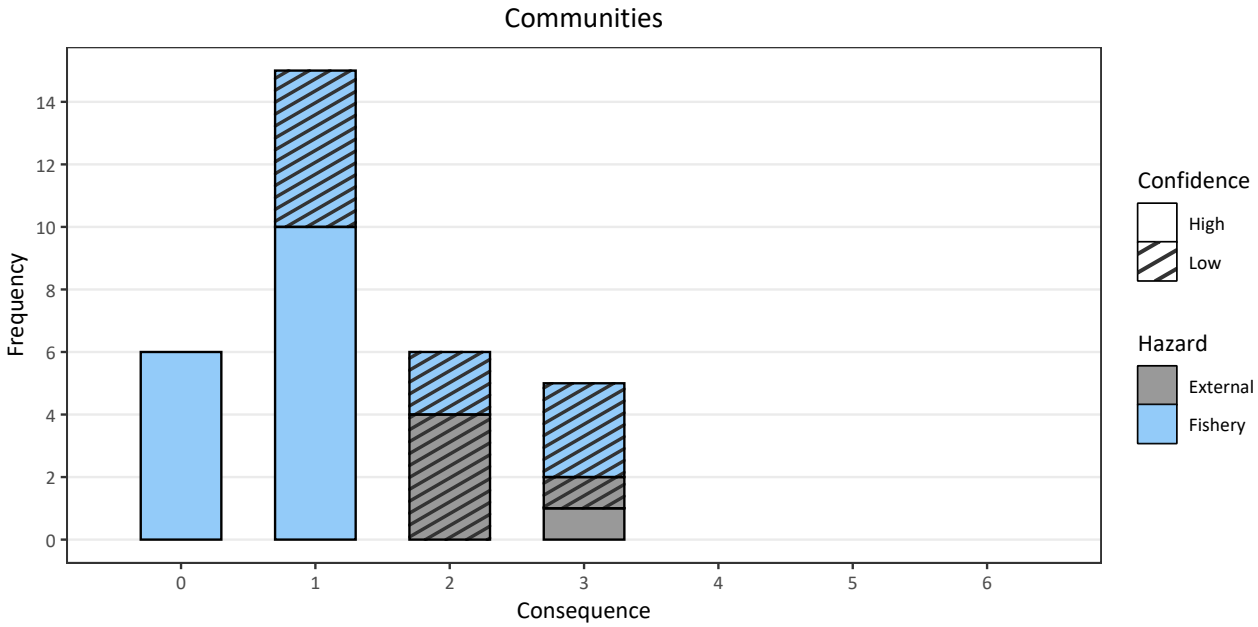


Figure 3.5: Communities component: Frequency of consequence score by high and low confidence.

3.12 Evaluation/Discussion of Level 1

Most hazards (fishing activities) were eliminated at Level 1 (risk scores 1 or 2; Table 3.11); Figure 3.1-Figure 3.5). Those remaining consist of:

- Direct impact of capture by fishing (byproduct/bycatch species, habitats and communities; moderate),
- Direct impact without capture by fishing (habitats and communities; moderate),
- Addition/movement of biological material by translocation of species (key commercial species, habitats and communities; moderate),
- Addition/movement of biological material by discarding (habitats; moderate) and
- Disturb physical processes by fishing (habitats; moderate).

As a result of capture by fishing, the most vulnerable bycatch species chosen were the Longnose skate *Dentiraja confusus*, Greenback Stingaree *Urolophus viridis* and the Pale Octopus *Octopus pallidus* were assessed at moderate risk. The two chondrichthyan species were chosen largely due to the fact they have slow reproduction rates, are endemic to south-eastern Australia, and that post capture mortality is likely to increase with tow duration and air exposure. While not listed on Australia's EPBC Act, the Longnose Skate has been listed as critically endangered and the Greenback Stingaree as vulnerable by the IUCN. The Pale Octopus *Octopus pallidus* was also chosen as vulnerable bycatch species because it is endemic to south-eastern Australia, its stock is depleting in northern Tasmania and its habitat overlaps with fishing areas.

Handfishes have been recorded at the family taxonomic level from pre-season biomass surveys (i.e., Brachionichthyidae- undifferentiated). This group has been expanded to comprise species that occur within the area of the BSCZSF, notably, the Warty Handfish *Thymichthys verrucosus*, Australian Handfish *Brachionichthys australis*, Humpback Handfish *Brachiopsilus dossenus*, Narrowbody Handfish *Pezichthys compressus*, Moulton's Handfish *Sympterichthys moultoni* and Cockatoo Handfish *Pezichthys amplispinus*. These species were chosen as most vulnerable for some hazards in the Level 1 analysis, as they are endemic to Australia, and in some cases only occur in south-eastern Australia within narrow geographical distributions. Also, most of these species appear to be data-deficient with respect to life history parameters (longevity, maturity etc.), apart from their size ranges and depth preferences.

As a result of capture by fishing by other fisheries, the most vulnerable bycatch species chosen were the Longnose skate *Dentiraja confusus*, Greenback Stingaree *Urolophus viridis* and the Pale Octopus *Octopus pallidus* which were assessed at moderate risk. The first two species are caught in the Southern and Eastern Scalefish and Shark Fishery (SESSF) by otter trawls and Danish seine and also by longlines in the Gillnet, Hook and Trap (GHAT) sector of the SESSF. As such they are susceptible to exploitation and population decline based on their typically long life spans, late age at maturity and low fecundity. Similarly, the Pale Octopus is also likely to be affected due to exploitation by several fisheries active in the Bass Strait; it is targeted by the Tasmanian Octopus Fishery (TOF), bycatch/byproduct in the GHATF, and targeted by a new, standalone commercial Octopus Fishery commenced in 2020 harvesting predominantly Pale Octopus in Eastern Victoria.

The habitats, communities ecological components were moderately impacted by other fisheries (i.e., external impacts). Hazards assessed as moderately contributing to external impacts included coastal development on key/secondary commercial species, and other extractive activities on habitats. Such activities include 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 that occurs across southern Australia.

Translocation of species was considered to be a moderate risk (3) to key commercial species (Commercial Scallop *Pecten fumatus*), due to the potential of introduced species (e.g., North Pacific Seastar *Asterias amurensis*). Both habitats and communities components were assessed at moderate risk and therefore triggered a Level 2 analysis, but was not analysed in this assessment.

There have been changes in (i) ERAEF methodology (ii) ERAEF species classification and (iii) availability of new information since the last ERA. Results of the two Level 1 BSCZSF SICA analyses (i.e., this assessment and 2007) showed that the same ecological components (except key/secondary commercial species) still have some units at high risk. Also, the changes resulted in different species being identified as most vulnerable with the same potential risk for direct impact of capture by fishing between the 2023 and 2007 Level 1

assessments. For example, the minor risk scores for the protected species component with respect to direct impact of capture by fishing was the Spiny Pipehorse *Solegnathus spinosissimus* in 2023 compared to the Big-bellied Seahorse *Hippocampus abdominalis* in 2007. No other species were identified at high risk for protected species component from internal hazards between assessments.

3.13 Components to be Examined at Level 2

As a result of the preliminary SICA, the components that are to be examined at Level 2 are those with any consequence scores of 3 or above. These components are:

- Byproduct and Bycatch
- Habitats
- Communities

It was not possible to conduct a Level 2 ERA for habitats and communities components, as it is outside the project scope.

4 Level 2

When the risk of an activity at Level 1 (SICA) on a component is moderate or higher and no planned management interventions that would remove this risk are identified, an assessment is required at Level 2.

A residual risk (RR) analysis was undertaken for species at high risk in PSA and for any species at high risk in bSAFE (Table 4.1). There may be instances where a RR analysis may be required for medium risk species resulting from a PSA and/or bSAFE.

Table 4.1: Residual risk guidelines drawn from document "Revision of residual risk guidelines to reflect updated Ecological Risk Assessment Methodology – version Oct 12, 2016.

1	Risk rating due to missing, incorrect or out of date information
2	At risk due to external factors (cumulative risks)
3	At risk in regards to level of interaction/capture with a zero or negligible level of susceptibility
4	Effort and catch management arrangements for target and byproduct species
5	Management arrangements to mitigate against the level of bycatch
6	Management arrangements relating to seasonal, spatial and depth closures

4.1 Level 2 Productivity and Susceptibility Analysis (PSA)

The PSA approach is a method of assessment which allows all units within any of the ecological components to be effectively and comprehensively screened for risk. The units of analysis are the complete set of species habitats or communities identified at the scoping stage. The PSA results in Sections 4.1.1 and 4.1.2 of this report measure risk of direct impacts of fishing only. Future iterations of the methodology will include PSAs modified to measure the risk due to other activities, such as gear loss.

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

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

Species

Table 4.2 outlines the seven attributes that are averaged to measure productivity, and the four aspects that are multiplied to measure susceptibility for all the species components.

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

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

Encounterability is the likelihood that a species will encounter fishing gear deployed within its range.

Table 4.2: Attributes that measure productivity and susceptibility.

Category	Attribute	Description
Productivity	Average age at maturity	
	Average size at maturity	
	Average maximum age	
	Average maximum size	
	Fecundity	
	Reproductive strategy	
	Trophic level	
Susceptibility	Availability	Overlap of fishing effort with a species distribution
	Encounterability	The likelihood that a species will encounter fishing gear that is deployed within the geographic range of that species (based on two attributes: adult habitat and bathymetry)
	Selectivity	The potential of the gear to capture or retain species
	Post capture mortality	The condition and subsequent survival of a species that is captured and released (or discarded)

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

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

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

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

Habitats

Similar to species, PSA methods for habitats are based around a set of attributes that measure productivity and susceptibility. Productivity attributes include speed of regeneration of fauna, and likelihood of natural disturbance. The susceptibility attributes for habitats are described in Table 4.3.

Communities

There are seven steps for the PSA undertaken for each component brought forward from Level 1 analysis (see Hobday et al., 2007a for full details).

- Step 1. Identify the units excluded from analysis and document the reason for exclusion (see Table 2.16)
- Step 2. Score units for productivity
- Step 3. Score units for susceptibility
- Step 4. Plot individual units of analysis onto a PSA Plot
- Step 5. Ranking of overall risk of each unit
- Step 6. Evaluation of the PSA results
- Step 7. Decision rules to move from Level 2 to Level 3

Table 4.3: Description of susceptibility attributes for habitats.

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

4.1.1 Level 2 PSA (Steps 2 and 3)

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

The PSA do not fully take account of management actions already in place in the fishery that may mitigate for high risk species. Some management actions or strategies, however, can be accounted for in the analysis where they exist. These include spatial management that limits the range of the fishery (affecting availability), gear limits that affect the size of animals that are captured (selectivity), and handling practices that may affect the survival of species after capture (post capture mortality). Management strategies that are not reflected in the PSA scores include limits to fishing effort, use of catch limits (such as TACs), and some other controls such as seasonal closures.

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

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

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

Observer data and observer expert knowledge are important sources of information in the PSA analyses, particularly for the bycatch and protected species components. There is no Observer coverage for this fishery. An AFMA observer program has been operating since July 2003, across other fisheries and coverage varies depending on the fishing location. Information on target and byproduct species is well collected, and bycatch attempts are made, but may be compromised by taxonomic difficulties. Interactions with protected species are recorded, although again, taxonomic resolution is weak for some taxa (e.g., whales and seabirds).

Summary of Habitats PSA results

The habitats component was not assessed at Level 2 as it was outside the project scope.

Summary of Communities PSA results

The communities component was not assessed at Level 2 as it was outside the project scope.

4.1.2 PSA Results for Individual Units of Analysis (Step 4-6)

The average productivity and susceptibility scores for each unit of analysis (e.g., for each species) are then used to place the individual units of analysis on 2D plots (as below). The relative position of the units on the plot will determine relative risk at the unit level as per PSA plot below. The overall risk value for a unit is the Euclidean distance from the origin of the graph. Units that fall in the upper third of the PSA plots are deemed to be at high risk. Units with a PSA score in the middle are at medium risk, while units in the lower third are at low risk with regard to the productivity and susceptibility attributes. The divisions between these risk categories are based on dividing the area of the PSA plots into equal thirds. If all productivity and susceptibility scores (scale 1-3) are assumed to be equally likely, then 1/3rd of the Euclidean overall risk values will be greater than 3.18 (high risk), 1/3rd will be between 3.18 and 2.64 (medium risk), and 1/3rd will be lower than 2.64 (low risk).

The PSA output allows identification and prioritization (via ranking the overall risk scores) of the units (e.g., species, habitat types, communities) at greatest risk to fishing activities. This prioritization means units with the lowest inherent productivity or highest susceptibility, which can only sustain the lowest level of impact, can be examined in detail. The overall risk of an individual unit will depend on the level of impact as well its productivity and susceptibility.

The overall risk value for each unit is the Euclidean distance from the origin to the location of the species on the PSA plot. The units are then divided into three risk categories, high, medium and low, according to the risk values described above.

4.1.3 Uncertainty Analysis Ranking of Overall Risk (Step 5)

The final PSA result for a species is obtained by ranking overall risk value resulting from scoring the productivity and susceptibility attributes. Uncertainty in the PSA results can arise when there is imprecise, incorrect or missing data, where an average for a higher taxonomic unit was used (e.g., average genera value for species units), or because an inappropriate attribute was included. The number of missing attributes, and hence conservative scores, is tallied for each unit of analysis. Units with missing scores will have a more conservative overall risk value than those species with fewer missing attributes, as the highest score for the attribute is used in the absence of data. Gathering the information to allow the attribute to be scored may reduce the overall risk value. Identification of high-risk units with missing attribute information should translate into prioritisation of additional research (an alternative strategy).

A second measure of uncertainty is due to the selection of the attributes. The influence of particular attributes on the final result for a unit of analysis (e.g., a habitat unit) can be quantified with an uncertainty analysis, using a Monte Carlo resampling technique. A set of productivity and susceptibility scores for each unit is calculated by removing one of the productivity or susceptibility attributes at a time, until all attribute combinations have been used. The variation (standard deviation) in the productivity and susceptibility scores is a measure of the uncertainty in the overall PSA score. If the uncertainty analysis shows that the unit would be treated differently with regard to risk, it should be the subject of more study.

The validity of the ranking can also be examined by comparing the results with those from other data sources or modelling approaches that have already been undertaken in specific fisheries. For example, the PSA results of the individual species (target, byproduct and bycatch and protected) can be compared against catch rates for any species or against completed stock assessments. These comparisons will show whether the PSA ranking agrees with these other sources of information or more rigorous approaches.

4.1.4 PSA Results and Discussion

Productivity Attributes

Available productivity attributes for each species used in a PSA and corresponding risk scores are listed in Table 4.4.

Table 4.4: Productivity attribute names and cutoff scores for the ERAF L2 PSA method. These cutoff scores have been determined from analysis of the distribution of attribute values for species in the ERAF database, and are intended to divide the attribute values into low, medium and high productivity categories.

Attribute number	Attribute name	Low productivity (risk score: 3)	Medium productivity (risk score: 2)	High productivity (risk score: 1)
P1	Average age at maturity	> 15 years	5 – 15 years	< 5 years
P2	Average max age	> 25 years	10-25 years	< 10 years
P3	Fecundity	< 100 eggs per year	100-20,000 eggs per year	> 20,000 eggs per year
P4	Average max size	> 300 cm	100-300 cm	< 100 cm
P5	Average size at Maturity	> 200 cm	40-200 cm	< 40 cm
P6	Reproductive strategy	Taxa is *Marine Bird* OR *Marine Mammal*	(Family is *Syngnathidae* OR *Solenostomidae*) OR (Reproductive Strategy is *Demersal Spawner* OR *Brooder*)	Reproductive Strategy is *Broadcast Spawner*
P7	Trophic level	> 3.25	2.75-3.25	< 2.75

Table 4.5: Susceptibility attribute names and cutoff scores for the ERAF L2 PSA method. These cutoff scores have been determined from analysis of the distribution of attribute values for species in the ERAF database, and are intended to divide the attribute values into low, medium and high susceptibility categories.

Attribute number	Attribute name	Low susceptibility (risk score: 1)	Medium susceptibility (risk score: 2)	High susceptibility (risk score: 3)
S1	Availability	< 10% overlap	Continuous [1,3]	> 30% overlap
S2	Encounterability (habitat and bathymetry based)	Fishery Specific	Fishery Specific	Fishery Specific
S3	Selectivity (size based)	Fishery Specific	Fishery Specific	Fishery Specific
S4	Post-Capture Mortality (role in fishery based, protected Species based)	Some Protected (Live)	Byproduct or bycatch; Some protected (generally alive)	Key or secondary commercial; Some protected (likely to be dead)

Susceptibility Attributes

Available susceptibility attributes for each species used in a PSA and corresponding risk scores are listed in Table 4.5.

Post Capture Mortality

The following rules were used to assign a risk score to Post Capture Mortality (PCM), based on each species ERAEF classification (see also Table 4.6):

- Commercial, secondary commercial, commercial bait or byproduct species: score is 3.
- Bycatch species: score is 2
- Protected species (which are discarded), PCM is based on taxa, i.e.,
  - marine birds and marine reptiles: score is 3
  - marine mammals and chondrichthyans: score is 2
  - syngnathids: score is 1

Table 4.6: Post capture mortality attribute risk score for the Bass Strait Central Zone Scallop Fishery for the ERAEF L2 PSA and bSAFE methods. High: H; medium: M; Low: L. Risk scores that are not assigned by taxa (not specific) for each ERAEF classification are in italics.

Role in fishery	Taxa	Rationale	Risk category	Risk score
Key commercial	*Not specific*	Retained, therefore dead	H	3
Secondary commercial	*Not specific*	Retained, therefore dead	H	3
Commercial bait	*Not specific*	Retained, therefore dead	H	3
Byproduct	*Not specific*	Retained, therefore dead	H	3
Bycatch	*Not specific*	Discarded alive or dead	M	2
Protected Species	Marine birds	long duration set, if caught, highly likely to drown	H	3
	Marine reptiles	long duration set, if caught, highly likely to drown	H	3
	Marine mammals	large enough/strong swimming to have a chance of survival	M	2
	Chondrichthyans	large enough/strong swimming to have a chance of survival	M	2
	All others (e.g., syngnathids, invertebrates (if any))	Do not get hooked	L	1

Manually Excluded Species

Cuttlefish *Sepia braggi* was not assessed at Level 2 (PSA) in this ERA, as a stock assessment has been undertaken for it (see stock assessment table in the Executive Summary).

Key Commercial Species

Under the revised ERAEF (AFMA, 2017), key commercial species were not assessed at Level 2.

Secondary Commercial Species

There were no secondary commercial species considered in the PSA.

Commercial Bait Species

There were no commercial bait species considered in the PSA.

Byproduct Species

One byproduct species was assessed in the PSA. The one species was found to be at low risk (Figure 4.1 and Table 4.7). Of these, none were non-robust (i.e., data deficient) species (Figure 4.1).

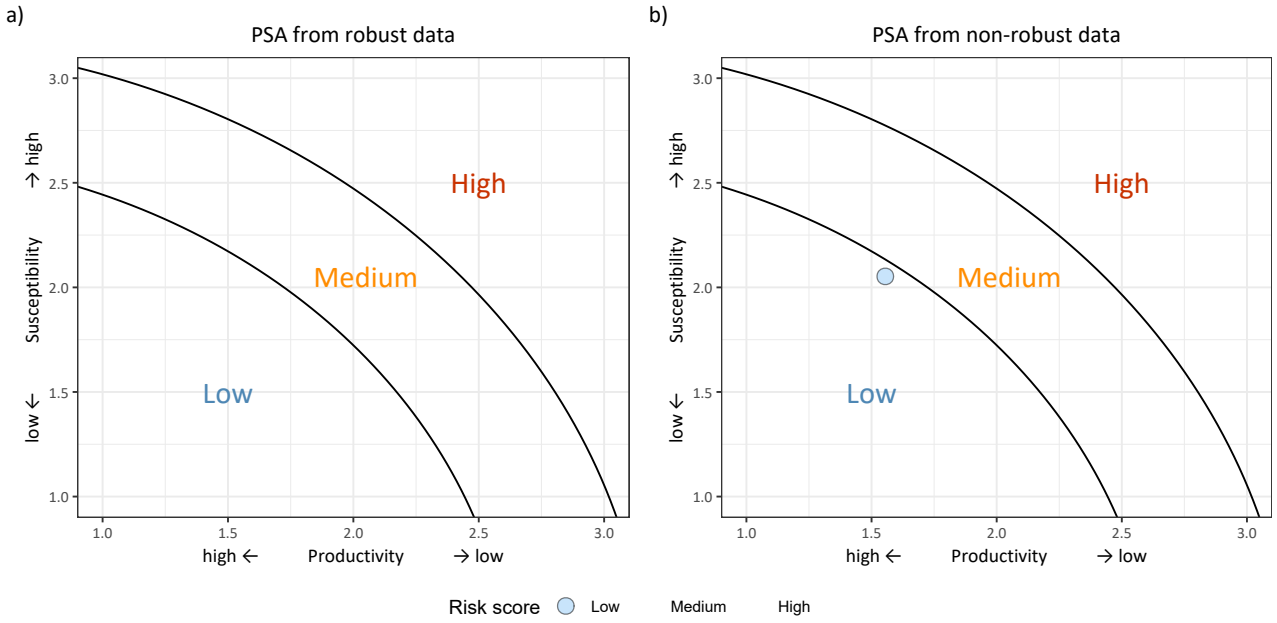


Figure 4.1: PSA plot for byproduct species in the Bass Strait Central Zone Scallop Fishery for (a) robust [left, less than three missing attributes] and (b) data deficient species [right, three or more missing attributes].

Table 4.7: Summary of the regular PSA scores on the set of productivity and susceptibility attributes for byproduct species and residual risk (RR) for high risk species. Productivity attributes (P1-P7) are listed in Table 4.4. Susceptibility attributes (S1-S4) are listed in Table 4.5. Missing attributes are highlighted (red). Productivity score (Prod. score); Susceptibility score (Susc. score).

CAAB code	Scientific name	Common name	P1	P2	P3	P4	P5	P6	P7	S1	S2	S3	S4	Prod. score	Susc. score	Missing attributes	PSA 2D	Risk category
23270006	*Mimachlamys asperrima*	Doughboy Scallop	3	3	1	1	1	1	1	3	3	2	1	1.57	2.06	3	2.59	Low

Bycatch Species

A total of 160 out of 330 bycatch species were assessed in the PSA. Of these, three were unassessable in bSAFE. Of all assessed bycatch species, 39 were at high risk, 110 were at medium risk, and 11 were at low risk (Figure 4.2 and Table 4.8 and 4.9). Of these, 136 were non-robust (i.e., data deficient) species (Figure 4.2). Of the 39 high risk species, none have all 11 attributes, four are missing one to three attributes, and 35 are non-robust (i.e., missing more than three attributes). A residual risk analysis was performed on 39 species (Table 4.8 and 4.9; see also Section 4.6). Following the residual risk analysis, 17 of the 39 species remained at high risk, i.e., 22 species were reduced to medium risk. Therefore, overall, there were a total of 17 high risk species, 132 medium risk species and 11 low risk species.

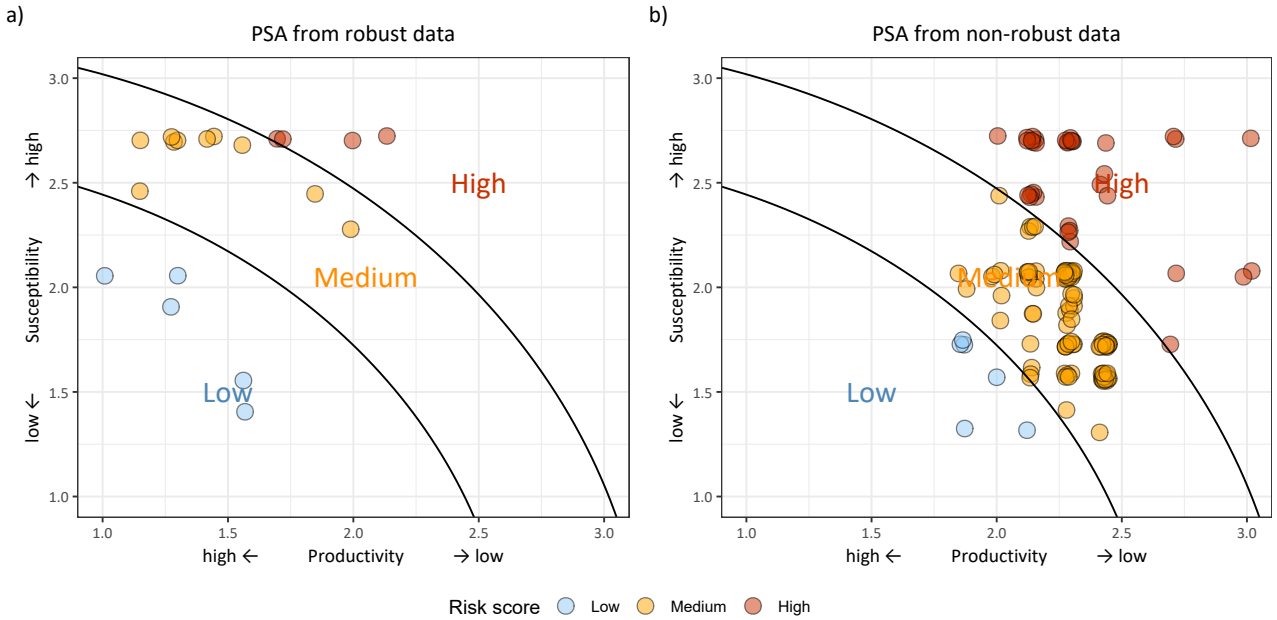


Figure 4.2: PSA plot for bycatch species in the Bass Strait Central Zone Scallop Fishery for (a) robust [left, less than three missing attributes] and (b) data deficient species [right, three or more missing attributes].

Table 4.8: Summary of the regular PSA scores on the set of productivity and susceptibility attributes for bycatch species and residual risk (RR) for high risk species. Productivity attributes (P1-P7) are listed in Table 4.4. Susceptibility attributes (S1-S4) are listed in Table 4.5. Missing attributes are highlighted (red). Productivity score (Prod. score); Susceptibility score (Susc. score). No. interactions (No. Int. 2017-2021) reported for high risk scores only (source: Commonwealth logbook (LOG) and Observer (AFMA OBS) databases). Residual risk guidelines drawn from document "Revision of residual risk guidelines to reflect updated Ecological Risk Assessment Methodology" - version Oct 12, 2016. See numbers in Table 4.1. NE: not entered. ALA: Atlas of Living Australia.

CAAB code	Scientific name	Common name	P1	P2	P3	P4	P5	P6	P7	S1	S2	S3	S4	Prod. score	Susc. score	Missing attributes	PSA 2D	Risk category	Species information	Risk score following Residual Risk	Final risk score
25105001	*Luidia australiae*	A Seastar	3	3	3	1	1	3	2	3	3	3	2	2.29	2.71	4	3.55	High	PSS	1- Risk ranking due to missing/ unavailable info. ALA: records occur off southern Australia and Tasmania, but no records off Flinders and King Islands. Therefore risk score remains High.	High
25171001	*Conocladus australis*	Southern Basketstar	3	3	3	1	1	2	3	3	3	3	2	2.29	2.71	6	3.55	High	expanded from 25160902, PSS	1- Risk ranking due to missing/ unavailable info. ALA suggests that this species occurs off southern Australia and Tasmania, including Flinders and King Islands. Uncertainty in the extent of the spatial overlap with fishery. Therefore risk score remains High.	High

Table 4.8: *(continued)*

CAAB code	Scientific name	Common name	P1	P2	P3	P4	P5	P6	P7	S1	S2	S3	S4	Prod. score	Susc. score	Missing at-tributes	PSA 2D	Risk cate-gory	Species information	Risk score following Residual Risk	Final risk score
25171017	*Astrosierra amblyconus*	A Basketstar	3	3	3	1	1	2	3	3	3	3	2	2.29	2.71	6	3.55	High	expanded from 25160902, PSS	1- Risk ranking due to missing/ unavailable info. Information on ALA suggests this species likely to occur between NSW and Vic border. One record in Bass Strait. Uncertainty in the extent of the spatial overlap with fishery. Therefore risk score remains High.	High
25171020	*Astrothrombus rugosus*	A Basketstar (*continued*)	3	3	3	1	1	2	3	3	3	3	2	2.29	2.71	6	3.55	High	expanded from 25160902, PSS	1- Risk ranking due to missing/ unavailable info. ALA: fewer than 10 records off Tasmania and not in Bass Strait. Uncertainty in the extent of the spatial overlap with fishery. Therefore risk score remains High.	High
25171023	*Gorgonocephalus pustulatum*	A Basketstar (*continued*)	3	3	3	1	1	1	3	3	3	3	2	2.14	2.71	6	3.45	High	expanded from 25160902, PSS	1- Risk ranking due to missing/ unavailable info. ALA: fewer than 10 records off Tasmania and not in Bass Strait. Uncertainty in the extent of the spatial overlap with fishery. Therefore risk score remains High.	High

Table 4.8: *(continued)*

CAAB code	Scientific name	Common name	P1	P2	P3	P4	P5	P6	P7	S1	S2	S3	S4	Prod. score	Susc. score	Missing at-tributes	PSA 2D	Risk cate-gory	Species information	Risk score following Residual Risk	Final risk score
25176005	*Ophiomisidium irene*	A Brittlestar	3	3	3	3	3	1	3	3	3	3	2	2.71	2.71	9	3.83	High	expanded from 25160000, PSS	1- Risk ranking due to missing/ unavailable info. ALA: 12 records around Tasmania, excluding Bass Strait. Uncertainty in the extent of the spatial overlap with fishery. Therefore risk score remains High.	High
25176006	*Ophioplinthus accomodata*	A Brittlestar (*continued*)	3	3	3	1	1	1	3	3	3	3	2	2.14	2.71	5	3.45	High	expanded from 25160000, PSS	1- Risk ranking due to missing/ unavailable info. ALA: 15 records along eastern Tas excluding Bass Strait. Uncertainty in the extent of the spatial overlap with fishery. Therefore risk score remains High.	High
25176010	*Amphiophiura urbana*	A Brittlestar (*continued*)	3	3	3	1	1	1	3	3	3	3	2	2.14	2.71	5	3.45	High	expanded from 25160000, PSS	1- Risk ranking due to missing/ unavailable info. ALA: 26 records around Tasmania, excluding Bass Strait. No other spatial distribution available. Therefore risk score remains High.	High

Table 4.8: *(continued)*

CAAB code	Scientific name	Common name	P1	P2	P3	P4	P5	P6	P7	S1	S2	S3	S4	Prod. score	Susc. score	Missing at-tributes	PSA 2D	Risk cate-gory	Species information	Risk score following Residual Risk	Final risk score
25190013	*Ophiactis resiliens*	A Brittlestar (*continued*)	3	3	3	1	1	1	3	3	3	3	2	2.14	2.71	5	3.45	High	expanded from 25160000, PSS	1- Risk ranking due to missing/ unavailable info. ALA: 33 records around Tasmania including eastern (north of North Point, Flinders Island) and Central Bass Strait (e.g., 44 km NE of Cape Wickham, King Island). Species depth range suggests that it may occur in Bass Strait, and potentially overlap fishery operations. Therefore risk score remains High.	High
25190016	*Ophiactis tricolor*	A Brittlestar (*continued*)	3	3	3	1	1	1	3	3	3	3	2	2.14	2.71	5	3.45	High	expanded from 25160000, PSS	1- Risk ranking due to missing/ unavailable info. ALA: 6 records around north-western Tasmania and Central Bass Strait (NE of King Island) and one record eastern Bass Strait (20 km SSW of Babel Island). Species depth range suggests that it may occur in Bass Strait, and potentially overlap fishery operations. Therefore risk score remains High.	High

Table 4.8: *(continued)*

CAAB code	Scientific name	Common name	P1	P2	P3	P4	P5	P6	P7	S1	S2	S3	S4	Prod. score	Susc. score	Missing at-tributes	PSA 2D	Risk cate-gory	Species information	Risk score following Residual Risk	Final risk score
25406041	*Thyone tourvillei*	A Sea Cucumber	3	3	3	1	1	1	3	3	3	2	2	2.14	2.45	6	3.25	High	expanded from 25400000, PSS	1- Risk ranking due to missing/ unavailable info. ALA: 2 records (1 east of Tasmania and 1 north-east of Flinders Island). Uncertainty in the extent of the spatial overlap with fishery. Therefore risk score remains High.	High
25408011	*Neoamphicyclus mutans*	A Sea Cucumber (*continued*)	3	3	3	1	1	1	3	3	3	2	2	2.14	2.45	5	3.25	High	expanded from 25400000, PSS	1- Risk ranking due to missing/ unavailable info. ALA: 15 records around Tasmania; includes 1 east of King Island. Uncertainty in the extent of the spatial overlap with fishery. Therefore risk score remains High.	High
25418005	*Bathyplotes sulcatus*	A Sea Cucumber (*continued*)	3	3	3	3	3	1	3	3	3	3	2	2.71	2.71	9	3.83	High	expanded from 25400000, PSS	1- Risk ranking due to missing/ unavailable info. ALA: 2 records in Bass Strait, 1 record off north-west Tasmania. Uncertainty in the extent of the spatial overlap with fishery. Therefore risk score remains High.	High

Table 4.8: *(continued)*

CAAB code	Scientific name	Common name	P1	P2	P3	P4	P5	P6	P7	S1	S2	S3	S4	Prod. score	Susc. score	Missing at-tributes	PSA 2D	Risk cate-gory	Species information	Risk score following Residual Risk	Final risk score
25418012	*Pseudostichopus hyalegerus*	A Sea Cucumber (*continued*)	3	3	3	3	3	1	3	3	1	3	2	2.71	2.06	8	3.4	High	expanded from 25400000, PSS	1- Risk ranking due to missing/ unavailable info. ALA: 2 records around eastern Tasmania, 4 records off Flinders Island-E, NE. AquaMaps: modelled distribution on edge of fishery area and likely outside Bass Strait. Species identified east off Cape Barren Island (CSIRO; Museum of Vic; https://collections.museumsvictoria.com.au/specimens/2236544). Therefore risk score remains High.	High
25431002	*Leptosynapta dolabrifera*	A Sea Cucumber (*continued*)	3	3	3	1	1	1	3	3	3	2	2	2.14	2.45	5	3.25	High	PSS	1- Risk ranking due to missing/ unavailable info. ALA: 19 records around Tasmania which includes 1 record off northern Flinders Island. Uncertainty in the extent of the spatial overlap with fishery. Therefore risk score remains High.	High

Table 4.8: *(continued)*

CAAB code	Scientific name	Common name	P1	P2	P3	P4	P5	P6	P7	S1	S2	S3	S4	Prod. score	Susc. score	Missing at-tributes	PSA 2D	Risk cate-gory	Species information	Risk score following Residual Risk	Final risk score
25432005	*Scoliorhapis theeli*	A Sea Cucumber (*continued*)	3	3	3	1	1	1	3	3	3	3	2	2.14	2.71	5	3.45	High	expanded from 25400000, PSS	1- Risk ranking due to missing/ unavailable info. ALA: 4 records around Tasmania. Uncertainty in the extent of the spatial overlap with fishery. Therefore risk score remains High.	High
25432017	*Taeniogyrus papillis*	A Sea Cucumber (*continued*)	3	3	3	1	1	1	3	3	3	2	2	2.14	2.45	5	3.25	High	expanded from 25400000, PSS	1- Risk ranking due to missing/ unavailable info. ALA: 1 record off northeastern Flinders Island. Uncertainty in the extent of the spatial overlap with fishery. Therefore risk score remains High.	High

Table 4.8: *(continued)*

CAAB code	Scientific name	Common name	P1	P2	P3	P4	P5	P6	P7	S1	S2	S3	S4	Prod. score	Susc. score	Missing at-tributes	PSA 2D	Risk cate-gory	Species information	Risk score following Residual Risk	Final risk score
23325015	*Purpurocardia amabilis*	A Cockle	3	3	3	3	3	1	3	3	1	3	1	2.71	1.73	8	3.22	High	expanded from previous ERA	1- Risk ranking due to missing/ unavailable info. This species collected and identified around King Island (Grove & Little, 2014). ALA: 106 records around Tasmania includes King and Flinders Islands. Attribute S1 was changed from 3 to 1 (based on Expert override in previous ERA). This changes the risk score from High to Medium. Therefore risk score reduced to Medium.	Medium
23600001	*Nautilus pompilius*	A Chambered Nautilus	3	3	3	1	1	3	3	3	2.2	3	2	2.43	2.51	6	3.49	High	expanded from 23600000, PSS	1- Risk ranking due to missing/ unavailable info. AquaMaps Native distribution maps suggest that this species is more likely to occur over northern Australia. Therefore risk score reduced to Medium.	Medium

Table 4.8: *(continued)*

CAAB code	Scientific name	Common name	P1	P2	P3	P4	P5	P6	P7	S1	S2	S3	S4	Prod. score	Susc. score	Missing at-tributes	PSA 2D	Risk cate-gory	Species information	Risk score following Residual Risk	Final risk score
23659002	*Octopus berrima*	An Octopus	1	1	3	1	1	2	3	3	3	3	2	1.71	2.71	1	3.2	High	PSS, also in 23659000, LOG, PSS	1- Risk ranking due to missing/ unavailable info. ALA: 17 records around Tasmania includes central Bass Strait. Attribute S1 was changed from 3 to 1 (based on Expert override in previous ERA). This changes the risk score from High to Medium. Therefore risk score reduced to Medium.	Medium
23659003	*Macroctopus maorum*	Maori Octopus	1	1	3	2	2	2	3	3	3	3	2	2	2.71	1	3.37	High	PSS, also in 23659000, LOG, PSS	1- Risk ranking due to missing/ unavailable info. ALA: 26 records exist mostly around southern Tasmania. However, 3 records exist near Flinders Island. Attribute S1 was changed from 3 to 1 (based on Expert override in previous ERA). This changes the risk score from High to Medium. Therefore risk score reduced to Medium.	Medium

Table 4.8: *(continued)*

CAAB code	Scientific name	Common name	P1	P2	P3	P4	P5	P6	P7	S1	S2	S3	S4	Prod. score	Susc. score	Missing at-tributes	PSA 2D	Risk cate-gory	Species information	Risk score following Residual Risk	Final risk score
23659004	*Octopus pallidus*	Pale Octopus	1	1	3	1	1	2	3	3	3	3	2	1.71	2.7	1	3.2	High	PSS, also in 23659000, LOG, PSS	1- Risk ranking due to missing/ unavailable info. ALA: 26 records exist around eastern and southern Tasmania, including Bass Strait (E and NE of Flinders Island). Attribute S1 was changed from 3 to 1 (based on Expert override in previous ERA). This changes the risk score from High to Medium. Therefore risk score reduced to Medium.	Medium
24176003	*Cabestana spengleri*	A Triton Shell	3	3	3	1	1	2	3	3	3	3	1	2.29	2.28	5	3.23	High	expanded from 24176000, PSS	1- Risk ranking due to missing/ unavailable info. ALA: records in Bass Strait (northeast of Flinders Island). Attribute S1 was changed from 3 to 1 (based on Expert override in previous ERA). This changes risk score from High to Medium. Therefore risk score reduced to Medium.	Medium

Table 4.8: *(continued)*

CAAB code	Scientific name	Common name	P1	P2	P3	P4	P5	P6	P7	S1	S2	S3	S4	Prod. score	Susc. score	Missing at-tributes	PSA 2D	Risk cate-gory	Species information	Risk score following Residual Risk	Final risk score
24176006	*Monoplex parthenopeus*	A Triton Shell (*continued*)	3	3	3	1	1	2	3	3	2.8	3	1	2.29	2.23	5	3.2	High	expanded from 24176000, PSS	1- Risk ranking due to missing/ unavailable info. ALA: records occur in Bass Strait (Flinders and King Islands). Attribute S1 was changed from 3 to 1 (based on Expert override in previous ERA). This changes the risk score from High to Medium. Therefore risk score reduced to Medium.	Medium
24222010	*Conus anemone*	A Cone Snail	3	3	3	1	1	2	3	3	3	3	1	2.29	2.28	5	3.23	High	expanded from previous ERA	1- Risk ranking due to missing/ unavailable info. ALA suggests that this species occurs off east Australia and Tasmania including Flinders and King Islands. Attribute S1 was changed from 3 to 1 (based on Expert override in previous ERA). This changes risk score from High to Medium. Therefore risk score reduced to Medium.	Medium

Table 4.8: *(continued)*

CAAB code	Scientific name	Common name	P1	P2	P3	P4	P5	P6	P7	S1	S2	S3	S4	Prod. score	Susc. score	Missing at-tributes	PSA 2D	Risk cate-gory	Species information	Risk score following Residual Risk	Final risk score
24432001	*Ceratosoma brevicaudatum*	A Nudibranch	3	3	3	1	1	2	3	3	3	3	2	2.29	2.71	5	3.55	High	expanded from previous ERA	1- Risk ranking due to missing/ unavailable info. ALA suggests that this species occurs off southern Australia and Tasmania including Flinders and King Islands. It is endemic to Australia. Attribute S1 was changed from 3 to 1 (based on Expert override in previous ERA). This changes risk score from High to Medium. Therefore risk score reduced to Medium.	Medium

Table 4.8: *(continued)*

CAAB code	Scientific name	Common name	P1	P2	P3	P4	P5	P6	P7	S1	S2	S3	S4	Prod. score	Susc. score	Missing at-tributes	PSA 2D	Risk cate-gory	Species information	Risk score following Residual Risk	Final risk score
25127039	*Nectria ocellata*	A Seastar	3	3	3	1	1	3	2	3	3	3	2	2.29	2.71	4	3.55	High	expanded from 25102000, PSS	1- Risk ranking due to missing/ unavailable info. ALA suggests that this species occurs off southern Australia and Tasmania, including Flinders and King Islands. This species is endemic to Australia. Attribute S1 was changed from 3 to 1 (based on Expert override in previous ERA). This changes risk score from High to Medium. Therefore risk score reduced to Medium.	Medium

Table 4.8: *(continued)*

CAAB code	Scientific name	Common name	P1	P2	P3	P4	P5	P6	P7	S1	S2	S3	S4	Prod. score	Susc. score	Missing at-tributes	PSA 2D	Risk cate-gory	Species information	Risk score following Residual Risk	Final risk score
25143015	*Plectaster decanus*	A Seastar (*continued*)	3	3	3	1	1	3	3	3	3	3	2	2.43	2.71	6	3.64	High	expanded from 25102000, PSS	1- Risk ranking due to missing/ unavailable info. ALA suggests that this species occurs off southern Australia and Tasmania, including Flinders and King Islands. This species is endemic to Australia. Attribute S1 was changed from 3 to 1 (based on Expert override in previous ERA). This changes risk score from High to Medium. Therefore risk score reduced to Medium.	Medium

Table 4.8: *(continued)*

CAAB code	Scientific name	Common name	P1	P2	P3	P4	P5	P6	P7	S1	S2	S3	S4	Prod. score	Susc. score	Missing at-tributes	PSA 2D	Risk cate-gory	Species information	Risk score following Residual Risk	Final risk score
25154011	*Coscinasterias muricata*	Eleven-Arm Seastar	3	3	3	1	1	1	3	3	3	3	2	2.14	2.71	5	3.45	High	PSS	1- Risk ranking due to missing/ unavailable info. ALA suggests that this species occurs off southern Australia and Tasmania, including Flinders and King Islands. This species is endemic to Australia. Attribute S1 was changed from 3 to 1 (based on Expert override in previous ERA). This changes risk score from High to Medium. Therefore risk score reduced to Medium.	Medium
25171002	*Astrothorax waitei*	A Basketstar	3	3	3	1	1	1	3	3	3	2	2	2.14	2.45	6	3.25	High	expanded from 25160902, PSS	1- Risk ranking due to missing/ unavailable info. Patchy occurrences along southern Australia. AquaMaps suggest native range excludes Bass Strait. Therefore risk score reduced to Medium.	Medium

Table 4.8: *(continued)*

CAAB code	Scientific name	Common name	P1	P2	P3	P4	P5	P6	P7	S1	S2	S3	S4	Prod. score	Susc. score	Missing at-tributes	PSA 2D	Risk cate-gory	Species information	Risk score following Residual Risk	Final risk score
25176007	*Ophiomusium lymani*	A Brittlestar	3	3	3	3	3	3	3	3	1	3	2	3	2.06	9	3.64	High	expanded from 25160000, PSS	1- Risk ranking due to missing/ unavailable info. ALA: 10 records off Tasmania, including east of Flinders Island. AquaMaps native range suggests that this species is unlikely to occur in central Bass Strait. Therefore risk score reduced to Medium.	Medium
25176016	*Ophiocrossota multispina*	A Brittlestar (*continued*)	3	3	3	1	1	2	3	3	3	3	2	2.29	2.71	5	3.55	High	expanded from 25160000, PSS	1- Risk ranking due to missing/ unavailable info. ALA: 6 records around King and Flinders Islands. Attribute S1 was changed from 3 to 1 (based on Expert override in previous ERA). This changes risk score from High to Medium. Therefore risk score reduced to Medium.	Medium

Table 4.8: *(continued)*

CAAB code	Scientific name	Common name	P1	P2	P3	P4	P5	P6	P7	S1	S2	S3	S4	Prod. score	Susc. score	Missing at-tributes	PSA 2D	Risk cate-gory	Species information	Risk score following Residual Risk	Final risk score
25205010	*Araeosoma thetidis*	A Sea Urchin	3	3	3	3	3	3	3	3	3	3	2	3	2.71	9	4.04	High	expanded from 25205000, PSS	1- Risk ranking due to missing/ unavailable info. AquaMaps: modelled distribution on edge of fishery area and likely outside Bass Strait. Therefore risk score reduced to Medium.	Medium
25205011	*Hygrosoma hoplacantha*	A Sea Urchin (*continued*)	3	3	3	3	3	3	3	3	1	3	2	3	2.06	9	3.64	High	expanded from 25205000, PSS	1- Risk ranking due to missing/ unavailable info. AquaMaps: modelled distribution on edge of fishery area and likely outside Bass Strait. Therefore risk score reduced to Medium.	Medium
25247001	*Heliocidaris erythrogramma*	Purple Sea Urchin	3	3	3	1	1	3	1	3	3	3	2	2.14	2.71	2	3.45	High	expanded from previous ERA	1- Risk ranking due to missing/ unavailable info. ALA: Over 5000 records around Tasmania, including around King and Flinders Islands. Attribute S1 was changed from 3 to 1 (based on Expert override in previous ERA). This changes risk score from High to Medium. Therefore risk score reduced to Medium.	Medium

Table 4.8: *(continued)*

CAAB code	Scientific name	Common name	P1	P2	P3	P4	P5	P6	P7	S1	S2	S3	S4	Prod. score	Susc. score	Missing at-tributes	PSA 2D	Risk cate-gory	Species information	Risk score following Residual Risk	Final risk score
25266009	*Peronella peronii*	A Sand Dollar	3	3	3	1	1	3	3	3	2.3	3	2	2.43	2.53	6	3.51	High	expanded from previous ERA	1- Risk ranking due to missing/ unavailable info. AquaMaps: modelled distribution on edge of fishery area and likely outside Bass Strait. Attribute S1 was changed from 3 to 1 (based on Expert override in previous ERA). This changes risk score from High to Medium. Therefore risk score reduced to Medium.	Medium
28827002	*Strigopagurus strigimanus*	Red Hermit Crab	3	3	3	1	1	2	3	3	3	3	1	2.29	2.28	5	3.23	High	expanded from 28827000, PSS	1- Risk ranking due to missing/ unavailable info. ALA: 618 records around Tasmania, including King and Flinders Island. Attribute S1 was changed from 3 to 1 (based on Expert override in previous ERA). This changes risk score from High to Medium. Therefore risk score reduced to Medium.	Medium

Table 4.8: *(continued)*

CAAB code	Scientific name	Common name	P1	P2	P3	P4	P5	P6	P7	S1	S2	S3	S4	Prod. score	Susc. score	Missing at-tributes	PSA 2D	Risk cate-gory	Species information	Risk score following Residual Risk	Final risk score
28911003	*Ovalipes australiensis*	Common Sand Crab	3	3	3	1	1	2	1	3	3	3	2	2	2.71	4	3.37	High	expanded from 28708000, PSS	1- Risk ranking due to missing/ unavailable info. ALA: 70 records off Tasmanian coast. Few records around King and Flinders Island. Attribute S1 was changed from 3 to 1 (based on Expert override in previous ERA). This changes risk score from High to Medium. Therefore risk score reduced to Medium.	Medium
28911009	*Carcinus maenas*	European Shore Crab	3	3	3	1	1	3	3	3	3	2	2	2.43	2.45	6	3.45	High	expanded from 28708000, PSS	1- Risk ranking due to missing/ unavailable info. AquaMaps: modelled distribution on edge of fishery area and likely outside Bass Strait. It is an introduced species. Therefore risk score reduced to Medium.	Medium
19170001	*Magellania flavescens*	A Brachiopod	3	3	3	1	1	2	3	3	3	2	1	2.29	2.06	5	3.08	Medium	NE	No RR required	Medium
23226001	*Anadara trapezia*	Sydney Cockle	3	3	3	1	1	3	3	3	1	2	1	2.43	1.57	6	2.89	Medium	NE	No RR required	Medium
23226006	*Barbatia parvivillosa*	An Ark Shell	3	3	3	1	1	3	3	3	1	2	1	2.43	1.57	6	2.89	Medium	NE	No RR required	Medium
23226019	*Barbatia pistachia*	An Ark Shell (*continued*)	3	3	3	1	1	3	3	3	1	2	1	2.43	1.57	6	2.89	Medium	NE	No RR required	Medium

Table 4.8: *(continued)*

CAAB code	Scientific name	Common name	P1	P2	P3	P4	P5	P6	P7	S1	S2	S3	S4	Prod. score	Susc. score	Missing at-tributes	PSA 2D	Risk cate-gory	Species information	Risk score following Residual Risk	Final risk score
23226044	*Bathyarca perversidens*	An Ark Shell (*continued*)	3	3	3	1	1	3	3	3	1	2	1	2.43	1.57	6	2.89	Medium	NE	No RR required	Medium
23230001	*Limopsis penelevis*	A Dog Cockle	3	3	3	1	1	3	3	3	3	1	1	2.43	1.73	7	2.98	Medium	NE	No RR required	Medium
23230003	*Limopsis tenisoni*	A Dog Cockle (*continued*)	3	3	3	1	1	3	3	3	3	1	1	2.43	1.73	7	2.98	Medium	NE	No RR required	Medium
23230014	*Limopsis loringi*	A Dog Cockle (*continued*)	3	3	3	1	1	3	3	3	3	1	1	2.43	1.73	7	2.98	Medium	NE	No RR required	Medium
23231007	*Glycymeris grayana*	Shiny Dog Cockle	3	3	3	1	1	1	1	3	3	2	1	1.86	2.06	4	2.78	Medium	NE	No RR required	Medium
23245001	*Pinna dolabrata*	Razor Clam	3	3	3	1	1	1	3	3	1	3	1	2.14	1.73	5	2.75	Medium	NE	No RR required	Medium
23245007	*Atrina tasmanica*	A Razor Clam	3	3	3	1	1	1	3	3	3	3	1	2.14	2.28	5	3.13	Medium	NE	No RR required	Medium
23257002	*Ostrea angasi*	Native Oyster	3	3	3	1	1	3	1	3	3	3	1	2.14	2.28	4	3.13	Medium	NE	No RR required	Medium
23280002	*Neotrigonia margaritacea*	A Brooch Shell	3	3	3	1	1	2	3	3	3	2	1	2.29	2.06	5	3.08	Medium	NE	No RR required	Medium
23380001	*Dosinia caerulea*	Surf Clam	3	3	3	1	1	2	3	3	3	1	1	2.29	1.73	5	2.87	Medium	NE	No RR required	Medium
23380006	*Bassina pachyphylla*	A Venus Cockle	3	3	3	1	1	2	3	3	3	1	1	2.29	1.73	5	2.87	Medium	NE	No RR required	Medium
23380040	*Circomphalus disjecta*	Wedding-Cake Cockle	3	3	3	1	1	1	3	3	3	2	1	2.14	2.06	5	2.97	Medium	NE	No RR required	Medium
23380041	*Placamen placidum*	A Venus Cockle	3	3	3	1	1	2	3	3	3	1	1	2.29	1.73	5	2.87	Medium	NE	No RR required	Medium
23380042	*Tawera gallinula*	A Venus Cockle (*continued*)	3	3	3	1	1	2	3	3	3	1	1	2.29	1.73	5	2.87	Medium	NE	No RR required	Medium
23380062	*Tawera lagopus*	A Venus Cockle (*continued*)	3	3	3	1	1	2	3	3	3	1	1	2.29	1.73	5	2.87	Medium	NE	No RR required	Medium
23387001	*Corbula hydropica*	A Cockle	3	3	3	1	1	1	3	3	2.3	1	1	2.14	1.62	5	2.68	Medium	NE	No RR required	Medium

Table 4.8: *(continued)*

CAAB code	Scientific name	Common name	P1	P2	P3	P4	P5	P6	P7	S1	S2	S3	S4	Prod. score	Susc. score	Missing at-tributes	PSA 2D	Risk cate-gory	Species information	Risk score following Residual Risk	Final risk score
23422002	*Myochama anomoides*	A Bivalve	3	3	3	1	1	2	3	3	3	1	1	2.29	1.73	5	2.87	Medium	NE	No RR required	Medium
23607001	*Sepia apama*	Giant Cuttlefish	1	1	2	1	1	2	3	3	2.8	3	2	1.57	2.67	1	3.1	Medium	NE	No RR required	Medium
23617005	*Sepioteuthis australis*	Southern Calamari	1	1	2	1	1	2	2	3	3	3	2	1.43	2.71	1	3.06	Medium	NE	No RR required	Medium
23636011	*Todarodes filippovae*	Southern Ocean Arrow Squid	1	1	1	1	1	2	3	3	3	3	2	1.43	2.71	1	3.06	Medium	NE	No RR required	Medium
23659013	*Hapalochlaena maculosa*	Southern Blue-Ringed Octopus	1	1	3	1	1	3	3	3	3	2	2	1.86	2.45	1	3.08	Medium	NE	No RR required	Medium
24046137	*Clanculus undatus*	A Top Shell	3	3	3	1	1	2	3	3	3	1	1	2.29	1.73	5	2.87	Medium	NE	No RR required	Medium
24047003	*Astele subcarinata*	A Top Shell (*continued*)	3	3	3	1	1	2	3	3	1.3	1	1	2.29	1.41	5	2.69	Medium	NE	No RR required	Medium
24079001	*Maoricolpus roseus*	New Zealand Screw Shell	3	3	3	1	1	2	3	3	3	2	1	2.29	2.06	5	3.08	Medium	NE	No RR required	Medium
24079004	*Gazameda gunnii*	A Screw Shell	3	3	3	1	1	2	3	3	3	2	1	2.29	2.06	5	3.08	Medium	NE	No RR required	Medium
24155005	*Notocypraea comptoni*	A Cowrie	3	3	3	1	1	2	3	3	1.4	3	1	2.29	1.89	5	2.97	Medium	NE	No RR required	Medium
24155023	*Umbilia hesitata hesitata*	A Cowrie (*continued*)	3	3	3	1	1	2	3	3	1.4	3	1	2.29	1.89	5	2.97	Medium	NE	No RR required	Medium
24171004	*Semicassis pyrum*	A Helmet Shell	3	3	3	1	1	2	3	3	1.2	3	1	2.29	1.82	5	2.93	Medium	NE	No RR required	Medium
24171027	*Semicassis semigranosa*	A Helmet Shell (*continued*)	3	3	3	1	1	2	3	3	2.2	2	1	2.29	1.91	5	2.98	Medium	NE	No RR required	Medium
24176014	*Charonia lampas*	Red Triton Shell	3	3	3	1	1	2	3	3	1.6	3	1	2.29	1.95	5	3.01	Medium	NE	No RR required	Medium
24202005	*Australaria australasia*	Tulip Shell	3	3	3	1	1	2	2	3	3	3	1	2.14	2.28	4	3.13	Medium	NE	No RR required	Medium

Table 4.8: *(continued)*

CAAB code	Scientific name	Common name	P1	P2	P3	P4	P5	P6	P7	S1	S2	S3	S4	Prod. score	Susc. score	Missing at-tributes	PSA 2D	Risk cate-gory	Species information	Risk score following Residual Risk	Final risk score
24202006	*Nassarius (Alectrion) glans particeps*	Acorn Dog Whelk	3	3	3	1	1	3	3	3	3	1	1	2.43	1.73	7	2.98	Medium	NE	No RR required	Medium
24202007	*Nassarius (Niotha) pauperatus*	Impoverished Dog Whelk	3	3	3	1	1	3	3	3	3	1	1	2.43	1.73	7	2.98	Medium	NE	No RR required	Medium
24202008	*Tritia burchardi*	Burchard's Dog Whelk	3	3	3	1	1	3	3	3	3	1	1	2.43	1.73	7	2.98	Medium	NE	No RR required	Medium
24202009	*Nassarius (Plicarcularia) jonasii*	Jonas's Dog Whelk	3	3	3	1	1	3	3	3	3	1	1	2.43	1.73	7	2.98	Medium	NE	No RR required	Medium
24202011	*Nassarius pyrrhus*	Banded Dog Whelk	3	3	3	1	1	3	3	3	3	1	1	2.43	1.73	7	2.98	Medium	NE	No RR required	Medium
24202026	*Penion maximus*	A Whelk	3	3	3	1	1	2	3	3	1.5	3	1	2.29	1.92	5	2.99	Medium	NE	No RR required	Medium
24202031	*Fusinus novaehollandiae*	A Spindle Shell	3	3	3	1	1	2	2	3	3	3	1	2.14	2.28	4	3.13	Medium	NE	No RR required	Medium
24202127	*Nassarius (Alectrion) spiratus*	A Dog Whelk	3	3	3	1	1	3	3	3	3	1	1	2.43	1.73	7	2.98	Medium	NE	No RR required	Medium
24202128	*Tritia ephamilla*	A Dog Whelk (*continued*)	3	3	3	1	1	3	3	3	3	1	1	2.43	1.73	7	2.98	Medium	NE	No RR required	Medium
24202129	*Nassarius (Hima) mobilis*	A Dog Whelk (*continued*)	3	3	3	1	1	3	3	3	1	1	1	2.43	1.32	6	2.77	Medium	NE	No RR required	Medium
24202130	*Reticunassa paupera*	Poor Dog Whelk	3	3	3	1	1	3	3	3	3	1	1	2.43	1.73	7	2.98	Medium	NE	No RR required	Medium
24202144	*Nassarius (Niotha) nigellus*	Tasmanian Dog Whelk	3	3	3	1	1	3	3	3	3	1	1	2.43	1.73	7	2.98	Medium	NE	No RR required	Medium

Table 4.8: *(continued)*

CAAB code	Scientific name	Common name	P1	P2	P3	P4	P5	P6	P7	S1	S2	S3	S4	Prod. score	Susc. score	Missing at-tributes	PSA 2D	Risk cate-gory	Species information	Risk score following Residual Risk	Final risk score
24202157	*Nassarius (Plicarcularia) pullus*	Ribbed Dog Whelk	3	3	3	1	1	3	3	3	3	1	1	2.43	1.73	7	2.98	Medium	NE	No RR required	Medium
24202283	*Reticunassa compacta*	A Dog Whelk	3	3	3	1	1	3	3	3	3	1	1	2.43	1.73	7	2.98	Medium	NE	No RR required	Medium
24207001	*Livonia mammilla*	False Bailer Shell	3	3	3	1	1	2	1	3	3	3	1	2	2.28	2	3.03	Medium	NE	No RR required	Medium
24207007	*Amoria undulata*	Wavy Volute	3	3	3	1	1	2	3	3	1.6	3	1	2.29	1.95	5	3.01	Medium	NE	No RR required	Medium
24207010	*Ericusa sowerbyi*	A Volute	3	3	3	1	1	2	3	3	1.7	3	1	2.29	1.97	5	3.02	Medium	NE	No RR required	Medium
25111017	*Bollonaster pectinatus*	A Seastar	3	3	3	1	1	1	2	3	3	2	2	2	2.45	4	3.16	Medium	NE	No RR required	Medium
25166001	*Ophiomyxa australis*	A Brittlestar	3	3	3	1	1	2	3	3	1	3	2	2.29	2.06	5	3.08	Medium	NE	No RR required	Medium
25176004	*Ophiocten hastatum*	A Brittlestar (*continued*)	3	3	3	1	1	2	3	3	1	3	2	2.29	2.06	5	3.08	Medium	NE	No RR required	Medium
25176030	*Ophioplocus bispinosus*	A Brittlestar (*continued*)	3	3	3	1	1	2	3	3	3	1	2	2.29	2.06	5	3.08	Medium	NE	No RR required	Medium
25176037	*Ophiura (Ophiura) kinbergi*	A Brittlestar (*continued*)	3	3	3	1	1	2	3	3	1.6	1	2	2.29	1.76	5	2.89	Medium	NE	No RR required	Medium
25176040	*Ophiura (Ophiura) palliata*	A Brittlestar (*continued*)	3	3	3	1	1	2	3	3	1	1	2	2.29	1.57	5	2.78	Medium	NE	No RR required	Medium
25176041	*Ophiura (Ophiuroglypha) rugosa*	A Brittlestar (*continued*)	3	3	3	1	1	2	3	3	1	1	2	2.29	1.57	5	2.78	Medium	NE	No RR required	Medium
25176067	*Ophiopleura inermis*	A Brittlestar (*continued*)	3	3	3	1	1	2	3	3	1	1	2	2.29	1.57	5	2.78	Medium	NE	No RR required	Medium

Table 4.8: *(continued)*

CAAB code	Scientific name	Common name	P1	P2	P3	P4	P5	P6	P7	S1	S2	S3	S4	Prod. score	Susc. score	Missing at-tributes	PSA 2D	Risk cate-gory	Species information	Risk score following Residual Risk	Final risk score
25176121	*Ophiosphalma armigerum*	A Brittlestar (*continued*)	3	3	3	1	1	3	3	3	1	1	2	2.43	1.57	6	2.89	Medium	NE	No RR required	Medium
25176136	*Ophiura (Ophiuroglypha) irrorata*	A Brittlestar (*continued*)	3	3	3	1	1	2	3	3	1	3	2	2.29	2.06	5	3.08	Medium	NE	No RR required	Medium
25179009	*Ophionereis schayeri*	A Brittlestar (*continued*)	3	3	2	1	1	2	3	3	3	1	2	2.14	2.06	4	2.97	Medium	NE	No RR required	Medium
25179016	*Ophioplax lamellosa*	A Brittlestar (*continued*)	3	3	2	1	1	2	3	3	1	1	2	2.14	1.57	4	2.65	Medium	NE	No RR required	Medium
25180001	*Bathypectinura heros*	A Brittlestar (*continued*)	3	3	3	1	1	2	3	3	1	3	2	2.29	2.06	5	3.08	Medium	NE	No RR required	Medium
25180013	*Ophiarachnella ramsayi*	A Brittlestar (*continued*)	3	3	3	1	1	2	3	3	1	1	2	2.29	1.57	5	2.78	Medium	NE	No RR required	Medium
25180024	*Ophiopeza cylindrica*	A Brittlestar (*continued*)	3	3	3	1	1	2	3	3	3	1	2	2.29	2.06	6	3.08	Medium	NE	No RR required	Medium
25185009	*Ophiocamax applicatus*	A Brittlestar (*continued*)	3	3	3	1	1	3	3	3	1	1	2	2.43	1.57	6	2.89	Medium	NE	No RR required	Medium
25185011	*Ophiacantha alternata*	A Brittlestar (*continued*)	3	3	3	1	1	3	3	3	1	1	2	2.43	1.57	6	2.89	Medium	NE	No RR required	Medium
25185012	*Ophiacantha brachygnatha*	A Brittlestar (*continued*)	3	3	3	1	1	3	3	3	1	1	2	2.43	1.57	6	2.89	Medium	NE	No RR required	Medium
25185013	*Ophiacantha clavigera*	A Brittlestar (*continued*)	3	3	3	1	1	3	3	3	1	1	2	2.43	1.57	6	2.89	Medium	NE	No RR required	Medium
25185017	*Ophiacantha fidelis*	A Brittlestar (*continued*)	3	3	3	1	1	3	3	3	1	1	2	2.43	1.57	6	2.89	Medium	NE	No RR required	Medium
25185019	*Ophiacantha heterotyla*	A Brittlestar (*continued*)	3	3	3	1	1	3	3	3	1	1	2	2.43	1.57	6	2.89	Medium	NE	No RR required	Medium

Table 4.8: *(continued)*

CAAB code	Scientific name	Common name	P1	P2	P3	P4	P5	P6	P7	S1	S2	S3	S4	Prod. score	Susc. score	Missing at-tributes	PSA 2D	Risk cate-gory	Species information	Risk score following Residual Risk	Final risk score
25185023	*Ophiacantha sollicita*	A Brittlestar (*continued*)	3	3	3	1	1	3	3	3	1	1	2	2.43	1.57	6	2.89	Medium	NE	No RR required	Medium
25185029	*Ophiophthalmus relictus*	A Brittlestar (*continued*)	3	3	3	1	1	3	3	3	1	1	2	2.43	1.57	6	2.89	Medium	NE	No RR required	Medium
25185039	*Ophiolimna antarctica*	A Brittlestar (*continued*)	3	3	3	1	1	3	3	3	1	1	2	2.43	1.57	6	2.89	Medium	NE	No RR required	Medium
25185042	*Ophioplinthaca plicata*	A Brittlestar (*continued*)	3	3	3	1	1	3	3	3	1	1	2	2.43	1.57	6	2.89	Medium	NE	No RR required	Medium
25185045	*Ophiurothamnus clausa*	A Brittlestar (*continued*)	3	3	3	1	1	3	3	3	1	1	2	2.43	1.57	6	2.89	Medium	NE	No RR required	Medium
25190002	*Ophiactis abyssicola*	A Brittlestar (*continued*)	3	3	3	1	1	1	3	3	1	3	2	2.14	2.06	5	2.97	Medium	NE	No RR required	Medium
25190003	*Ophiactis hirta*	A Brittlestar (*continued*)	3	3	3	1	1	1	3	3	1	3	2	2.14	2.06	5	2.97	Medium	NE	No RR required	Medium
25190004	*Ophiactis amator*	A Brittlestar (*continued*)	3	3	3	1	1	1	3	3	1	3	2	2.14	2.06	5	2.97	Medium	NE	No RR required	Medium
25191015	*Amphipholis squamata*	A Brittlestar (*continued*)	3	3	3	1	1	1	3	3	1	1	2	2.14	1.57	5	2.65	Medium	NE	No RR required	Medium
25191016	*Amphistigma minuta*	A Brittlestar (*continued*)	3	3	3	1	1	2	3	3	3	1	2	2.29	2.06	5	3.08	Medium	NE	No RR required	Medium
25191023	*Amphiura (Amphiura) constricta*	A Brittlestar (*continued*)	3	3	3	1	1	2	3	3	3	1	2	2.29	2.06	5	3.08	Medium	NE	No RR required	Medium
25191031	*Amphiura (Amphiura) magellanica*	A Brittlestar (*continued*)	3	3	3	1	1	2	3	3	3	1	2	2.29	2.06	5	3.08	Medium	NE	No RR required	Medium

Table 4.8: *(continued)*

CAAB code	Scientific name	Common name	P1	P2	P3	P4	P5	P6	P7	S1	S2	S3	S4	Prod. score	Susc. score	Missing at-tributes	PSA 2D	Risk cate-gory	Species information	Risk score following Residual Risk	Final risk score
25191039	*Amphiura (Amphiura) poecila*	A Brittlestar (*continued*)	3	3	3	1	1	2	3	3	3	1	2	2.29	2.06	5	3.08	Medium	NE	No RR required	Medium
25191054	*Ophiocentrus pilosus*	A Brittlestar (*continued*)	3	3	3	1	1	1	3	3	2	1	2	2.14	1.86	5	2.84	Medium	NE	No RR required	Medium
25192001	*Ophiothrix (Ophiothrix) aristulata*	A Brittlestar (*continued*)	3	3	3	1	1	2	3	3	1	3	2	2.29	2.06	5	3.08	Medium	NE	No RR required	Medium
25192002	*Ophiothrix caespitosa*	A Brittle-Star	3	3	3	1	1	2	3	3	1	1	2	2.29	1.57	5	2.78	Medium	NE	No RR required	Medium
25241005	*Amblypneustes ovum*	A Sea Urchin	3	3	3	1	1	1	1	3	1.3	2	2	1.86	1.98	4	2.72	Medium	NE	No RR required	Medium
25241010	*Holopneustes inflatus*	A Sea Urchin (*continued*)	3	3	3	1	1	3	1	3	1.3	2	2	2.14	1.98	4	2.92	Medium	NE	No RR required	Medium
25406038	*Thyone joshuai*	A Sea Cucumber	3	3	3	1	1	1	3	3	3	1	2	2.14	2.06	6	2.97	Medium	NE	No RR required	Medium
25417009	*Australostichopus mollis*	A Sea Cucumber (*continued*)	1	2	1	1	1	1	1	3	3	3	2	1.14	2.71	1	2.94	Medium	NE	No RR required	Medium
28711052	*Melicertus plebejus*	Eastern King Prawn	1	1	1	1	1	2	1	3	3	2	2	1.14	2.45	1	2.7	Medium	NE	No RR required	Medium
28821004	*Ibacus peronii*	Eastern Balmain Bug	1	1	2	1	1	2	1	3	3	3	2	1.29	2.71	1	3	Medium	NE	No RR required	Medium
28827087	*Areopaguristes tuberculatus*	Friendly Hermit Crab	3	3	3	1	1	2	3	3	3	2	1	2.29	2.06	5	3.08	Medium	NE	No RR required	Medium
28852002	*Lamarckdromia globosa*	Fringed Sponge Crab	3	3	3	1	1	2	3	3	3	1	2	2.29	2.06	5	3.08	Medium	NE	No RR required	Medium
28852004	*Metadromia wilsoni*	A Sponge Crab	3	3	3	1	1	2	3	3	1	2	2	2.29	1.86	5	2.95	Medium	NE	No RR required	Medium

Table 4.8: *(continued)*

CAAB code	Scientific name	Common name	P1	P2	P3	P4	P5	P6	P7	S1	S2	S3	S4	Prod. score	Susc. score	Missing at-tributes	PSA 2D	Risk cate-gory	Species information	Risk score following Residual Risk	Final risk score
28852010	*Stimdromia lateralis*	Ridged Sponge Crab	3	3	3	1	1	2	3	3	3	1	2	2.29	2.06	5	3.08	Medium	NE	No RR required	Medium
28876003	*Bellidilia undecimspinosa*	Large Pebble Crab	3	3	3	1	1	2	1	3	3	1	2	2	2.06	4	2.87	Medium	NE	No RR required	Medium
28880008	*Notomithrax ursus*	A Decorator Crab	3	3	3	1	1	2	1	3	1	3	2	2	2.06	4	2.87	Medium	NE	No RR required	Medium
28911004	*Nectocarcinus tuberculosus*	Velvet Crab	1	1	1	1	1	2	2	3	3	3	2	1.29	2.71	1	3	Medium	NE	No RR required	Medium
28911010	*Nectocarcinus integrifrons*	Rough Rock Crab	1	1	1	1	1	2	2	3	3	3	2	1.29	2.71	1	3	Medium	NE	No RR required	Medium
28911016	*Liocarcinus corrugatus*	Dwarf Swimmer Crab	3	3	3	1	1	2	1	3	1.2	2	2	2	1.95	4	2.79	Medium	NE	No RR required	Medium
28911020	*Ovalipes molleri*	A Swimmer Crab	3	3	3	1	1	2	1	3	1	2	2	2	1.86	4	2.73	Medium	NE	No RR required	Medium
28920001	*Actaea peronii*	Thorn-Legged Crab	3	3	3	1	1	2	3	3	3	1	2	2.29	2.06	5	3.08	Medium	NE	No RR required	Medium
28926057	*Pilumnus etheridgei*	A Hairy Crab	3	3	3	1	1	2	3	3	3	1	2	2.29	2.06	5	3.08	Medium	NE	No RR required	Medium
23230025	*Limopsis bassi*	A Dog Cockle	3	3	3	1	1	1	3	3	1	1	1	2.14	1.32	5	2.51	Low	NE	No RR required	Low
23231001	*Glycymeris striatularis*	A Dog Cockle (*continued*)	3	3	3	1	1	1	1	3	3	1	1	1.86	1.73	4	2.54	Low	NE	No RR required	Low
23231010	*Tucetona flabellata*	A Dog Cockle (*continued*)	3	3	3	1	1	1	1	3	3	1	1	1.86	1.73	4	2.54	Low	NE	No RR required	Low
23270005	*Equichlamys bifrons*	Queen Scallop	1	1	1	1	1	1	1	3	3	2	1	1	2.06	1	2.29	Low	NE	No RR required	Low
23330004	*Eucrassatella kingicola*	A Cockle	3	3	3	1	1	1	1	3	3	1	1	1.86	1.73	4	2.54	Low	NE	No RR required	Low
23607002	*Sepia cultrata*	Cuttlefish	1	1	2	1	1	2	3	1	1	2	2	1.57	1.41	0	2.11	Low	NE	No RR required	Low

Table 4.8: *(continued)*

CAAB code	Scientific name	Common name	P1	P2	P3	P4	P5	P6	P7	S1	S2	S3	S4	Prod. score	Susc. score	Missing at-tributes	PSA 2D	Risk cate-gory	Species information	Risk score following Residual Risk	Final risk score
23607021	*Sepia hedleyi*	Cuttlefish (*continued*)	1	1	2	1	1	2	3	1	1	3	2	1.57	1.57	0	2.22	Low	NE	No RR required	Low
23636004	*Nototodarus gouldi*	Gould's Squid	1	1	1	1	1	2	2	3	1	3	2	1.29	2.06	1	2.43	Low	NE	No RR required	Low
27560004	*Balanus trigonus*	A Barnacle	1	3	2	1	1	2	3	3	1	1	1	1.86	1.32	3	2.28	Low	NE	No RR required	Low
28821001	*Ibacus alticrenatus*	Whitetail Bug	1	1	2	1	1	2	1	3	1.1	2	2	1.29	1.89	1	2.29	Low	NE	No RR required	Low
28880010	*Leptomithrax gaimardii*	Great Spider Crab	3	3	3	1	1	2	1	1	1	3	2	2	1.57	3	2.54	Low	NE	No RR required	Low

Table 4.9: Summary of the 'unassessable species in bSAFE' PSA scores on the set of productivity and susceptibility attributes for bycatch species and residual risk (RR) for high risk species. Three BC species (listed at the top of the table) were found to be unassessable in bSAFE and were assessed in PSA instead. Productivity attributes (P1-P7) are listed in Table 4.4. Susceptibility attributes (S1-S4) are listed in Table 4.5. Missing attributes are highlighted (red). Productivity score (Prod. score); Susceptibility score (Susc. score).

CAAB code	Scientific name	Common name	P1	P2	P3	P4	P5	P6	P7	S1	S2	S3	S4	Prod. score	Susc. score	Missing at-tributes	PSA 2D	Risk cate-gory
37141001	*Gonorynchus greyi*	Beaked Salmon	3	3	3	1	2	1	1	1	3	3	2	2	2.06	3	2.87	Medium
37309003	*Pegasus lancifer*	Sculptured Seamoth	3	3	3	1	1	1	3	1	3	2	2	2.14	1.86	3	2.84	Medium
37466003	*Aracana aurita*	Shaw's Cowfish	3	3	3	1	1	1	3	1	3	3	2	2.14	2.06	3	2.97	Medium

Protected Species

There were no protected species considered in the PSA.

4.2 bSAFE Results and Discussion

Each of the reference points (MSM, LIM, and CRASH) were evaluated. If the biological reference point mean was higher than the estimated F attributed to this sub-fishery, then the species was categorised as *Below*. When the biological reference point mean was lower than the estimated F attributed to the sub-fishery, then the species was categorised as *Above* for that species and reference point measure. The overall risk is a summary of the three reference point measures (Table 4.10). If all reference points are categorised as *Below*, then the overall risk is low.

Table 4.10: Overall risk summary against each of the three reference point measures.

MSM	LIM	CRASH	Overall risk
Below	Below	Below	Low
Above	Below	Below	Medium
Above	Above	Below	High
Above	Above	Above	Extreme

4.2.1 bSAFE – Key Commercial Species

Under the revised ERAEF (AFMA, 2017), key commercial species were not assessed at Level 2.

4.2.2 bSAFE - Secondary Commercial Species

There were no secondary commercial species assessed in the bSAFE.

TODO: FILL OUT ManualInput/Level2/bSAFE_C2_after.Rmd

EXAMPLE:

Some additional text on bSAFE analysis

4.2.3 bSAFE - Commercial Bait Species

There were no commercial bait species assessed in the bSAFE.

4.2.4 bSAFE - Byproduct Species

There were no byproduct species assessed in the bSAFE.

4.2.5 bSAFE - Bycatch Species

There were 172 out of 330 bycatch species considered in the bSAFE (Figure 4.3 and Table 4.11). Three species were unassessable due to missing biological attributes employed in the bSAFE method (classified as NA - not assessable in Table 4.11). Of the remaining 169 species, all 169 species were below the three reference points (low risk), none were medium risk (i.e., above the bSAFE-MSM reference point), and none were high or extreme risk (i.e., above the bSAFE-MSM and bSAFE-LIM reference points, Table 4.11).

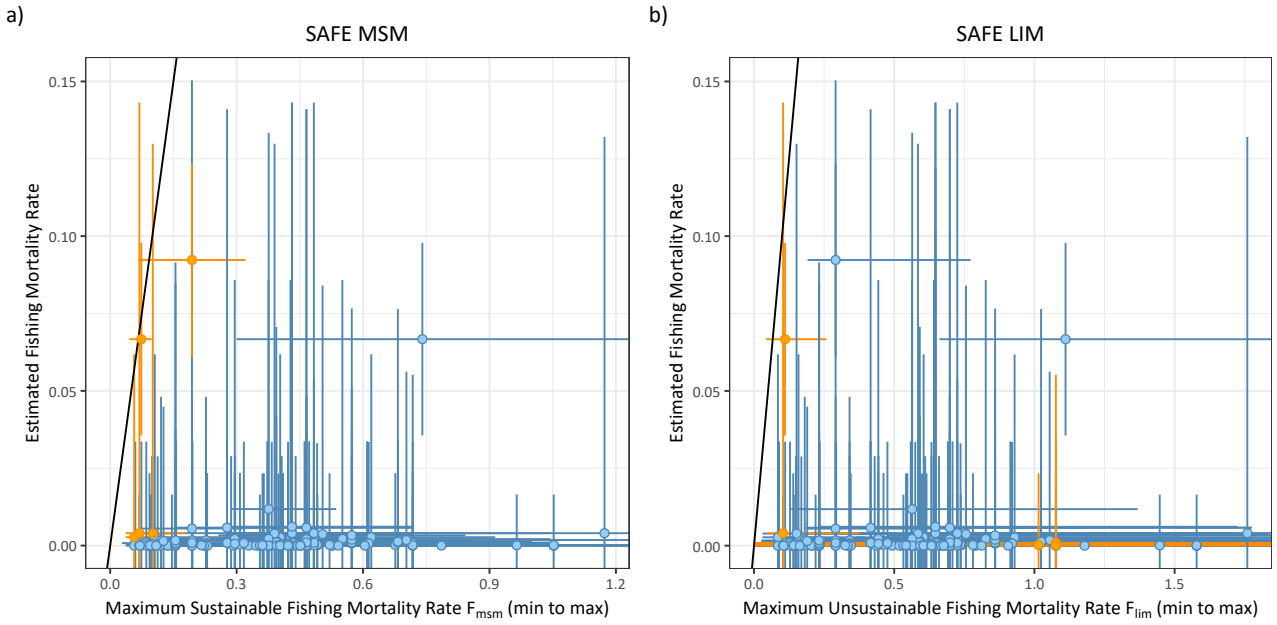


Figure 4.3: SAFE plot for bycatch species in the Bass Strait Central Zone Scallop Fishery for (a) bSAFE-MSM reference point [left] and (b) bSAFE limit (LIM) [right] reference point. Eight species (out of a total of 172 species) have missing data and may not be shown in the figure. Three of these are unassessable in bSAFE and have been assessed in PSA instead; five of these lack some biological data but have a susceptibility of 0 and therefore a low risk. Red: Best estimate of mortality rate is above reference point; orange: best estimate of mortality rate is below reference point, but the top of the uncertainty range is above the reference point; blue: mortality rate is below reference point for the given uncertainty.

Table 4.11: bSAFE risk categories for bycatch species ecological component for F_{MSM}, F_{Lim}, and F_{Crash}. Three BC species (listed at the top of the table) were found to be unassessable in bSAFE and were assessed in PSA instead.

CAAB code	Scientific name	Common name	Susceptibility	F MSM	F MSM risk	F Lim	F Lim risk	F Crash	F Crash risk	F overall risk
37141001	*Gonorynchus greyi*	Beaked Salmon	0.001	-	NA	-	NA	-	NA	Assessed in PSA (Table 4.8)
37309003	*Pegasus lancifer*	Sculptured Seamoth	0.002	-	NA	-	NA	-	NA	Assessed in PSA (Table 4.8)
37466003	*Aracana aurita*	Shaw's Cowfish	0.001	-	NA	-	NA	-	NA	Assessed in PSA (Table 4.8)
37005001	*Heptranchias perlo*	Sharpnose Sevengill Shark	<0.001	0.0996	Below	0.1494	Below	0.1992	Below	Low
37005002	*Notorynchus cepedianus*	Broadnose Shark	<0.001	0.0999	Below	0.1499	Below	0.1998	Below	Low
37005005	*Hexanchus griseus*	Bluntnose Sixgill Shark	<0.001	0.0996	Below	0.1494	Below	0.1992	Below	Low
37007001	*Heterodontus portusjacksoni*	Port Jackson Shark	0.001	0.0596	Below	0.0894	Below	0.1192	Below	Low

Table 4.11: ***(continued)***

CAAB code	Scientific name	Common name	Susceptibility	F MSM	F MSM risk	F Lim	F Lim risk	F Crash	F Crash risk	F overall risk
37015001	*Cephaloscyllium laticeps*	Draughtboard Shark	0.003	0.1058	Below	0.1587	Below	0.2116	Below	Low
37015003	*Asymbolus vincenti*	Gulf Catshark	<0.001	0.1368	Below	0.2052	Below	0.2736	Below	Low
37015009	*Figaro boardmani*	Australian Sawtail Cat-shark;Sawtail Catshark	<0.001	0.1464	Below	0.2196	Below	0.2928	Below	Low
37015013	*Cephaloscyllium albipinnum*	Whitefin Swellshark	<0.001	0.1182	Below	0.1773	Below	0.2363	Below	Low
37015024	*Asymbolus rubiginosus*	Orange Spotted Catshark	<0.001	0.1368	Below	0.2052	Below	0.2736	Below	Low
37015027	*Asymbolus analis*	Australian Spotted Catshark	<0.001	0.1368	Below	0.2052	Below	0.2736	Below	Low
37023001	*Pristiophorus nudipinnis*	Southern Sawshark	0.002	0.1206	Below	0.1809	Below	0.2412	Below	Low
37023002	*Pristiophorus cirratus*	Common Sawshark	<0.001	0.1126	Below	0.1688	Below	0.2251	Below	Low
37024001	*Squatina australis*	Australian Angel Shark	0.001	0.074	Below	0.111	Below	0.148	Below	Low
37024004	*Squatina albipunctata*	Eastern Angelshark	<0.001	0.074	Below	0.111	Below	0.148	Below	Low
37027011	*Trygonorrhina dumerilii*	Southern Fiddler Ray	0.004	0.1011	Below	0.1517	Below	0.2023	Below	Low
37028002	*Narcinops tasmaniensis*	Tasmanian Numbfish	<0.001	0.6765	Below	1.0148	Below	1.353	Below	Low
37031003	*Dentiraja cerva*	Whitespotted Skate	<0.001	0.0933	Below	0.1399	Below	0.1865	Below	Low
37031005	*Dentiraja confusus*	Longnose Skate	0.001	0.0856	Below	0.1284	Below	0.1712	Below	Low
37031006	*Spiniraja whitleyi*	Melbourne Skate	0.003	0.0569	Below	0.0853	Below	0.1138	Below	Low
37031007	*Dentiraja lemprieri*	Thornback Skate	0.004	0.0693	Below	0.1039	Below	0.1385	Below	Low
37031009	*Pavoraja nitida*	Peacock Skate	<0.001	0.1057	Below	0.1585	Below	0.2113	Below	Low
37031010	*Dipturus gudgeri*	Bight Skate	<0.001	0.0568	Below	0.0852	Below	0.1136	Below	Low
37031018	*Notoraja azurea*	Blue Skate	<0.001	0.0912	Below	0.1368	Below	0.1824	Below	Low
37031023	*Pavoraja arenaria*	Sandy Skate	<0.001	0.0983	Below	0.1474	Below	0.1965	Below	Low
37031028	*Dipturus canutus*	Grey Skate	<0.001	0.0879	Below	0.1319	Below	0.1759	Below	Low
37031034	*Dipturus wengi*	Weng's Skate	<0.001	0.069	Below	0.1035	Below	0.138	Below	Low

Table 4.11: ***(continued)***

CAAB code	Scientific name	Common name	Susceptibility	F MSM	F MSM risk	F Lim	F Lim risk	F Crash	F Crash risk	F overall risk
37031035	*Dipturus acrobelus*	Deepwater Skate	<0.001	0.0877	Below	0.1315	Below	0.1754	Below	Low
37031040	*Rajella challengeri*	Challenger Skate	<0.001	0.0703	Below	0.1054	Below	0.1406	Below	Low
37031041	*Amblyraja hyperborea*	Arctic Skate	0.067	0.0739	Below	0.1108	Below	0.1478	Below	Low
37035001	*Bathytoshia brevicaudata*	Short-Tail Stingray	0.000	0.1004	Below	0.1505	Below	0.2007	Below	Low
37035002	*Bathytoshia lata*	Brown Stingray / Black Stingray	<0.001	0.0947	Below	0.1421	Below	0.1895	Below	Low
37035010	*Pteroplatytrygon violacea*	Pelagic Stingray	<0.001	0.1089	Below	0.1633	Below	0.2178	Below	Low
37038001	*Urolophus bucculentus*	Sandyback Stingaree	<0.001	0.1549	Below	0.2323	Below	0.3098	Below	Low
37038002	*Urolophus cruciatus*	Banded Stingaree	0.001	0.1563	Below	0.2344	Below	0.3125	Below	Low
37038003	*Urolophus gigas*	Spotted Stingaree	0.001	0.1549	Below	0.2323	Below	0.3098	Below	Low
37038004	*Urolophus paucimaculatus*	Sparsely-Spotted Stingaree	0.001	0.1953	Below	0.2929	Below	0.3905	Below	Low
37038005	*Urolophus sufflavus*	Yellowback Stingaree	<0.001	0.1549	Below	0.2323	Below	0.3098	Below	Low
37038006	*Trygonoptera testacea*	Common Stingaree	<0.001	0.1549	Below	0.2323	Below	0.3098	Below	Low
37038007	*Urolophus viridis*	Greenback Stingaree	<0.001	0.1549	Below	0.2323	Below	0.3098	Below	Low
37038014	*Trygonoptera imitata*	Shovelnose Stingaree	0.001	0.1549	Below	0.2323	Below	0.3098	Below	Low
37038024	*Urolophus sp. cf viridis [off Stanley]*	A Stingaree	0.002	0.1549	Below	0.2323	Below	0.3098	Below	Low
37043001	*Callorhinchus milii*	Elephantfish	0.002	0.1265	Below	0.1897	Below	0.2529	Below	Low
37067002	*Gnathophis longicauda*	Little Conger	0.002	0.2272	Below	0.3408	Below	0.4544	Below	Low
37067007	*Conger verreauxi*	Southern Conger	0.001	0.2272	Below	0.3408	Below	0.4544	Below	Low
37067012	*Bassanago bulbiceps*	Swollenhead Conger	<0.001	0.2272	Below	0.3408	Below	0.4544	Below	Low
37067013	*Bassanago hirsutus*	Deepsea Conger	<0.001	0.2272	Below	0.3408	Below	0.4544	Below	Low
37067016	*Gnathophis umbrellabius*	Umbrella Conger	<0.001	0.2272	Below	0.3408	Below	0.4544	Below	Low

Table 4.11: ***(continued)***

CAAB code	Scientific name	Common name	Susceptibility	F MSM	F MSM risk	F Lim	F Lim risk	F Crash	F Crash risk	F overall risk
37067027	*Gnathophis macroporis*	Largepore Conger	0.001	0.2272	Below	0.3408	Below	0.4544	Below	Low
37068001	*Ophisurus serpens*	Serpent Eel	<0.001	0.2955	Below	0.4433	Below	0.5911	Below	Low
37068003	*Scolecenchelys australis*	Shortfin Worm Eel	0.002	0.2955	Below	0.4433	Below	0.5911	Below	Low
37117001	*Latropiscis purpurissatus*	Sergeant Baker	<0.001	0.3079	Below	0.4618	Below	0.6158	Below	Low
37120001	*Paraulopus nigripinnis*	Blacktip Cucumberfish	<0.001	0.5268	Below	0.7902	Below	1.0536	Below	Low
37120008	*Paraulopus melanostomus*	Cucumberfish 1	<0.001	0.5268	Below	0.7902	Below	1.0536	Below	Low
37209001	*Thymichthys verrucosus*	Warty Handfish	0.001	0.7178	Below	1.0766	Below	1.4355	Below	Low
37209005	*Brachionichthys australis*	Australian Handfish	<0.001	0.7178	Below	1.0766	Below	1.4355	Below	Low
37209010	*Brachiopsilus dossenus*	A Handfish	0.001	0.7178	Below	1.0766	Below	1.4355	Below	Low
37209011	*Pezichthys amplispinus*	A Handfish	<0.001	0.7178	Below	1.0766	Below	1.4355	Below	Low
37209012	*Pezichthys compressus*	A Handfish	<0.001	0.7178	Below	1.0766	Below	1.4355	Below	Low
37209016	*Sympterichthys moultoni*	A Handfish	<0.001	0.7178	Below	1.0766	Below	1.4355	Below	Low
37224003	*Pseudophycis barbata*	Bearded Rock Cod	0.001	0.3833	Below	0.575	Below	0.7667	Below	Low
37224006	*Pseudophycis bachus*	Red Cod	<0.001	0.4101	Below	0.6151	Below	0.8202	Below	Low
37264002	*Cyttus australis*	Silver Dory	0.000	0.2869	Below	0.4303	Below	0.5738	Below	Low
37279001	*Centriscops humerosus*	Banded Bellowsfish	<0.001	1.0524	Below	1.5786	Below	2.1048	Below	Low
37279002	*Macroramphosus scolopax*	Common Bellowsfish	<0.001	0.9646	Below	1.4469	Below	1.9292	Below	Low
37279003	*Notopogon lilliei*	Crested Bellowsfish	<0.001	1.0524	Below	1.5786	Below	2.1048	Below	Low
37279005	*Notopogon xenosoma*	Orange Bellowsfish	<0.001	1.0524	Below	1.5786	Below	2.1048	Below	Low
37287001	*Helicolenus percoides*	Reef Ocean Perch	<0.001	0.23	Below	0.345	Below	0.46	Below	Low
37287003	*Neosebastes pandus*	Bighead Gurnard Perch	0.092	0.194	Below	0.291	Below	0.388	Below	Low
37287005	*Neosebastes scorpaenoides*	Common Gurnard Perch	0.002	0.194	Below	0.291	Below	0.388	Below	Low
37287006	*Neosebastes thetidis*	Thetis Fish	<0.001	0.194	Below	0.291	Below	0.388	Below	Low

Table 4.11: ***(continued)***

CAAB code	Scientific name	Common name	Susceptibility	F MSM	F MSM risk	F Lim	F Lim risk	F Crash	F Crash risk	F overall risk
37287007	*Maxillicosta scabriceps*	Little Gurnard Perch	0.005	0.194	Below	0.291	Below	0.388	Below	Low
37287008	*Scorpaena papillosa*	Southern Red Scorpionfish	0.003	0.4033	Below	0.6049	Below	0.8065	Below	Low
37287018	*Gymnapistes marmoratus*	Soldier	<0.001	0.3783	Below	0.5674	Below	0.7565	Below	Low
37287019	*Neosebastes incisipinnis*	Incised Gurnard Perch	<0.001	0.194	Below	0.291	Below	0.388	Below	Low
37287023	*Glyptauchen panduratus*	Goblinfish	0.002	0.3944	Below	0.5916	Below	0.7888	Below	Low
37287045	*Maxillicosta whitleyi*	Whitley's Gurnard Perch	<0.001	0.194	Below	0.291	Below	0.388	Below	Low
37287046	*Trachyscorpia eschmeyeri*	Deepsea Ocean Perch	<0.001	0.2228	Below	0.3342	Below	0.4456	Below	Low
37287048	*Centropogon australis*	Eastern Fortescue	<0.001	0.3783	Below	0.5674	Below	0.7565	Below	Low
37287053	*Ectreposebastes niger*	Black Scorpionfish	<0.001	-	Below	-	Below	-	Below	Low
37287093	*Helicolenus barathri*	Bigeye Ocean Perch	<0.001	0.2305	Below	0.3457	Below	0.461	Below	Low
37287103	*Trachyscorpia carnomagula*	Deepsea Scorpionfish	<0.001	0.2228	Below	0.3342	Below	0.4456	Below	Low
37287126	*Maxillicosta meridianus*	A Scorpionfish	0.001	0.194	Below	0.291	Below	0.388	Below	Low
37288001	*Chelidonichthys kumu*	Red Gurnard	<0.001	0.5205	Below	0.7808	Below	1.0411	Below	Low
37288002	*Lepidotrigla papilio*	Spiny Gurnard	0.003	0.6195	Below	0.9293	Below	1.239	Below	Low
37288003	*Lepidotrigla vanessa*	Butterfly Gurnard	0.001	0.6096	Below	0.9144	Below	1.2193	Below	Low
37288004	*Peristedion picturatum*	Robust Amour Gurnard	<0.001	-	Below	-	Below	-	Below	Low
37288005	*Pterygotrigla andertoni*	Painted Latchet	<0.001	0.4916	Below	0.7374	Below	0.9832	Below	Low
37288006	*Pterygotrigla polyommata*	Latchet	0.001	0.44	Below	0.66	Below	0.88	Below	Low
37288007	*Lepidotrigla modesta*	Cocky Gurnard	0.001	0.6105	Below	0.9158	Below	1.2211	Below	Low
37288008	*Lepidotrigla mulhalli*	Roundsnout Gurnard	0.001	0.6135	Below	0.9203	Below	1.227	Below	Low
37288045	*Satyrichthys sp. W2*	An Armoured Gurnard	<0.001	-	Below	-	Below	-	Below	Low
37296001	*Platycephalus richardsoni*	Tiger Flathead	0.000	0.4069	Below	0.6104	Below	0.8139	Below	Low

Table 4.11: ***(continued)***

CAAB code	Scientific name	Common name	Susceptibility	F MSM	F MSM risk	F Lim	F Lim risk	F Crash	F Crash risk	F overall risk
37296002	*Platycephalus conatus*	Deepwater Flathead	<0.001	0.2914	Below	0.4371	Below	0.5828	Below	Low
37296003	*Platycephalus bassensis*	Southern Sand Flathead	0.002	0.4278	Below	0.6417	Below	0.8557	Below	Low
37296006	*Platycephalus laevigatus*	Rock Flathead	<0.001	0.3513	Below	0.527	Below	0.7027	Below	Low
37296007	*Platycephalus caeruleopunc-tatus*	Bluespotted Flathead	<0.001	0.3833	Below	0.5749	Below	0.7665	Below	Low
37296011	*Ratabulus diversidens*	Orange-Freckled Flathead	<0.001	0.3899	Below	0.5849	Below	0.7798	Below	Low
37296035	*Platycephalus aurimaculatus*	Toothy Flathead	0.001	0.3726	Below	0.559	Below	0.7453	Below	Low
37296036	*Platycephalus grandispinis*	Longspine Flathead	<0.001	0.453	Below	0.6795	Below	0.906	Below	Low
37296037	*Platycephalus speculator*	Southern Bluespotted Flathead	0.012	0.3761	Below	0.5641	Below	0.7522	Below	Low
37296038	*Platycephalus marmoratus*	Marbled Flathead	0.001	0.3941	Below	0.5911	Below	0.7881	Below	Low
37296045	*Thysanophrys cirronasus*	Tasselsnout Flathead	0.004	0.3899	Below	0.5849	Below	0.7798	Below	Low
37311001	*Lepidoperca pulchella*	Eastern Orange Perch	<0.001	0.3992	Below	0.5988	Below	0.7983	Below	Low
37311002	*Caesioperca lepidoptera*	Butterfly Perch	0.001	0.2772	Below	0.4158	Below	0.5544	Below	Low
37311003	*Caesioperca rasor*	Barber Perch	0.001	0.2772	Below	0.4158	Below	0.5544	Below	Low
37311036	*Hypoplectrodes maccullochi*	Halfbanded Seaperch	0.006	0.2772	Below	0.4158	Below	0.5544	Below	Low
37330002	*Sillago bassensis*	Southern School Whiting	<0.001	0.6042	Below	0.9063	Below	1.2084	Below	Low
37337002	*Trachurus declivis*	Common Jack Mackerel	<0.001	0.4724	Below	0.7087	Below	0.9449	Below	Low
37349001	*Parequula melbournensis*	Silverbelly	0.004	1.1729	Below	1.7593	Below	2.3457	Below	Low
37377003	*Nemadactylus macropterus*	Jackass Morwong	<0.001	0.2166	Below	0.3249	Below	0.4332	Below	Low
37384018	*Dotalabrus aurantiacus*	Castelnau's Wrasse	<0.001	0.3721	Below	0.5582	Below	0.7442	Below	Low
37384023	*Pseudolabrus rubicundus*	Rosy Wrasse	0.002	0.3755	Below	0.5632	Below	0.7509	Below	Low
37393008	*Enigmapercis reducta*	Broad Duckbill	0.002	0.7029	Below	1.0544	Below	1.4058	Below	Low

Table 4.11: ***(continued)***

CAAB code	Scientific name	Common name	Susceptibility	F MSM	F MSM risk	F Lim	F Lim risk	F Crash	F Crash risk	F overall risk
37400001	*Xenocephalus armatus*	Bulldog Stargazer	<0.001	0.3286	Below	0.4929	Below	0.6572	Below	Low
37400003	*Kathetostoma laeve*	Common Stargazer	0.001	0.3172	Below	0.4758	Below	0.6344	Below	Low
37400018	*Kathetostoma canaster*	Speckled Stargazer	<0.001	0.3645	Below	0.5468	Below	0.7291	Below	Low
37427001	*Foetorepus calauropomus*	Common Stinkfish	0.001	0.6826	Below	1.0238	Below	1.3651	Below	Low
37427014	*Eocallionymus papilio*	Painted Stinkfish	0.001	0.6826	Below	1.0238	Below	1.3651	Below	Low
37439001	*Thyrsites atun*	Barracouta	<0.001	0.3457	Below	0.5185	Below	0.6913	Below	Low
37445005	*Seriolella brama*	Blue Warehou	0.001	0.2959	Below	0.4439	Below	0.5919	Below	Low
37460001	*Lophonectes gallus*	Crested Flounder	0.001	0.5732	Below	0.8598	Below	1.1464	Below	Low
37460028	*Arnoglossus armstrongi*	Armstrong's Flounder	0.001	0.5732	Below	0.8598	Below	1.1464	Below	Low
37460029	*Arnoglossus bassensis*	Bass Strait Flounder	0.002	0.5732	Below	0.8598	Below	1.1464	Below	Low
37460030	*Arnoglossus muelleri*	Mueller's Flounder	0.003	0.5732	Below	0.8598	Below	1.1464	Below	Low
37460031	*Pseudorhombus tenuirastrum*	Slender Flounder	<0.001	0.491	Below	0.7366	Below	0.9821	Below	Low
37461001	*Ammotretis rostratus*	Longsnout Flounder	0.001	0.4833	Below	0.725	Below	0.9667	Below	Low
37461002	*Azygopus pinnifasciatus*	Banded-Fin Flounder	<0.001	0.4833	Below	0.725	Below	0.9667	Below	Low
37461003	*Rhombosolea tapirina*	Greenback Flounder	0.001	0.472	Below	0.708	Below	0.944	Below	Low
37461004	*Ammotretis lituratus*	Spotted Flounder	0.002	0.4833	Below	0.725	Below	0.9667	Below	Low
37461011	*Taratretis derwentensis*	Derwent Flounder	0.004	0.4833	Below	0.725	Below	0.9667	Below	Low
37461012	*Ammotretis macrolepis*	Largescale Flounder	0.001	0.4833	Below	0.725	Below	0.9667	Below	Low
37462010	*Zebrias scalaris*	Manyband Sole	<0.001	0.3761	Below	0.5642	Below	0.7523	Below	Low
37462017	*Brachirus nigra*	Black Sole	<0.001	0.3552	Below	0.5328	Below	0.7104	Below	Low
37465002	*Acanthaluteres vittiger*	Toothbrush Leatherjacket	0.004	0.4314	Below	0.6471	Below	0.8628	Below	Low
37465003	*Eubalichthys mosaicus*	Mosaic Leatherjacket	<0.001	0.4314	Below	0.6471	Below	0.8628	Below	Low
37465004	*Meuschenia hippocrepis*	Horseshoe Leatherjacket	0.006	0.4656	Below	0.6983	Below	0.9311	Below	Low

Table 4.11: ***(continued)***

CAAB code	Scientific name	Common name	Susceptibility	F MSM	F MSM risk	F Lim	F Lim risk	F Crash	F Crash risk	F overall risk
37465005	*Meuschenia scaber*	Velvet Leatherjacket	<0.001	0.4656	Below	0.6983	Below	0.9311	Below	Low
37465006	*Nelusetta ayraud*	Ocean Jacket	<0.001	0.3614	Below	0.5421	Below	0.7228	Below	Low
37465007	*Scobinichthys granulatus*	Rough Leatherjacket	0.004	0.4314	Below	0.6471	Below	0.8628	Below	Low
37465008	*Meuschenia australis*	Brownstriped Leatherjacket	0.002	0.4656	Below	0.6983	Below	0.9311	Below	Low
37465009	*Monacanthus chinensis*	Fan-Bellied Leatherjacket	<0.001	0.4314	Below	0.6471	Below	0.8628	Below	Low
37465011	*Abalistes stellatus*	Starry Triggerfish	0.067	0.7407	Below	1.111	Below	1.4813	Below	Low
37465024	*Paramonacanthus filicauda*	Threadfin Leatherjacket	0.001	0.4314	Below	0.6471	Below	0.8628	Below	Low
37465025	*Brachaluteres jacksonianus*	Southern Pygmy Leatherjacket	0.004	0.4314	Below	0.6471	Below	0.8628	Below	Low
37465034	*Eubalichthys gunnii*	Gunn's Leatherjacket	0.006	0.4314	Below	0.6471	Below	0.8628	Below	Low
37465035	*Meuschenia flavolineata*	Yellowstriped Leatherjacket	0.006	0.4656	Below	0.6983	Below	0.9311	Below	Low
37465036	*Meuschenia freycineti*	Sixspine Leatherjacket	0.001	0.4611	Below	0.6916	Below	0.9221	Below	Low
37465037	*Thamnaconus degeni*	Bluefin Leatherjacket	0.004	0.504	Below	0.7561	Below	1.0081	Below	Low
37465039	*Eubalichthys bucephalus*	Black Reef Leatherjacket	0.001	0.4314	Below	0.6471	Below	0.8628	Below	Low
37465040	*Meuschenia galii*	Bluelined Leatherjacket	0.002	0.4656	Below	0.6983	Below	0.9311	Below	Low
37465043	*Acanthaluteres spilomelanurus*	Bridled Leatherjacket	<0.001	0.4314	Below	0.6471	Below	0.8628	Below	Low
37465060	*Meuschenia venusta*	Stars-And-Stripes Leatherjacket	0.001	0.4656	Below	0.6983	Below	0.9311	Below	Low
37466001	*Aracana ornata*	Ornate Cowfish	<0.001	-	Below	-	Below	-	Below	Low
37467001	*Contusus richei*	Barred Toadfish	0.002	0.5509	Below	0.8264	Below	1.1019	Below	Low
37467002	*Omegophora armilla*	Ringed Toadfish	0.001	0.422	Below	0.633	Below	0.844	Below	Low
37467003	*Tetractenos glaber*	Smooth Toadfish	<0.001	0.422	Below	0.633	Below	0.844	Below	Low
37467004	*Sphoeroides pachygaster*	Balloonfish	<0.001	0.5413	Below	0.8119	Below	1.0825	Below	Low
37467005	*Arothron firmamentum*	Starry Toadfish	0.000	0.422	Below	0.633	Below	0.844	Below	Low

Table 4.11: ***(continued)***

CAAB code	Scientific name	Common name	Susceptibility	F MSM	F MSM risk	F Lim	F Lim risk	F Crash	F Crash risk	F overall risk
37467007	*Lagocephalus sceleratus*	Silver Toadfish	<0.001	0.3952	Below	0.5928	Below	0.7904	Below	Low
37467008	*Lagocephalus inermis*	Smooth Golden Toadfish	<0.001	0.4447	Below	0.6671	Below	0.8895	Below	Low
37467012	*Lagocephalus lunaris*	Rough Golden Toadfish	<0.001	0.4031	Below	0.6046	Below	0.8061	Below	Low
37467017	*Lagocephalus spadiceus*	Brownback Toadfish	<0.001	0.4031	Below	0.6046	Below	0.8061	Below	Low
37467023	*Lagocephalus lagocephalus*	Oceanic Puffer;Ocean Puffer	<0.001	0.4031	Below	0.6046	Below	0.8061	Below	Low
37467044	*Contusus brevicaudus*	Prickly Toadfish	<0.001	0.786	Below	1.179	Below	1.572	Below	Low
37467050	*Reicheltia halsteadi*	Halstead's Toadfish	<0.001	0.422	Below	0.633	Below	0.844	Below	Low
37467056	*Torquigener altipinnis*	Highfin Toadfish	<0.001	0.422	Below	0.633	Below	0.844	Below	Low
37468001	*Triodon macropterus*	Threetooth Puffer	<0.001	-	Below	-	Below	-	Below	Low
37469001	*Diodon nicthemerus*	Globefish	<0.001	0.4511	Below	0.6766	Below	0.9022	Below	Low
37469002	*Allomycterus pilatus*	Australian Burrfish	<0.001	0.4511	Below	0.6766	Below	0.9022	Below	Low

4.2.6 bSAFE - Protected Species

There were no protected species assessed in the bSAFE.

4.3 Habitats Component

The habitats component was not assessed at Level 2 as it was outside the project scope.

4.4 Communities Component

The communities component was not assessed at Level 2 as it was outside the project scope.

4.5 Decision Rules to Move from Level 2 to Level 3 (Step 7)

For the PSA overall risk values, units that fall in the upper third (risk value > 3.18) and middle third (2.64 < risk value < 3.18) of the PSA plots are deemed to be at high and medium risk respectively. For the SAFE method, species that fall above the SAFE-MSM or limit reference point (SAFE-LIM) are considered to be at risk of overfishing (Table 4.10). Species identified from either method need to be the focus of further work, either through implementing a management response to address the risk to the vulnerable species or by further examination for risk within the particular ecological component at Level 3. PSA-units at low risk, (i.e., in the lower third), or at SAFE where units were below the overfishing limit point (i.e., SAFE-LIM) will be deemed not at risk from the sub-fishery and the assessment is concluded for these units.

The output from the Level 2 analysis will result in four options:

- The risk of a unit of analysis within a component (e.g., single species or habitat type) is not high, the rationale is documented, and the impact of the fishing activity on this unit need not be assessed at a higher level unless management or the fishery changes.
- The risk of a unit is high but management strategies are introduced rapidly that will reduce this risk, this unit need not be assessed further unless the management or the fishery changes.
- The risk of a unit is high but there is additional information that can be used to determine if Level 3, or even a new management action is required. This information should be sought before action is taken
- The risk of a unit is high and there are no planned management interventions that would remove this risk, therefore the reasons are documented and the assessment moves to Level 3. At the conclusion of the Level 2 analysis, a fishery can decide to further investigate the risk of fishing to the species via a Level 3 assessment or implement a management response to mitigate the risk. To ensure all fisheries follow a consistent process in responding to the results of the risk assessment, AFMA has developed an ecological risk management framework. The framework makes use of the existing AFMA management structures to enable the ERAs to become a part of normal fisheries management, including the involvement of fisheries consultative committees (Figure 4.4). A separate document, the ERM report, will be developed that outlines the reasons why species are at high risk and what actions the fishery will implement to respond to the risks.

4.6 High and Medium Risk Categorisation (Step 8) Update with Residual Risk Information

4.6.1 PSA

Byproduct species

The one byproduct species was low risk following a PSA, so no residual risk analysis was conducted (Table 4.7).

Bycatch species

A residual risk analysis was performed on the 39 high risk species, resulting in 22 species reduced to medium risk mostly due to missing attributes (Table 4.8 and 4.9). Consequently, 17 species remained at high risk.

Protected species

No residual risk analysis was required, as there were no protected species assessed in the PSA.

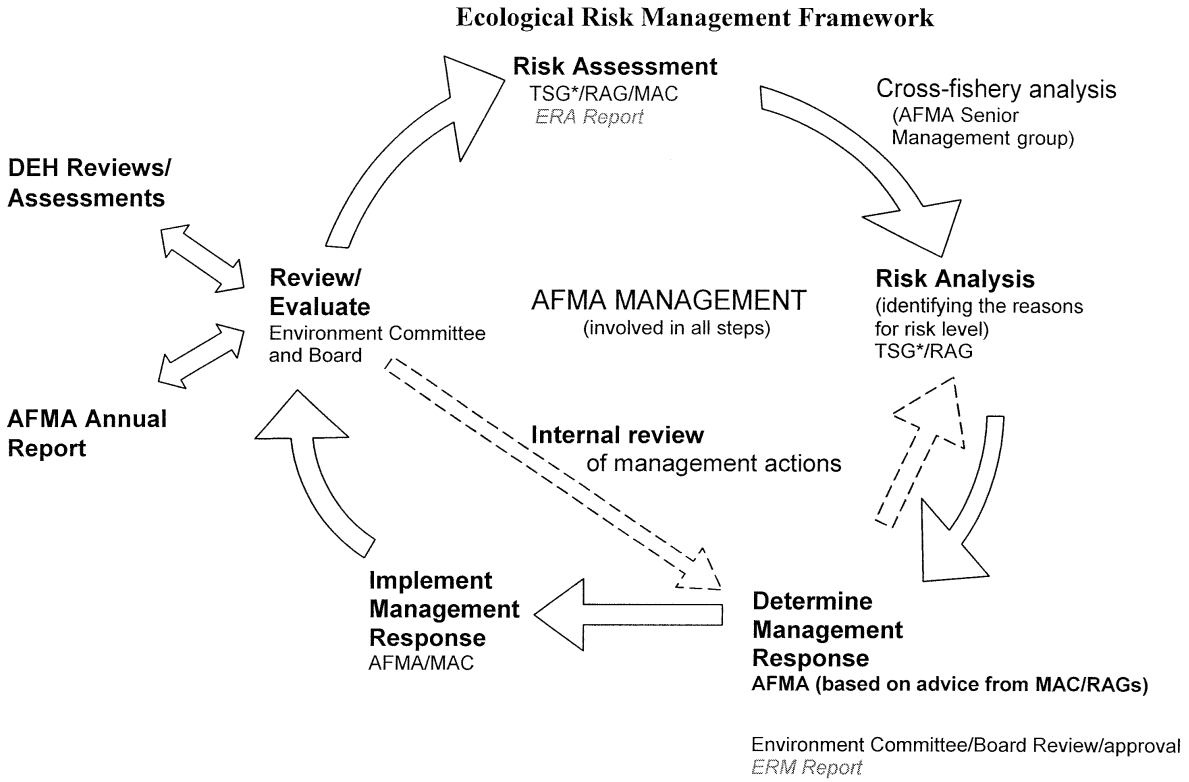


Figure 4.4: Schematic of the Ecological risk management cycle. TSG – Technical Support Group.

4.6.2 bSAFE

Byproduct species

No residual risk analysis was required, as there were no byproduct species assessed in the bSAFE analysis.

Bycatch species

All 169 bycatch species were low risk following a bSAFE analysis, so no residual risk analysis was conducted (Table 4.11).

Protected species

No residual risk analysis was required, as there were no protected species assessed in the bSAFE analysis.

5 General Discussion and Research Implications

5.1 Level 1

Most hazards (fishing activities) were eliminated at Level 1 (risk scores 1 or 2; (ref:optional-section-ref-l1-discussion)). Those remaining consist of:

- Direct impact of capture by fishing (byproduct/bycatch species, habitats and communities; moderate),
- Direct impact without capture by fishing (habitats and communities; moderate),
- Addition/movement of biological material by translocation of species (key commercial species, habitats and communities; moderate),
- Addition/movement of biological material by discarding (habitats; moderate) and
- Disturb physical processes by fishing (habitats; moderate).

As a result of capture by fishing, the most vulnerable bycatch species chosen were the Longnose skate *Dentiraja confusus*, Greenback Stingaree *Urolophus viridis* and the Pale Octopus *Octopus pallidus* were assessed at moderate risk. The two chondrichthyan species were chosen largely due to the fact they have slow reproduction rates, are endemic to south-eastern Australia, and that post capture mortality is likely to increase with tow duration and air exposure. While not listed on Australia's EPBC Act, the Longnose Skate has been listed as critically endangered and the Greenback Stingaree as vulnerable by the IUCN. The Pale Octopus *Octopus pallidus* was also chosen as vulnerable bycatch species because it is endemic to south-eastern Australia, its stock is depleting in northern Tasmania and its habitat overlaps with fishing areas.

Handfishes have been recorded at the family taxonomic level from pre-season biomass surveys (i.e., Brachionichthyidae- undifferentiated). This group has been expanded to comprise species that occur within the area of the BSCZSF, notably, the Warty Handfish *Thymichthys verrucosus*, Australian Handfish *Brachionichthys australis*, Humpback Handfish *Brachiopsilus dossenus*, Narrowbody Handfish *Pezichthys compressus*, Moulton's Handfish *Sympterichthys moultoni* and Cockatoo Handfish *Pezichthys amplispinus*. These species were chosen as most vulnerable for some hazards in the Level 1 analysis, as they are endemic to Australia, and in some cases only occur in south-eastern Australia within narrow geographical distributions. Also, most of these species appear to be data-deficient with respect to life history parameters (longevity, maturity etc.), apart from their size ranges and depth preferences.

As a result of capture by fishing by other fisheries, the most vulnerable bycatch species chosen were the Longnose skate *Dentiraja confusus*, Greenback Stingaree *Urolophus viridis* and the Pale Octopus *Octopus pallidus* which were assessed at moderate risk. The first two species are caught in the Southern and Eastern Scalefish and Shark Fishery (SESSF) by otter trawls and Danish seine and also by longlines in the Gillnet, Hook and Trap (GHAT) sector of the SESSF. As such they are susceptible to exploitation and population decline based on their typically long life spans, late age at maturity and low fecundity. Similarly, the Pale Octopus is also likely to be affected due to exploitation by several fisheries active in the Bass Strait; it is targeted by the Tasmanian Octopus Fishery (TOF), bycatch/byproduct in the GHATF, and targeted by a new, standalone commercial Octopus Fishery commenced in 2020 harvesting predominantly Pale Octopus in Eastern Victoria.

The habitats, communities ecological components were moderately impacted by other fisheries (i.e., external impacts). Hazards assessed as moderately contributing to external impacts included coastal development on key/secondary commercial species, and other extractive activities on habitats. Such activities include 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 that occurs across southern Australia.

Translocation of species was considered to be a moderate risk (3) to key commercial species (Commercial Scallop *Pecten fumatus*), due to the potential of introduced species (e.g., North Pacific Seastar *Asterias amurensis*). Both habitats and communities components were assessed at moderate risk and therefore triggered a Level 2 analysis, but was not analysed in this assessment.

There have been changes in (i) ERAEF methodology (ii) ERAEF species classification and (iii) availability of new information since the last ERA. Results of the two Level 1 BSCZSF SICA analyses (i.e., this assessment and 2007) showed that the same ecological components (except key/secondary commercial species) still have

some units at high risk. Also, the changes resulted in different species being identified as most vulnerable with the same potential risk for direct impact of capture by fishing between the 2023 and 2007 Level 1 assessments. For example, the minor risk scores for the protected species component with respect to direct impact of capture by fishing was the Spiny Pipehorse *Solegnathus spinosissimus* in 2023 compared to the Big-bellied Seahorse *Hippocampus abdominalis* in 2007. No other species were identified at high risk for protected species component from internal hazards between assessments.

5.2 Level 2

5.2.1 Species at Risk

PSA and Residual Risk

Overall, a total of 17 of the 45 species were assessed at high risk following a preliminary residual risk analysis (Table 0.4). All 17 were invertebrates of the phylum Echinodermata. These echinoderms comprised of seastars (1), basketstars (4), brittlestars (5), and sea cucumbers (7). Fifteen of these bycatch species were expanded from high group codes recorded from Commercial Scallop pre-season surveys.

Of the 17 high risk species, all had some missing biological productivity attributes, and all had missing distributional information that is used for the calculate the overall susceptibility (total missing attributes: 4 - 9). As such, these species could be potential false positives. The low productivity attributes are due to missing attribute data for most of these species. Also, the most conservative scores were used for attribute data that were missing. Efforts were made to obtain information on missing productivity and susceptibility attributes for invertebrates in the species list. Very little productivity attributes were found for most of these invertebrates, apart from minimum and maximum sizes and/or depth preferences. So, it is suggested that further efforts be made to obtain some of the missing attributes, if they are available. In addition, there appears to be a lack of available digitized invertebrate species distribution information that is used to assess susceptibility. It is therefore suggested that this information be obtained and/or the likelihood of invertebrate species occurring in the fishery area be confirmed, for each of the 17 potential high risk species and also the 28 medium risk species that were reduced from high risk following a residual risk analysis.

There have been methodological changes to the Level 2 analysis since the last ERA assessment undertaken for this fishery over 15 years ago. All species conducted at Level 2 were based on a PSA in the previous assessment. By contrast, both PSA and bSAFE Level 2 analyses have been undertaken in this assessment. The potential high risk seastar *Luidia australiae* in this assessment was also high risk in the previous assessment. Also, the potential high risk brittlestars and basketstars were all expanded species from Commercial Scallop pre-season surveys and not in the previous (2007) assessment. Six of the seven potential high risk sea cucumbers were expanded species from Commercial Scallop pre-season surveys and not in the previous assessment.

5.2.2 Residual Risk

As discussed elsewhere in this report (Section 1), the ERAEF methods are both hierarchically structured and precautionary. The Level 1 (SICA) analyses are used to identify potential hazards associated with fishing and which broad components of the ecological system they apply to. The Level 2 (PSA and SAFE) analyses consider the direct impacts of fishing on individual species and habitats (rather than whole components), but the large numbers of species that need to be assessed and the nature of the information available for most species in the L2 analyses limits these analyses in several important respects. These include that some existing management measures are not directly accounted for, and that no direct account is taken of the level of mortality associated with fishing. Both these factors are taken into account in the ERAEF framework at Level 3, but the analyses reported here stop at Level 2. This means that the risk levels for species must be regarded as identifying potential rather than actual risk, and due to the precautionary assumptions made in the PSA, in particular, there will be a tendency to overestimate absolute levels of risk from fishing.

In moving from ERA to ERM, AFMA will focus resources on the highest priority species and habitats (those likely to be most at risk from fishing). To that end, and because Level 3 analyses are not yet available for most species, AFMA (with input from CSIRO and other stakeholders) has developed guidelines to assess “residual

risk" for those species identified as being at high potential risk based on the PSA. The residual risk guidelines will be applied on a species by species basis, and include consideration of existing management measures not currently accounted for in the PSA, as well as additional information about the levels of direct mortality. These guidelines will also provide a transparent process for including more precise or missing information into the PSA as it becomes available.

5.2.3 Habitats at Risk

It was not possible to conduct a Level 2 ERA for habitats, as it is outside the project scope.

5.2.4 Community Assemblages at Risk

It was not possible to conduct a Level 2 ERA for communities, as it is outside the project scope.

5.3 Key Uncertainties/Recommendations for Research and Monitoring

If possible, it is suggested that further efforts be made to obtain the below listed information for each of the 17 potential high risk species and also the 28 medium risk species that were reduced from high risk following a residual risk analysis.

- missing productivity and/or susceptibility attributes
- available digitized invertebrate species distribution
- the likelihood of each species occurring in the fishery area

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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	Defence, shipping lanes, dumping of munitions, submarine cables.
	Other anthropogenic activities	Recreational activities, such as scuba diving leading to coral damage, power boats colliding with whales, dugongs, turtles. Shipping, oil spills.

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 5 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 5 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 5 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 5 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 5 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 5 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

2024-09-05 12:28:33.778991

C.2 Execution environment

R Version: R version 4.4.0 (2024-04-24 ucrt)

A list of versions of all the R packages used can be found in the following file: renv.lock

pandoc Version: 3.1.1

LaTeX distribution: MiKTeX-pdfTeX 4.19 (MiKTeX 24.4) © 1982 D. E. Knuth, © 1996-2023 Hàn Thế Thành TeX is a trademark of the American Mathematical Society. using bzip2 version 1.0.8, 13-Jul-2019 compiled with curl version 8.4.0; using libcurl/8.4.0 Schannel compiled with expat version 2.5; using expat_2.5.0 compiled with jpeg version 9.5 compiled with liblzma version 50040002; using 50040002 compiled with libpng version 1.6.39; using 1.6.39 compiled with libressl version LibreSSL 3.8.1; using LibreSSL 3.8.1 compiled with MiKTeX Application Framework version 4.8; using 4.8 compiled with MiKTeX Core version 4.24; using 4.24 compiled with MiKTeX Archive Extractor version 4.1; using 4.1 compiled with MiKTeX Package Manager version 4.10; using 4.10 compiled with uriparser version 0.9.7 compiled with xpdf version 4.04 compiled with zlib version 1.2.13; using 1.2.13

C.3 Version Control

C.3.1 Bitbucket

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

Branch: Scallops

Commit Number: 10fd26ba9cb292d9b348f0c218595999490eded9

C.3.2 Data Sources

Table C.1: Version control for data sources.

Item No.	Aspect	Version No./Git ID	Comments
1.	Bioregionalization information	2023	
1.1	New species distribution information added manually	08/03/2024	Date of last added species
2	Update of species attributes from FishBase	Jan. 2024	
3	Manual updates to ERAEF species attributes	08/03/2024	Date of last added species
4	Database snapshots for fishery ERAEF extracts	10/03/2024	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

Table C.1: *(continued)*

Item No.	Aspect	Version No./Git ID	Comments
6	PLSQL for generating PSA and SAFE calculations	v1.3, git commit: 3er330fdskek	
7	Effort overlaps	12/10/2023; 16/02/2024	

C.3.3 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	1.2	2024-02-09
ManualInput/Scoping/GeneralFisheryCharacteristics.xlsx	1.2	2024-02-09

C.4 Parameters

C.4.1 index.Rmd

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## [7,1]   data_to: 2021
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## [47,1] sansfont: Calibri
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## [50,1] citecolor: black
## [51,1] link-citations: yes
## [52,1] bibliography: [ERAEF.bib, Fishery.bib]
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## [61,1] author: "M. Sporcic, M. Fuller, C. Gerber, M. Roos, H. Pethybridge, C. Sutt
## [61,2] on"
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## [64,2] 2021"
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## [65,2] Sutton, C. (`r format(Sys.Date(), '%Y')`). `r rmarkdown::metadata$title`. `
## [65,3] r rmarkdown::metadata$subtitle`. Report for the Australian Fisheries Manage
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## [66,2] ment for the effects of fishing.
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C.4.2 _bookdown.yml

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##  [7] "    "                            ""
##  [9] ""                                ""
## [11] ""                                ""
## [13] ""                                ""
## [15] ""                                ""
## [17] ""                                ""
## [19] ""                                ""
## [21] ""                                ""
## [23] ""                                "rmd_files: "
## [25] "- index.Rmd"                     "- 01-frontmatters.Rmd"
## [27] "- 03-executivesummary.Rmd"       "- 04-overview.Rmd"
## [29] "- 05-scoping.Rmd"                "- 06-results-level1.Rmd"
## [31] "- 07-results-level2.Rmd"         "- 08-discussion.Rmd"
## [33] "- 09-references.Rmd"             "- 10-glossary.Rmd"
## [35] "- 11-appendix-automated.Rmd"     "- 12-appendix-manual.Rmd"
## [37] "- 13-backmatters.Rmd"
```

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