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Ecological Risk Assessment for the Effects of Fishing

Report for the Southern and Eastern Scalefish and Shark Fishery, Great Australian Bight Sector: Otter trawl sub-fishery 2012-2016

M. Sporcic, C.M. Bulman, M. Fuller

June 2021

Report for the Australian Fisheries Management Authority

CSIRO Oceans and Atmosphere

Castray Esplanade Hobart 7001

Citation

Sporcic, M., Bulman, C.M., Fuller, M. (2021). Ecological Risk Assessment for the Effects of Fishing. Report for Southern and Eastern Scalefish and Shark Fishery, Great Australian Bight Sector: Otter trawl sub-fishery 2012- 2016. Report for the Australian Fisheries Management Authority. 174 p.

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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Acknowledgments

Thanks goes to Dan Corrie (AFMA) and Giverny Rodgers (AFMA) for providing initial species lists and useful discussions pertaining to fishery operations and management used for this report. Thanks also to Eric Woehler (BirdLife Tasmania) for his discussion on marine birds that were used in the species list, and to Nick Mammides (AFMA) for his useful insights in the GAB Trawl Observer Program. Jemery Day (CSIRO) kindly provided useful discussions pertaining to stock assessments, while Jason Hartog (CSIRO) is acknowledged for his discussions on different aspects of Level 2 analyses.

Executive summary

The "Ecological Risk Assessment for Effect of Fishing" ERAEF was developed jointly by CSIRO Marine and Atmospheric Research and the Australian Fisheries Management Authority (Hobday et al. 2007, 2011b). This assessment of the ecological impacts of the Southern and Eastern Scalefish and Shark (SESSF), Great Australian Bight (GAB) Trawl Sector: Otter trawl sub-fishery (herein referred to as the GAB Otter trawl sub-fishery) was undertaken using the ERAEF method version 9.2, with some additional modifications currently in final stages of development with AFMA (Australian Fisheries Management Authority 2017). This revised ERAEF provides a hierarchical framework for a comprehensive assessment of the ecological risks arising from fishing, with impacts assessed against five new ecological components –key commercial and secondary commercial species; byproduct and bycatch species; protected species; habitats; and (ecological) communities (ERM Guide; AFMA, 2017).

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

Application of the ERAEF methods to a fishery 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 SAFE. The Level 2 methods do not provide absolute measures of risk. Instead, they combine information on productivity and exposure to fishing to assess potential risk – the term used at Level 2 is risk. Because of the precautionary approach to uncertainty, there will be more false positives than false negatives at Level 2, and the list of high-risk species or habitats should not be interpreted as all being at high risk from fishing. Level 2 is a screening process to identify species or habitats that require further investigation. Some of these may require only a little further investigation to identify them as a false positive; for some of them managers and industry may decide to implement a management response; others will require further analysis using Level 3 methods, which do assess absolute levels of risk.

This 2012-2016 assessment of the SESSF Great Australian Bight Trawl Sector: Otter trawl sub-fishery (GAB Otter trawl sub-fishery) consists of the following:

- Scoping
- Level 1 results for all components
- Level 2 results for one component (byproduct/bycatch)
- Residual risk analysis for high-risk PSA and extreme/high risk bSAFE species

Fishery Description

Gear:	Otter trawl
Area:	GAB Otter Trawl Sector of the Southern and Eastern Scalefish and Shark Fishery (Cape Jervis, SA to Cape Leeuwin, WA)
Depth range:	14-958 m (mean: 156 m; median: 140 m; 95% of shots < 235 m; 99% of shots < 600 m)
Fleet size:	3 to 7 vessels. *cf* 10 vessels in 2005
Effort:	12262-18758 hours trawled per year
Landings:	1497 - 1866 t per year
Discard rate:	0.2% (deepwater flathead in 2016); 1.3% (bight redfish in 2016)
Commercial species (ERA classification):	Deepwater flathead (*Platycephalus conatus*) and bight redfish (*Centroberyx gerrardi*)
Management:	Quota management system across species/stocks; see also Table ES1.3
Observer program:	AFMA Observer program: 1-4% per year

Ecological Units Assessed

Table ES1.1. Ecological units assessed in 2018 and 2006.

ECOLOGICAL COMPONENT	2018#	2006
Key/secondary commercial species	2	3^
Byproduct and bycatch species	37 byproduct; 122 bycatch	108 byproduct; 61 bycatch
Protected species	34	135
Habitats	7 demersal, 2 pelagic	77 demersal
Communities	6 demersal, 3 pelagic	6 demersal, 3 pelagic

* these habitats are not comparable with current assessment
# based on assessment period: 2012-2016
^ corresponds to target species

A total of 195 species across the three ecological components were assessed in this ERAEF compared to 307 species in 2006 (Table ES1.1). The difference in the number of protected species between assessments is mainly due to the inclusion of species that interacted in this sub-fishery (apart from any expansion of species groups identified from AFMA logbook, Observer data or Electronic Monitoring data). The reduction in the number of habitats between assessments is due to the change in habitat analyses as a result of the studies by Pitcher et al. 2016 as outlined in the Habitat Scoping section.

Level 1 Results and Summary

Two ecological components were eliminated at Level 1 (i.e. no components with risk scores of 3 – moderate – or above): key/commercial and protected species.

A number of hazards (fishing activities) were eliminated at Level 1 (i.e. no components with risk scores of 3 – moderate – or above). Those remaining included:

- Fishing (direct capture impacts on three components)
- Fishing (without capture impacts on one component)
- Disturbance of physical processes (on one component)

As a result of direct capture by fishing, the most vulnerable byproduct/bycatch species, latchets and a variety of chondrichthyans that are mostly discarded (AFMA logbooks) were assessed at moderate risk largely due to unknown population size within this assessment period. Also, latchets were mostly discarded within this assessment period (~375 t retained; ~809 t discarded; AFMA Logbooks).

Shy albatross was considered to be most at risk from capture although only two birds were fatally injured during the assessment period and therefore were not considered at high enough risk for further assessment. Longnosed fur seals are currently stable or increasing and were not considered at risk.

The impact of fishing represented a significant risk to habitats largely due to the relatively large footprint that the otter trawl has on the seafloor and the concentration within the assemblage in which the most vulnerable habitat types are known to exist (Pitcher et al. 2016).

Significant external hazards included other fisheries in the region on key commercial, and byproduct/bycatch species.

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

- Byproduct/bycatch

Therefore, a Level 2 examination was required for the byproduct/bycatch component.

The habitats and community's components will not be examined at Level 2 (Table ES1.2).

Table ES1.2. Outcomes of assessments for ecological components conducted in 2018 and 2006.

ECOLOGICAL COMPONENT	2018 (CURRENT)	2006 (PREVIOUS)
Key/secondary commercial species	Level 1	Level 2
Byproduct and bycatch species	Level 2	Level 2^
Protected species	Level 1	Level 2
Habitats	Level 2*	Level 2
Communities	Level 2*	Level 2*

* triggered but due to lack of methodology available in 2006 and ecosystem modelling projects underway in 2016 this component was not assessed at L2 in the ERA process. ^SAFE analysis was also performed on bycatch species 2007-2010 (Zhou et al. 2012). Risk scores for Level 2 are not directly comparable with 2018 assessment.

Table ES1.3. Key/secondary commercial species stock status, assessment and tier status, and ERA classification for SESSF GAB Otter trawl sub-fishery. NSTOF: Not subject to overfishing; NOF: Not overfished; OF: Overfished; UNC: uncertain. Primary: C1; Secondary: C2. ^: based on ABARES classification. ^^ based on stock assessment.

COMMON NAME	SPECIES NAME	ERA CLASSIFICA-TION	FISHING MOR-TALITY^	BIO-MASS^	STATUS^^	REFER-ENCE	YEAR LAST ASSESSED	TIER	COMMENTS
Deepwater flathead	*Platycephalus conatus*	C1	NSTOF	NOF	Above limit reference	Haddon 2016a	2016	1	-
Bight redfish	*Centroberyx gerrardi*	C1	NSTOF	NOF	Above limit reference	Haddon 2015b	2015	1	-

Level 2 Results and Summary

PSA

Byproduct

The only teleost assessed in the PSA was the common gurnard perch *Neosebastes scorpaenoides* because it was unassessable in bSAFE resulted in a medium risk score. Of the two invertebrate species assessed, the Gould's squid *Nototodarus gouldi* was high risk and the southern calamari *Sepioteuthis australis* was low risk. The Gould's squid remained at high risk following a residual risk analysis (Table ES1.4).

Bycatch

There were 16 species analysed comprising 11 teleosts which were unassessable in bSAFE and five invertebrate species. Of these 16 species, three were high risk, 10 were medium risk and three were low risk. The two teleosts assessed at high risk were three-spined cardinal fish *Verilus anomalus* and thetis fish *Neosebastes thetidis* which were both subsequently reduced to low risk following a residual risk analysis due to low capture within the assessment period.

Of the invertebrates, only one species was assessed at high risk: champagne crab *Hypothalassia armata*, three at medium risk: giant crab *Pseudocarcinus gigas,* southern rock lobster *Jasus edwardsii* and false bailer shell *Livonia mammilla* and one at low risk: blue swimmer crab *Portunus armatus.* The high risk champagne crab was reduced to low risk following a residual risk analysis due to low capture within the assessment period.

bSAFE

Byproduct

All 34 species were assessed at low risk.

Bycatch

There were 117 bycatch species analysed, of which 11 were unassessable. Of the 106 remaining species, one was medium and 105 were low risk.

Summary

One invertebrate, Gould's squid *Nototodarus gouldi*, remained at high risk following a residual risk analysis (Table ES1.4). It has no tiered or formal assessment in this fishery or the Southern Squid Jig (SSJ) fishery, but the SSJ assessment group consider this species to be sustainable i.e. not overfished and not subject to overfishing. Also, it is mainly managed by effort controls in the Southern Squid Jig Fishery (SSJF), and a combined trigger limit (2000 t) exists in the GAB and SESSF Otter trawl sub-fisheries. Therefore, this species should be further considered.

The finding of one species deemed to be high risk in this assessment is not directly comparable with those of Zhou et al. (2012), due to differences in (i) methodology, (ii) species assessed and (iii) species categorizations (i.e., inclusion of byproduct species). There have also been updates to underlying species distribution information used to calculate species overlaps, along with improved (higher) resolution bathymetry used to refine species ranges since the 2012 eSAFE assessment.

Table ES1.4. Extreme or high-risk PSA or bSAFE species following a residual risk (RR) analysis in the SESSF GAB Otter trawl sub-fishery. x: risk score following RR analysis. #: unassessable in bSAFE. CH: chondrichthyan; TEL: teleost; INV: invertebrate; MM: marine mammal; MB: marine bird. No. Missing: Number of missing attributes in PSA analysis. Grey shading: expanded species from group code. BC: bycatch; BP: byproduct; PS: Protected.

LEVEL 2 ANALYSIS	ERA CLASSIFICATION	TAXA	No. MISSING	SCIENTIFIC NAME	COMMON NAME	EXTREME RISK	HIGH RISK
PSA	BP	INV	1	*Nototodarus gouldi*	Gould's squid		x

1 Overview

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

1.1.1 The Hierarchical Approach

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

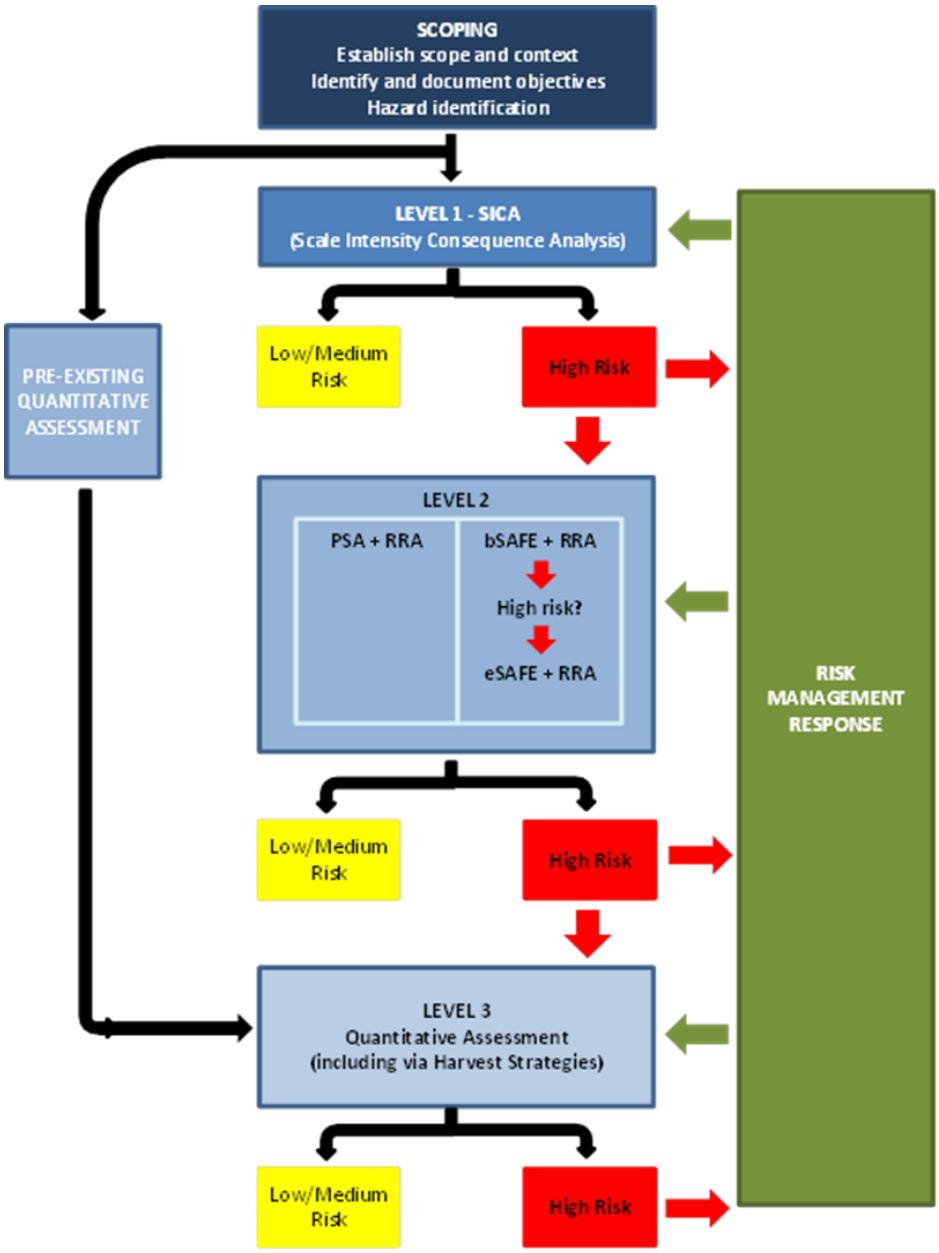


Figure 1.1. Structure of the 3 level hierarchical ERAEF methodology. SICA – Scale Intensity Consequence Analysis; PSA – Productivity Susceptibility Analysis; SAFE – Sustainability Assessment for Fishing Effects; RRA – Residual Risk Analysis. T1 – Tier 1. eSAFE may be used for species classified as high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

Conceptual Model

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

- Key commercial species and secondary commercial species
- Byproduct and bycatch species

- protected[1] species (formerly referred to as threatened, endangered and Protected[2] species or TEPs)
- Habitats
- Ecological communities

This conceptual model (Figure 1.2) progresses from *fishery characteristics* of the fishery or sub-fishery, → *fishing activities* associated with fishing and *external activities*, which may impact the five ecological components (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 achievement of management objectives.

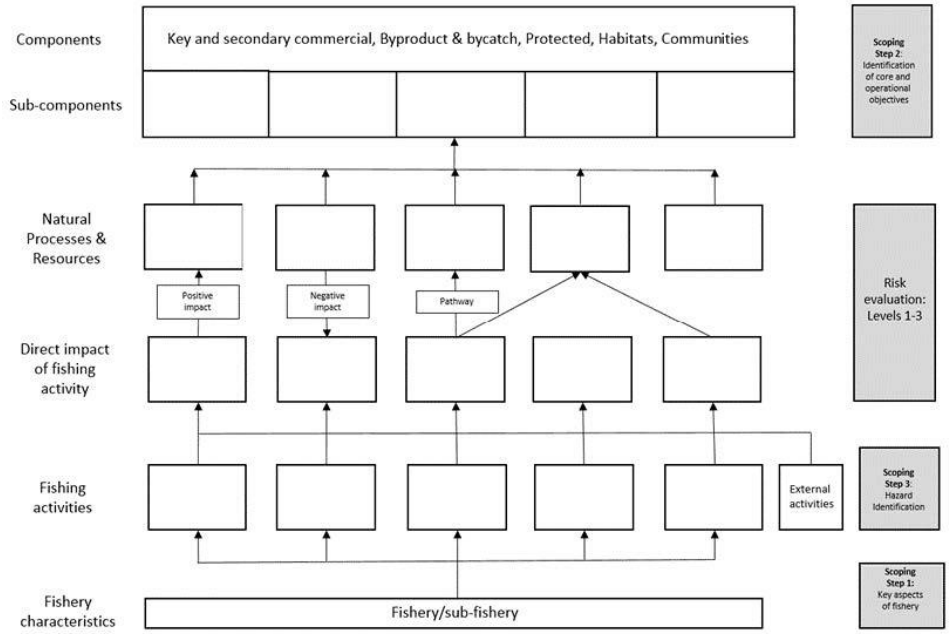


Figure 1.2. Generic conceptual model used in ERAEF.

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

The assessment of risk at each level considers 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

[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).

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

1.1.2 ERAEF stakeholder engagement process

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

1.1.3 Scoping

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

1. Identification of units of analysis (species, habitats, and communities) potentially impacted by fishery activities (Section 2.2.2; Scoping Documents S2A, S2B1, S2B2 and S2C1, S2C2).
2. Selection of objectives (Section 2.2.3; Scoping Document S3). The primary objective to be pursued for species assessed under ERAEF is that of ensuring populations are maintained at biomass levels above which recruitment failure is likely, as stated in Chapter 2 (ERM Guide; AFMA 2017). This is consistent with current legislation and fisheries policies and represents a change from when the ERAEF was first developed and there was less policy or legislation-based guidance on sustainability objectives, with stakeholders able to choose from a range of "sustainability" objectives (e.g.: tables 5A-C in Hobday et al. 2007).
3. Selection of activities (hazards) (Section 2.2.4; Scoping Document S4) that occur in the sub-fishery is made using a checklist of potential activities provided. The checklist was developed following extensive review and allows repeatability between fisheries. Additional activities raised by the stakeholders can be included in this checklist (and would feed back into the original checklist). The background information and consultation with the stakeholders is used to finalize the set of activities. Many activities will be self-evident (e.g. fishing, which obviously occurs), but for others, expert or anecdotal evidence may be required.

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

The SICA analysis evaluates the risk to ecological components resulting from the stakeholder-agreed set of activities. Evaluation of the temporal and spatial scale, intensity, sub-component, unit of analysis, and credible scenario (consequence for a sub-component) should be prepared by the draft fishery ERAEF report author and reviewed at an appropriate stakeholder meeting

(e.g. Resource Assessment Group meeting). Due to the number of activities (up to 24) in each of five components (resulting in up to 120 SICA elements), preparation before involving the full set of stakeholders may allow time and attention to be focused on the uncertain or controversial or high-risk elements. Documenting the rationale for each SICA element ahead of time for the straw-man scenarios is crucial to allow the workshop debate to focus on the right portions of the logical progression that resulted in the consequence score.

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

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

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

In the period since the first ERAEF was implemented across Commonwealth fisheries, much of the management focus has been on the assessment results associated with Level 2 and Level 2.5 or 3 risk assessment methods, which comprise semi-quantitative 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 4.8.3 of AFMA ERM Guide, AFMA (2017)), however a more quantitative method called the Sustainability Assessment for Fishing Effects (SAFE) (see Chapter 4.8.4 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.

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

- Species estimated to be at high risk under bSAFE may then be assessed under eSAFE which may provide reduced estimates of uncertainty pertaining to the actual risk.
- Where either the data or species biological characteristics are insufficient to support bSAFE analyses, it is recommended that PSA be applied instead. This will be the case for many protected species, invertebrate bycatch species and some other species.
- At Level 2, either PSA or SAFE methods should be applied to any given species, not both.
- For high-risk species it is a management choice whether to progress to eSAFE, pursue a Level 3 fully quantitative stock assessment, or to take more immediate management action to reduce the risk. The types of considerations required in making that choice (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 several additional tools, including some of the "data poor" assessment tools that are used to inform harvest strategies, could potentially be included within the Level 2 toolkit. They are distinguished from Level 3 quantitative tools (i.e. stock assessment models) that are more data rich and able to more precisely quantify uncertainty.

PSA (Productivity Susceptibility Analysis)

Details of the PSA method are described in the accompanying ERAEF Methods Document and summarised in Section 4.8.3 of the AFMA ERM Guide (AFMA (2017)). Stakeholders can provide input and suggestions on appropriate attributes, including novel ones, for evaluating risk in the specific fishery. Attribute values for many of the units (e.g. age at maturity, depth range, mean trophic level) can be obtained from published literature and other resources (e.g. scientific experts) without initial stakeholder involvement. Stakeholder input is required after preliminary attribute values are obtained. In particular, where information is missing, expert opinion can be used to derive the most "reasonable" conservative estimate. For example, if species attribute values for annual fecundity have been categorized as low, medium, or high on the set (<5, 5-500, >500), estimates for species with no data can still be made. Also, estimated fecundity of a broadcast-spawning fish species with unknown fecundity is still likely to be greater than the high fecundity category (>500). Susceptibility attribute estimates, such as "fraction alive when landed", can also be made based on input from experts such as scientific observers. Feedback to stakeholders regarding comments received during the preliminary PSA consultations is considered crucial. The final PSA is completed by scientists and results are presented to the relevant stakeholder group (e.g. RAG and/or MAC) before decisions regarding Level 3 analysis are considered. The stakeholder group may also decide on priorities for analysis at Level 3.

Residual Risk Analysis

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

high-risk rating (those likely to be most at risk from fishing activities). It could in theory be used to also determine if some species have been incorrectly classified as low risk.
Recently revised Residual risk guidelines have been developed (see below) to assist in making accurate judgments of residual risk consistently across all fisheries. At the moment, they are applied to species and not applicable to habitats or communities.
These guidelines are not seen as a definitive guide on the determination of residual risk, and it is expected they may not apply in a small number of cases. Care must also be taken when applying them to ensure residual risk results are appropriate in a practical sense. There are several conditions which underpin the residual risk guidelines and should be understood before the guidelines are applied:

- All assessments and management measures used within the residual risk assessment must be implemented prior to the assessment with sufficient data to demonstrate the effect. Any planned or proposed measures can be referred to in the assessment but cannot be used to revise the risk score.
- When applied, the guidelines generally result in changes to particular "attribute" scores for a particular species. Only after all guidelines have been applied to a particular species, should the overall risk category be re-calculated. This will ensure consistency, as well as facilitating the application of multiple guidelines.
- Unless there is clear and substantiated information to support applying an individual guideline, then the attribute and residual risk score should remain unchanged. All supporting information considered in applying these Guidelines must be clearly documented and referenced where applicable. This is consistent with the precautionary approach applied in ERAs, with residual risk remaining high unless there is evidence to the contrary ensuring a transparent process is applied.

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

SAFE (Sustainability Assessment for Fishing Effects)

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

bSAFE

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

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

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

As such it is recommended that bSAFE be used as the preferred Level 2 assessment tool for all fish species and some invertebrates and reptiles (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 and
- Post-capture mortality.

The fishing mortality is essentially the fraction of overlap between fished area and the species distribution area within the jurisdiction, adjusted by catchability and post-capture mortality.
Uncertainty around the estimated fishing mortality is estimated by including variances in encounterability, selectivity, survival rate and fishing effort between years.
The three biological reference points are based on a simple surplus production model:

- $\mathbf{F_{MSY}}$ – 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 target species MSY.
- $\mathbf{F_{LIM}}$ – instantaneous fishing mortality rate that corresponds to the limit biomass B_{LIM} where B_{LIM} is a assumed to be half of the biomass that supports a maximum sustainable fishing mortality ($0.5B_{MSM}$)
- $\mathbf{F_{CRASH}}$ – 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) are related to the variation in the estimation of the scores for each axis.
It is recommended that species assessed as being potentially at high risk under bSAFE are then progressed to analysis by eSAFE which can 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).
- 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)[4].

- The method also assumes that the mean fish density does not vary between fished area and non-fished area within their distributional range. Hence, the level of risk would be over-estimated for species found primarily in non-fished habitat, while risk would be under-estimated for species that prefer fished habitat (ERA TWG 2015).
- The SAFE methodology makes greater assumptions than Tier 1 stock assessments in coming to its F estimates (due to a lack of the data relative to that used in a Tier 1 assessment) and it is not capable of measuring risk of a stock being already overfished (so the type of risk it measures relates only to overfishing, which may then lead to future overfished state). The limitations of SAFE with respect to measuring overfished risks are the same essentially as for PSA.

eSAFE

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

1.1.6 Level 3

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

1.1.7 Conclusion and final risk assessment report

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

1.1.8 Subsequent risk assessment iterations for a fishery

The frequency at which each fishery must revise and update the risk assessment is not fully prescribed. As new information arises or management changes occur, the risks can be re-

[4] ERA Technical Working Group, September 2015

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[5] or sooner if triggered by re-assessment triggers. The five-year timeframe is based on several 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 Fisheries Management Strategy (FMS).

For byproduct and bycatch species, in the periods between scheduled five-year ERA reviews[6], AFMA will develop and monitor a set of fishery indicators and triggers, on an annual basis, 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 consider 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:

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

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

The final set of indicators and triggers will be developed for each fishery by AFMA in consultation with its fishery RAG (or for fisheries lacking a RAG, the ERA TWG), in association with the next planned re-assessment (see Table 8 in AFMA ERM Guide, AFMA (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)[7]. 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.

[7] ERA TWG recommendation, September 2015

2 Results

The focus of analysis is the fishery as identified by the responsible management authority. The assessment area is defined by the fishery management jurisdiction within the 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 SESSF GAB Otter trawl sub-fishery of the Southern and Eastern Scalefish and Shark Fishery (SESSF) Commonwealth Trawl Sector (CTS). A full description of the ERAEF method is provided in the methodology document (Hobday et al. 2007, 2011b). This fishery report contains figures and tables with numbers that correspond to this methodology document. Thus, table and figure numbers within this fishery ERAEF report are not sequential, as not all figures and tables are relevant to the fishery risk assessment results.

2.1 Stakeholder Engagement

Table 2.1. Summary Document SD1. Summary of stakeholder involvement for sub-fishery: SESSF GAB Otter trawl sub-fishery.

FISHERY ERA REPORT STAGE	TYPE OF STAKEHOLDER INTERACTION	DATE OF STAKEHOLDER INTERACTION	COMPOSITION OF STAKEHOLDER GROUP (NAMES OR ROLES)	SUMMARY OF OUTCOME
Scoping	Phone calls and emails	various	Dan Corrie (AFMA), Giverny Rodgers (AFMA)	Discussion re. species list, Scoping and management in the GABT sector
Draft report	Submitted to AFMA	June 2018	AFMA, GABRAG members	
Draft report	Presented results of Level 1, 2 and residual risk analyses	Dec 2018	AFMA, GABRAG members and invited participants	Species list and overall potential risk scores discussed
Draft final report	Submitted to AFMA	March 2019	AFMA, GABRAG members	-
Updated methodology report	Submitted to AFMA; Presentation of updated methodology results	August 2019	AFMA, SESSFRAG members	Supplement on updated methodology presented
Updated methodology report	Presentation of results at GABRAG meeting	February 2020	AFMA, GABRAG members	Updated methodology accepted
Updated methodology report	-	February 2020	AFMA, SEMAC members	Additional consultation on report
Final report	Submitted to AFMA	April 2021	Dan Corrie (AFMA)	Final report submitted
Final report	Submitted to AFMA	June 2021	Dan Corrie (AFMA)	Final report submitted

2.2 Scoping

The aim in 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.

Scoping Document S1 General Fishery Characteristics

Fishery Name: Southern and Eastern Scalefish and Shark Fishery GAB Trawl (GABT) Sector: Otter trawl sub-fishery

Assessment date: May 2018

Assessor: AFMA and authors of this report (CSIRO)

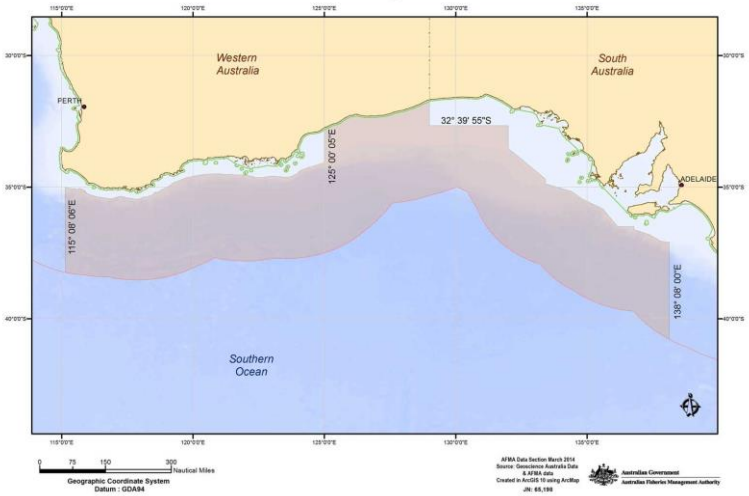
Table 2.2. General fishery characteristics

GENERAL FISHERY CHARACTERISTICS	
Fishery Name	Southern and Eastern Scalefish and Shark Fishery

Sub-fisheries	In 2003 four Commonwealth fisheries in the southern region were amalgamated into the Southern and Eastern Scalefish and Shark Fishery (SESSF) under a common set of management objectives. The component sectors of the SESSF are:
	• Commonwealth Trawl Sector (previously South East Trawl Fishery (SETF) comprised of:
	  ○ Otter trawl
	  ○ Danish seine
	• Gillnet Hook and Trap Sector
	  ○ Scalefish Hook – demersal longline
	  ○ Scalefish Hook – auto-longline
	  ○ Scalefish Hook – dropline
	  ○ Scalefish trap
	  ○ Shark gillnet
	  ○ Shark Hook – demersal longline
	• Great Australian Bight Trawl Sector
	• East Coast Deepwater Trawl Sector

Sub-fisheries assessed	This report covers the otter board trawl method in the Great Australian Bight Trawl Sector (GABTS) of the Southern and Eastern Scalefish and Shark Fishery (SESSF).
Start date/ history	Demersal trawling in the area of the GABT fishery first occurred in 1912, with the exploratory work of the government Fisheries Research Vessel Endeavour. Over the next 70 years there was some sporadic commercial

<table>
<tr><td></td><td>fishing on the continental shelf for Bight redfish and jackass morwong. These ventures were generally short-lived, hindered by inadequate vessels, poor cold-storage facilities and the distance of the fishing grounds from eastern markets.

There was renewed interest in the GABT fishery during the mid-1980s when commercial quantities of orange roughy were discovered in the adjacent South East Trawl Fishery. Since 1988 there has been continuous commercial fishing in the GABT fishery, initially targeting the deeper slope waters but there has been increasing effort targeting the shelf and upper slope waters.</td></tr>
<tr><td>Geographic extent of fishery</td><td>Great Australian Bight Trawl Sector
 

The GABTS extends from Cape Jervis in South Australia westward to Cape Leeuwin in southern Western Australia. It overlaps with gillnet and hook sectors in waters off South Australia and is adjoined by the CTS to the east.</td></tr>
<tr><td>Regions or Zones within the fishery</td><td>The fishery is divided into four management zones differentiated by longitude:
• Far West (115°08’ - 123°E)
• West (123° – 129°E)
• Central 129° - 134°E and
• Eastern 115°08’ - 123°E.</td></tr>
<tr><td>Fishing season</td><td>Fishing occurs throughout the year. The fishing season for all sectors of the SESSF is from 1 May to 30 April each year.</td></tr>
<tr><td>Key/secondary commercial species and stock status</td><td>Key and secondary species for the GAB board trawl sector are those species (or species groups) which contribute a significant proportion of the total landed catch. For this fishery they are deepwater flathead and bight redfish.

A full list of primary and secondary species and their stock status is included in Appendix A.</td></tr>
<tr><td>Bait collection and usage</td><td>Not applicable.</td></tr>
<tr><td>Current entitlements</td><td>Concession holders by fishing season and number of vessels since last assessment including current assessment period (2012-16 inclusive).

<table>
<tr><th>QUOTA YEAR</th><th>NO. OF CONCESSION HOLDERS</th><th>NO. OF GAB TRAWL BOAT SFRS*</th><th>NO. OF ACTIVE OTTER TRAWL VESSELS</th><th>NO. OF ACTIVE SEINE VESSELS</th><th>NO. OF INACTIVE CONCESSIONS</th></tr>
<tr><td>2008/09</td><td>6</td><td>10</td><td>6</td><td>0</td><td>4</td></tr>
<tr><td>2009/10</td><td>6</td><td>10</td><td>4</td><td>0</td><td>6</td></tr>
<tr><td>2010/11</td><td>7</td><td>10</td><td>4</td><td>1</td><td>5</td></tr>
<tr><td>2011/12</td><td>7</td><td>10</td><td>4</td><td>1</td><td>5</td></tr>
<tr><td>2012/13</td><td>7</td><td>10</td><td>5</td><td>1</td><td>4</td></tr>
<tr><td>2013/14</td><td>8</td><td>10</td><td>7</td><td>2</td><td>1</td></tr>
<tr><td>2014/15</td><td>7</td><td>10</td><td>5</td><td>1</td><td>4</td></tr>
<tr><td>2015/16</td><td>7</td><td>10</td><td>3</td><td>1</td><td>6</td></tr>
<tr><td>2016/17</td><td>9</td><td>10</td><td>4</td><td>1</td><td>5</td></tr>
</table>
*Can be used for demersal otter trawl, midwater trawl, pair trawling and Danish seine.</td></tr>
</table>

Current and recent TACs, quota trends by method

Quota exist for the main species and Total Allowable Catches (TACs) apply to all fishing methods in the SESSF. Research quota are included in these figures. See also **Appendix B** for additional TAC related information.

In the GABT fishery certain species are managed under statutory fishing rights (SRFs). These are:

- Bight Redfish
- Deepwater Flathead
- Orange Roughy, Albany/Esperance zone
- School Shark
- Gummy Shark
- Saw Shark
- Elephantfish

Concession holders must have uncaught quota prior to the commencement of a fishing trip. It is important to monitor catch against quota holdings at all times.

Agreed Total Allowable Catch (t) for main shark quota species in the SESSF for assessment period (2012-16 inclusive) and current. Fishing season-01 May to 30 April.

	AGREED TAC									
QUOTA SPECIES	08/09	09/10	10/11	11/12	12/13	13/14	24/15	15/16	16/17	17/18
Bight Redfish	2000	2000	1653	1556	2334	2358	2358	2358	800	800
Deepwater Flathead	1400	1400	1100	1650	1560	1150	1150	1150	1150	1128
Elephant Fish	94	94	65	89	89	109	109	163	92	114
Gummy Shark	1717.2	1717.2	1717	1717	1714	1836	1836	1836	1836	1774
Orange Roughy (Albany/ Esperance)	25	50	50	50	50	50	50	50	50	50
Saw Shark	312	312	255	226	226	339	459	482	433	442
School Shark	240	240	216	176	150	215	215	215	215	215

Source: AFMA

GABT fishery slope species development strategy

SPECIES	TRIGGER TO COLLECT BIOLOGICAL DATA	TRIGGER FOR DATA COLLECTION AND DEVELOPMENT OF ASSESSMENT PLAN	CEASE FISHING FOR THAT SPECIES	COMMENCE STOCK ASSESSMENT
Gemfish	Currently collected (if> 300kg in a shot or > 3t in any trip)	400t	500t/year	1000t/3 years
Blue Grenadier	Currently collected (if> 300kg in a shot or > 3t in any trip)	400t	500t/year cease fishing. If a spawning aggregation is found, trigger an acoustic survey (500t) and operator collects 100 whole fish.	1000t/3 years
Ling	Currently collected (if> 50kg in a shot or > 200 kg in any trip)	100t	250t	250t
Blue-eye Trevalla	Currently collected (if> 50kg in a shot or > 200 k in any trip)	100t	250t	–
Ribaldo	Currently collected (if> 50kg in a shot or > 200 k in any trip)	100t	250t	–

Hapuku	Currently collected (if> 50kg in a shot or > 200 kg in any trip)	100t	250t	–
Gulper sharks	Code of practice by industry to not target these species in addition to area closure.	–	2t	–
Deepwater sharks (Black/Brier)	Code of practice by industry to not target these species in addition to area closure	-	-	-
Chinamen Leatherjacket	Management measures on Bight Redfish and Deepwater Flathead influences catch	-	-	-
Angel Shark	Management measures on Bight Redfish and Deepwater Flathead influences catch	-	-	-
Jackass Morwong	Management measures on Bight Redfish and Deepwater Flathead influences catch	-	-	-

In addition, there incidental catch limits pertaining to state managed species. (**Appendix D**)
https://www.afma.gov.au/sites/default/files/uploads/2014/02/boat-operating-procedures-great-australian-bight-apri-2011.pdf?acsf_files_redirect

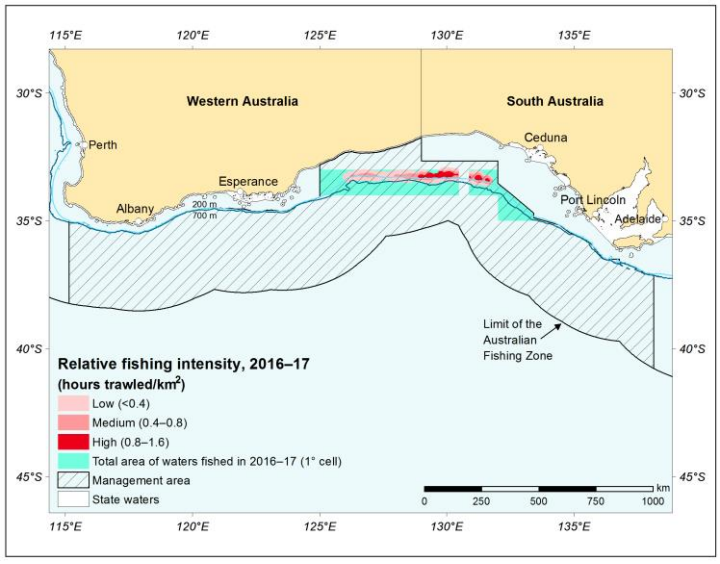
Current and recent fishery effort trends by method

Trawl effort (hours trawled and number of shots) decreased in 2007 with the structural adjustment of the SESSF which saw several vessels leave the fishery. Since then, hours trawled have shown a decreasing trend however number of shots has remained relatively stable. There has been an overall reduction of more than 50% in effort since the last assessment (27,552 h in 2005 *cf* 12,262 h in 2015).

GAB trawl effort (total hours and number of shots) since the last ERA assessment (current assessment period is 2012-16 inclusive).

YEAR	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Hours trawled	16,205	17,536	14,410	18,354	18,758	17,793	15,820	12,262	12,479	11,645
No. of shots	3,276	3,489	2,904	3,505	3,643	3,376	3,131	2,380	2,440	2,415

Source: AFMA logbook database.



Source: Patterson et al. 2017.

Current and recent fishery catch trends by method

Total catch (kg) of the main species caught by otter trawl.

COMMON NAME	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Deepwater Flathead	786,641	826,985	935,657	838,196	841,445	657,555	572,622	484,368	547,814	402,475
Bight Redfish	644,106	475,094	282,246	333,110	271,195	182,992	249,532	176,474	277,657	359,139
Other	776,340	884,383	724,827	766,749	753,315	865,481	878,970	657,285	671,409	720,657

Source: AFMA

Current and recent value of fishery ($)

The current and recent value for this sub-fishery is confidential and withheld in this report. See ABARES Fishery Status Report 2017 (Patterson et al. 2017).

Relationship with other fisheries

The following fisheries operate in the area coved by this fishery, either under Commonwealth jurisdiction or Joint jurisdiction between the Commonwealth and States:

- Southern Bluefin Tuna Fishery
- Southern Squid Jig Fishery
- Western Tuna and Billfish Fishery
- Small Pelagic Fishery
- Scalefish Hook – autolongline, demersal, dropline
- Shark Gillnet
- Shark Hook – demersal longline
- Western Skipjack Tuna fishery (not currently operating)

and the State managed:

- South Australian Pilchard Fishery
- South Australian Marine Scale Fishery
- South Australian Rock Lobster Fishery
- Western Australian South Coast Purse Seine Fishery

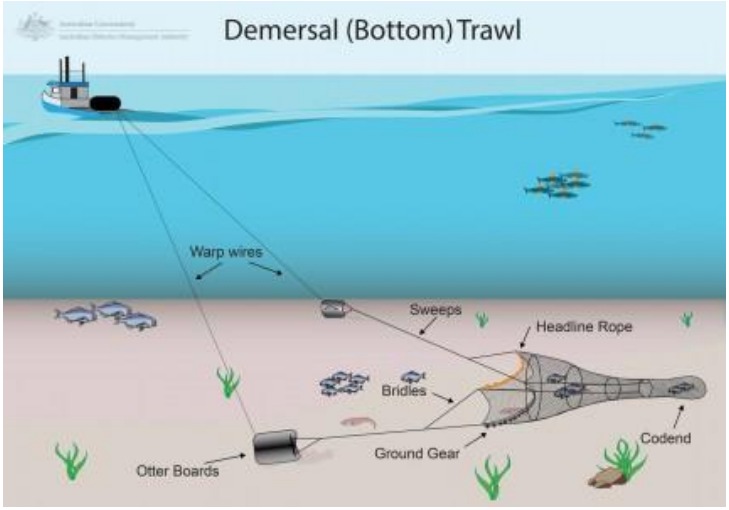
GEAR

,

Demersal trawling is the term used to describe the fishing method where a net is towed along, or just above, the ocean floor in depths of water ranging from a few metres to 1,300 m. A trawl net is attached to the vessel by two long wires, called warps which are attached to an otter board either side of the net. The net opening (mouth) is spread horizontally by the outward force acting on the otter boards as they are towed through the water. The bottom of the net opening is called the footrope and is heavier than the headline and normally in contact with the bottom. The footrope is often rigged with rubber rollers to minimise the damage to the seafloor and allow it to move across the substrate without becoming snagged. The top of the mouth (headline) is lifted vertically by a series of floats.

Otter trawling relies on the principle of herding fish inward from the otter boards and the sweep (wire from otter board to the headline and footrope) towards the mouth of the trawl net. Fish have a natural tendency to swim away from the otter boards, sweeps and net wings and fall backwards, towards the codend. The codend is the end of the net where the fish are caught. The size of the mesh in the codend is one of the most important factors in the size and shape of fish which are caught and those that escape.

A trawl shot involves the net being deployed from the stern of the vessel by way of winches. The net is then towed along the bottom, usually at around 3 knots for a period of time before being hauled up toward the vessel. The fish are contained in the codend, which is fastened with a rope to release the catch on the vessel deck.



	Source: http://www.afma.gov.au/portfolio-item/trawling/
Fishing gear restrictions	SESSF operators are only permitted to fish using the gear/methods specified on their boat statutory fishing right and/or fishing permit. Mesh requirements – Must not be less than 90 mm at any part of net. The holder must ensure that when fishing in waters shallower than 200 m, a T90 gear extension and/or codend configuration is fitted.
Selectivity of fishing methods	Generally, trawling is considered as a relatively non-selective fishing method, catching a range of species and fish of varying sizes in any one shot. The selectivity of the gear used in the GABT fishery is only governed by the stipulation of a minimum mesh size of 90 mm. The implications of this mesh selectivity for each of the sub-fisheries are summarized below. 1) Shelf demersal trawl. There is virtually no discarding of the main target species of deepwater flathead and Bight redfish from the demersal trawl fishery in the shelf waters. Because the trawlers do not operate in shallow inshore waters, the small juveniles of these species are not available to the nets. Thus, the size of these fish caught by the gear is likely to be more influenced by the spatial extent of the fishery than the mesh size. Based on the biology of the main target species, it is likely that a larger minimum mesh size would provide better selectivity for both these species. There are, however, significant levels of bycatch in the shots in shelf waters of the GABT fishery. In general, between 40-60% of the catch in these shots is discarded. While the bycatch consists of many species (detailed elsewhere), small latchet and leatherjackets make up the bulk of the discarded catch. 2) Deepwater demersal trawl. Like above, the selectivity of the gear for the orange roughy fishery is somewhat outweighed by the availability of fish to the nets. By targeting dense aggregations of fish, only one main species is caught (orange roughy) and there is virtually no bycatch or discarding.
Spatial gear zone set	Fishing with otter board demersal trawl occurs along the continental shelf, shelf break, and continental slope. Deepwater closures are in place and limited deepwater areas are open to fishing.
Depth range gear set	Otter board trawling occurs in depths ranging from approximately 40 m to depths of 1000 m.
How gear set	The net is deployed from the stern of the vessel by way of winches. The net is then towed along the bottom, usually at around 3 knots for a period of time (highly variable, 4-6 hours but may be shorter or longer dependant on location or target species) before being hauled up toward the vessel.
Area of gear impact per set or shot	This varies considerably as a function of tow duration, towing speed, and net width.
Capacity of gear	Net size is not recorded for otter board trawling. It is possible that a requirement to collect this information could be added to observer duties, however the data is not currently collected.
Effort per annum all boats	See Current and recent fishery effort trends by method.
Lost gear and ghost fishing	Whole or parts of nets are occasionally lost however no quantitative data is available. Gear retrieval depends on circumstances however ghost fishing is not considered to be a significant issue with this gear.
ISSUES	
Key/secondary commercial species issues and Interactions	Both the deepwater flathead and Bight redfish resources are currently considered to be fished at sustainable levels. The biological stock structure of both deepwater flathead and bight redfish is unknown. They are a single biological stock in the GABTS for assessment and management purposes.
Byproduct and bycatch issues and interactions	Latchet and leatherjackets are commonly caught species in the GABT fishery. Chondrichthyans such as squatinids and gummy shark, morwong, boarfish and knifejaw, western gemfish, and squid are also common byproduct species for some of which there are catch triggers for implementing data collection or management actions. Sponges are also a common component of the bycatch. The SAFE ERA assessment in 2014 for teleosts and chondrichthyans did not assess any as high risk. Cuttlefish and octopods were assessed in the previous ERA in the PSA as high risk due to lack of data. The GABT fishery FIS and ISMP addressed these issues during surveys in 2015 and 2016 but recorded few cuttlefish and no octopods. https://www.afma.gov.au/sites/default/files/uploads/2014/11/GAB-2014-16-Bycatch-and-Discarding-Workplan.pdf?acsf_files_redirect
Protected species issues and interactions	Operators are required to report all interactions with protected species in their logbooks and AFMA reports quarterly to the Department of Environment and Energy. The highest number of interactions within the reference period occurred with seabirds. Since 2017, all board trawlers were required to use one of three seabird mitigation devices which have been proven effective at reducing seabird interactions but within this fishery their effectiveness remains to be seen within the next assessment.

Recorded wildlife interactions from the AFMA Logbooks for the period 2012-2016 inclusive. A: alive; D: dead.

CAAB CODE	SCIENTIFIC NAME	COMMON NAME	2012 A	2012 D	2013 A	2013 D	2014 A	2014 D	2015 A	2015 D	2016 A	2016 D	TOTAL A	TOTAL D
40041000	Procellariidae - undifferentiated	Shearwaters	1							1			1	1
41131001	*Arctocephalus forsteri*	New Zealand Fur Seal					1		1				2	0
40040002	*Thalassarche cauta*	Shy albatross								2		1	0	3
37282000	Syngnathidae - undifferentiated	Seahorses and pipefishes										1	0	1

Source: AFMA and AFMA Wildlife Interaction Reports http://www.afma.gov.au/sustainability-environment/protected-species-management/protected-species-interaction-reports/

Habitat issues and interactions

Due to the nature of board trawling and the species targeted, there are interactions with the seabed as part of fishing. Removal, modification or disturbance of seabed flora and fauna by these methods does occur.

However, there are substantial closures in place which afford protection to large areas. Pitcher et al. (2016) showed that on average approximately 7.6 per cent of the available trawl grounds between 0-1500 m are trawled annually.

Community issues and interactions

By removing one species or size range of the population, in addition to changes to the community from which it is removed, there is a possibility that food web dynamics may change, for example increased prey populations, displacement by competing species, or predators having to find alternative food sources. Removals of particular species do drive changes to the ecosystem. For example, Klaer (2001) reported increases in the catch of some species by steam trawlers between 1918 and 1957 and decreases of other species.

Discarding

The level of discarding varies based on which area of the fishery a vessel is operating in and which species they are targeting. For example, discards are relatively low when fishing spawning aggregations because operators target large spawning aggregations and there are typically few other species.

Estimated discard rates for the key commercial species in 2016 are 0.2% (deepwater flathead) and 1.3% (bight redfish); Castillo-Jordán et al. (2018).

In contrast, fishing on the continental shelf for mixed species means operators will catch non-target species including undersized (non-marketable) target species.

MANAGEMENT: PLANNED AND THOSE IMPLEMENTED

Management objectives

The objectives of the Southern and Eastern Scalefish and Shark Fishery Management Plan 2003 (updated 4 May 2016) are as follows:

a) to implement efficient and cost-effective fisheries management of the fishery on behalf of the Commonwealth;

b) to ensure that the exploitation of the resources of 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;

c) to maximise economic efficiency in the exploitation of scalefish and shark resources within the fishery;

d) to ensure AFMA's accountability to the fishing industry and to the Australian community in the management of the resources of the fishery;

e) to reach Government targets for the recovery of the costs of AFMA in relation to the fishery;

f) to ensure, through proper conservation and management, that the living resources of the fishery are not endangered by over-exploitation;

g) to ensure the best use of the living resources of the fishery;

h) to ensure that conservation and management measures in the fishery implement Australia's obligations under international agreements that deal with fish stocks, and other relevant international agreements;

i) to ensure, as far as practicable, that measures adopted in pursuit of these objectives are not inconsistent with the preservation, conservation and protection of all whale species.

Fishery management plan

The SESSF, which includes the GAB trawl sector, is managed under the *Southern and Eastern Scalefish and Shark Fishery Management Plan 2003*. The 2017 SESSF Management Arrangements Booklet describes the current arrangements. 34 species or species groups have Total Allowable Catches (TACs) set which are allocated to fishers as quota Statutory Fishing Rights, two of which are in the GAB trawl sector.

	The management plan incorporates under a single umbrella seven sectors; • Shark Gillnet sector; • Scalefish hook sector; • Shark hook sector; • Commonwealth South East Trawl sector CTS (Danish seine and otter trawl); • Great Australian Bight Trawl sector GABTS; • Trap sector and • East Coast Deepwater Trawl sector (ECDWTS), with overlapping fishing entitlements, gear types and capture species. Managing the fisheries under a single management plan provides the opportunity to manage the combined effects of the fishery on the ecosystem, including target species, bycatch and the broader environment. Boat Operating Procedures Manual Great Australian Bight Trawl Fishery https://www.afma.gov.au/sites/default/files/uploads/2014/02/boat-operating-procedures-great-australian-bight-apri-2011.pdf?acsf_files_redirect Bycatch Action Plans contain a list of actions designed to minimise the impact of fisheries interactions with bycatch species and the marine environment. The Plans are updated every two years to ensure that they are kept current. These Plans outline some actions that have been incorporated in management arrangements. The GABT fishery Bycatch and Discard Workplan is available at https://www.afma.gov.au/sites/default/files/uploads/2014/11/GAB-2014-16-Bycatch-and-Discarding-Workplan.pdf?acsf_files_redirect A GABT fishery Seabird Management Plan has been specifically tailored for each boat in the GABT fishery outlining in responsibility of crew with regard to mitigation measures and is regulated through the fishing permit conditions, https://www.afma.gov.au/sites/default/files/uploads/2014/11/GAB-2014-16-Bycatch-and-Discarding-Workplan.pdf?acsf_files_redirect Other relevant management plans are: AFMA 2016 Southern and Eastern Scalefish and Shark Fishery Five Year Strategic Research Plan 2016-2020: https://www.afma.gov.au/sites/default/files/uploads/2017/06/SESSF-Five-Year-Strategic-Research-Plan-2016-2020.pdf?acsf_files_redirect AFMA 2017 Southern and Eastern Scalefish and Shark Fishery Management Arrangements Booklet: www.afma.gov.au/wp-content/uploads/2014/08/SESSF-Management-Arrangements-Booklet-2017.pdf GAB Bycatch and Discard Workplan: https://www.afma.gov.au/sites/default/files/uploads/2014/11/GAB-2014-16-Bycatch-and-Discarding-Workplan.pdf?acsf_files_redirect Guide to AFMA's Ecological Risk Management 2017: https://www.afma.gov.au/sites/default/files/uploads/2017/08/Final-ERM-Guide_June-2017.pdf Southern and Eastern Scalefish and Shark Fishery Management Plan 2003 (updated 4 May 2016): www.legislation.gov.au/Series/F2005B02463 Stock rebuilding strategies for conservation dependent species: a. School shark rebuilding strategy b. Upper Slope dogfish Management Strategy www.afma.gov.au/sustainability-environment/protected-species-management-strategies/
Input controls	There is a limit of 10 vessels permitted to operate in the area. A vessel must have a boat Statutory Fishing Right (SFR) allowing a vessel to trawl. This SFR will entitle a vessel to use trawl gear in a specific area of water. Other input controls include minimum mesh size in the codend (mandatory use of T-90 extension) to prevent the capture of juvenile fish and closures. Gear requirements are detailed earlier in this report. Closures are legislated under the *Southern and Eastern Scalefish and Shark Fishery and Small Pelagic Fishery (Closures) Direction 2016*, *Southern and Eastern Scalefish and Shark Fishery (Closures) Direction No. 11 2013*, *Southern and Eastern Scalefish and Shark Fishery (Closures) Direction No. 6 2013, Southern and Eastern Scalefish and Shark Fishery (Closures) Direction No. 2 2015* and under SFR conditions (**Appendix C**). Australia's South-west Commonwealth Marine Reserves Network extends offshore from the eastern end of Kangaroo Island in South Australia to Shark Bay in Western Australia - adjacent to the longest coastline in the world facing the Southern Ocean and Antarctica. The reserves cover an area of 1.3 million km^2 of both temperate and subtropical waters. The network includes 14 marine parks. Zoning and maps for each of the 14 marine parks are available from the Department of Environment and Energy website: http://www.environment.gov.au/topics/marine/marine-reserves/south-west.

Output controls	All major target and byproduct species in the CTS of the SESSF are managed under quota. Quota is issued in the form of 'quota' SFRs and an operator must hold both the appropriate boat SFR and Quota SFRs to fish for quota species. Quota SFRs are tradable among sectors. There are also trip limits in place for some byproduct species (**Appendix D**).
Technical measures	A holder must not take flathead less than 280 millimetres in length when measured from the point of the snout to the tip of the tail. Additional technical measures are discussed in other sections.
Regulations	The *Fisheries Management Regulations 1992* prescribes detail on the management arrangements implemented in Commonwealth fisheries. Specifically, they cover; bans on vessels over 130 m, administration of and standard conditions for fishing concessions including VMS operation, carrying observers, processing fish, marine environment impacts, payments and fees, registers and administration and allocation of SFRs, discarding offal at sea (not attributed to this fishery). Additional regulations were introduced regarding navigation in closures. Additional rules are contained in the Management Plan and SFR conditions. Under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act 1999), interactions with a protected species must be reported within seven days of the incident occurring to the Department of the Environment and Energy. A Memorandum of Understanding between AFMA and the Department for the Reporting of Fisheries Interactions with Protected Species streamlines those reporting requirements (2005 Reporting MOU). AFMA reports its protected species interactions to the Department of the Environment and Energy on a quarterly basis. Amendments to the International Maritime Organisation's International Convention for the Prevention of Pollution from Ships (MARPOL) Annex V which came into force on 1 January 2013 prohibit the discharge of all garbage, from all ships, into the sea (except as provided otherwise, under specific circumstances). Australian fishing vessels are subject to these regulations particularly regarding oil and garbage discharge including fishing gear applied through Commonwealth, state and territory legislation. The main Commonwealth legislation is the Protection of the Sea (Prevention of Pollution from Ships) Act 1983.Australian MARPOL regulations apply to Australian fishing vessels wherever they are operating. AMSA website; accessed 23 April 2018: https://www.amsa.gov.au/marine-environment/marine-pollution/pollution-fishing-vessels
Initiatives, strategies and incentives	The SESSF Management Arrangements Booklet 2017 documents all management requirements. Bycatch and Discarding Workplans document planned actions to minimize the risk of interactions with bycatch and protected species. Industry codes of conduct include: - Industry Code of Practice for Responsible Fishing 2006 - Industry Code of Practice for Responsible Fishing reducing seal interactions 2007 - Industry Code of Practice for minimising catches of snapper in waters adjacent to Victoria
Enabling processes	AFMA is responsible for data collection and monitoring in this fishery. Commonwealth scientific logbooks have been compulsory in the south east trawl sector since 1985, and electronic logbooks will be compulsory for all full time trawl operators as of 1 May 2018. Prior to 1997, shark and non-trawl operators completed State logbooks. This data has been collated and is used in assessments. Landings are also recorded through the quota monitoring system by catch disposal records. The collection of age-length data for scalefish was conducted by State agencies and often sporadic or duplicated prior to 1991. The Central Aging Facility (CAF) was established in 1991 to conduct age estimation for these fisheries. Fish Ageing Services now provides ageing services for the main quota species in the SESSF. The Integrated Scientific Monitoring Program (ISMP) was implemented in 1997 to replace the Scientific Monitoring Program in the South East Trawl Fishery. It provides statistically rigorous port-based and at sea monitoring in the south-east trawl, south east non-trawl and Great Australian Bight trawl sectors of this fishery. ISMP provides important information on discards, non-commercial and non-quota commercial species. Fishery independent trawl surveys (FIS) have been carried out since 2006. They were original planned as a yearly summer and winter survey. However, these are now carried during the winter of every second year in the Great Australian Bight Trawl and Commonwealth Trawl Sector. These surveys provide an independent abundance index, as well as other important biological and environmental data, some of which are used in current stock assessments. The assessment group structure comprises: • SESSF Resource Assessment Group (SESSFRAG - an assessment group for the whole SESSF) • South East Resource Assessment Group (formerly Shelf and Slope RAG) • Shark Resource Assessment Group (SharkRAG) • Great Australian Bight Assessment Group (GABRAG) SERAG, SharkRAG and GABRAG are responsible for undertaking stock assessments for a suite of key species, and for reporting on the status of those species to SESSFAG. SERAG is responsible for the assessment of scalefish species and SharkRAG is responsible for assessments of shark species taken by all sectors of the SESSF. GABRAG is responsible for assessment of a suite of species taken in the GAB trawl sector of the SESSF.

Summary of SESSF Harvest Strategy including assessments and harvest control rules

TIER LEVEL	REFERENCE POINT	REFERENCE POINT FUNCTION	INFORMATION REQUIREMENTS	CONTROL RULE
Tier 1	B_{20}	Limit	Catch, effort, discards, age, length, relative abundance, biomass information from: - Logbooks - ISMP - FIS	<B_{20}: No targeted fishing, rebuild strategy required
	B_{35}	HCR inflection	As above	<B_{35}: TACs are set at levels that allow stock to rebuild to target
	B_{48}	Target	As above	<B_{48}: Rebuild towards B_{48} > B_{48}: Fish at F_{48}
Tier 3	F_{20}	Limit	Catch, discards, age, length, information from: - Logbooks and CDRs - ISMP	<F_{20}: No targeted fishing, rebuild strategy required
	F_{40}	MSY Proxy	As above	<F_{40}: TACs are set at levels that allow stock to rebuild to target
	F_{48}	Target	As above	<F_{48}: Rebuild towards F_{48} >F_{48}: Fish at F_{48}
Tier 4	$CPUE_{20}$	Limit	Catch, effort, discards information from: - Logbooks - ISMP	<$CPUE_{20}$: No targeted fishing, rebuild strategy required
	$CPUE_{40}$	MSY Proxy	As above	<$CPUE_{40}$: TACs are set at levels that allow stock to rebuild to target
	$CPUE_{48}$	Target	As above	<$CPUE_{48}$: Rebuild towards $CPUE_{48}$ >$CPUE_{48}$: Fish at F_{48}

Other initiatives or agreements

Relevant to the GABT fishery, Offshore Constitutional Settlements (OCS) are in place between the Commonwealth and the State of South Australia. These OCS agreements define who has jurisdiction for which species stock and puts trip limits in place where necessary.

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

- Oceans Policy 1998
- National Plan of Action for the Conservation and Management of Sharks 2012 http://www.daff.gov.au/sharkplan2/.
- United Nations Convention Law of the Sea. http://www.un.org/depts/los/convention_agreements/texts/unclos/unclos_e.pdf.
- United Nations Fish Stocks Agreement. http://www.un.org/Depts/los/convention_agreements/texts/fish_stocks_agreement/CONF164_37.htmFAO Code of Conduct for Responsible Fisheries

  www.fao.org/docrep/005/v9878e/v9878e00.htm
- Declaration of the Harvest Operations of the Southern and Eastern Scalefish and shark Fishery as an approved wildlife trade operation, February 2016

  www.environment.gov.au/biodiversity/wildlife-trade/trading/commercial/operations

DATA

Logbook data

Catch and effort data and all interactions with protected species are recorded on a shot-by-shot basis in Daily Logbooks. Data has been compiled into a centralised database by AFMA and is updated annually to CSIRO.

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

Observer data

The purpose of the Observer Program is to "provide fisheries managers, research organizations, environmental agencies, the fishing industry and the wider community with independent, reliable, verified and accurate

information on the fishing catch, effort and practice of a wide range of boats operating inside, and periodically outside, the Australian Fishing Zone" (AFMA http://www.afma.gov.au/fisheries-services/observer-services/: accessed 29 June 2016).

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

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

Observer data is collated in AFMA's centralised database and data have been made available outside AFMA in the form of observer trip reports and as raw data.

Observer coverage (%) in the GAB Otter trawl sub-fishery by fishing season.

SESSF FISHING SEASON	NUMBER OF BOAT DAYS	NUMBER OF OBSERVED DAYS	PERCENTAGE OBSERVER COVERAGE
2010-11	846	16	1.89
2011-12	1032	12	1.16
2012-13	1032	29	2.81
2013-14	966	11	1.14
2014-15	896	42	4.69
2015-16	658	12	1.82
2016-17	693	21	3.03

Other data

Additional data is obtained via the Fishery Independent Surveys every second year in the GABT fishery.

The Southern and Eastern Scalefish and Shark Fishery Five Year Strategic Research Plan 2016-2020 (AFMA 2016) identifies the research priorities for the fishery over the next five years to assist with the pursuit of the management objectives for the SESSF and to enable the effective implementation and appraisal of management arrangements.

Legislative instruments and directions

Environment Protection and Biodiversity Conservation Act 1999 www.legislation.gov.au/Series/C2004A00485

Fisheries Management Act 1991

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

Fisheries Administration Act

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

Oceans Policy 1998. Commonwealth of Australia 1998, ISBN 0 642 54592 8.

Southern and Eastern Scalefish and Shark Fishery and Small Pelagic Fishery (Closures) Direction 2016

Southern and Eastern Scalefish and Shark Fishery (Closures) Direction No. 6 2013

Southern and Eastern Scalefish and Shark Fishery (Closures) Direction No. 11 2013

Southern and Eastern Scalefish and Shark Fishery (Closures) Direction No. 2 2015

Southern and Eastern Scalefish and Shark Fishery Management Plan 2003

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/bycatch 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:	2
Byproduct and bycatch species:	37 (BP); 122 (BC)
Protected species:	34
Habitats:	7 demersal, 2 pelagic
Communities:	6 demersal, 3 pelagic

Scoping Document S2A. Species

Each species identified during the scoping is added to the ERAEF database used to run the 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.marine.csiro.au/caab/

Key commercial/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.

Table 2.3. Key commercial (C1) and secondary commercial (C2) species list for the SESSF GAB Otter trawl sub-fishery. AFMA: refers to AFMA Logbook, Observer and/or Electronic Monitoring data.

ROLE IN FISHERY	TAXA NAME	FAMILY NAME	CAAB CODE	SCIENTIFIC NAME	COMMON NAME	SOURCE
C1	Teleost	Berycidae	37258004	*Centroberyx gerrardi*	Bight redfish	AFMA
C1	Teleost	Platycephalidae	37296002	*Platycephalus conatus*	Deepwater flathead	AFMA

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 2.4. Byproduct (BP) species list for the SESSF GAB Otter trawl sub-fishery. AFMA: refers to AFMA Logbook, Observer and/or Electronic Monitoring data.

ROLE IN FISHERY	TAXA NAME	FAMILY NAME	CAAB CODE	SCIENTIFIC NAME	COMMON NAME	SOURCE
BP	Chondrichthyan	Carcharhinidae	37018001	*Carcharhinus brachyurus*	Bronze whaler	AFMA
BP	Chondrichthyan	Myliobatidae	37039001	*Myliobatis tenuicaudatus*	New Zealand eagle ray; Southern eagle ray	AFMA
BP	Chondrichthyan	Orectolobidae	37013003	*Orectolobus maculatus*	Spotted wobbegong	AFMA
BP	Chondrichthyan	Pristiophoridae	37023002	*Pristiophorus cirratus*	Common sawshark	AFMA
BP	Chondrichthyan	Squatinidae	37024001	*Squatina australis*	Australian angel shark	AFMA
BP	Chondrichthyan	Squatinidae	37024002	*Squatina tergocellata*	Ornate angelshark	AFMA
BP	Chondrichthyan	Triakidae	37017001	*Mustelus antarcticus*	Gummy shark	AFMA
BP	Invertebrate	Loliginidae	23617005	*Sepioteuthis australis*	southern calamari	AFMA
BP	Invertebrate	Ommastrephidae	23636004	*Nototodarus gouldi*	Gould's squid	AFMA
BP	Teleost	Carangidae	37337062	*Pseudocaranx georgianus*	Silver trevally	AFMA
BP	Teleost	Cheilodactylidae	37377003	*Nemadactylus macropterus*	Jackass morwong	AFMA
BP	Teleost	Cheilodactylidae	37377004	*Nemadactylus valenciennesi*	Blue morwong	AFMA
BP	Teleost	Cyttidae	37264001	*Cyttus traversi*	King dory	AFMA
BP	Teleost	Gempylidae	37439002	*Rexea solandri*	Gemfish	AFMA
BP	Teleost	Labridae	37384014	*Xiphocheilus typus*	Bluetooth tuskfish	AFMA
BP	Teleost	Macruronidae	37227001	*Macruronus novaezelandiae*	Blue grenadier	AFMA
BP	Teleost	Monacanthidae	37465006	*Nelusetta ayraud*	Ocean jacket	AFMA
BP	Teleost	Moridae	37224002	*Mora moro*	Ribaldo	AFMA
BP	Teleost	Neosebastidae	37287005	*Neosebastes scorpaenoides*	Common gurnard perch	AFMA
BP	Teleost	Ophidiidae	37228001	*Dannevigia tusca*	Tusk	AFMA
BP	Teleost	Ophidiidae	37228002	*Genypterus blacodes*	Pink ling	AFMA

ROLE IN FISHERY	TAXA NAME	FAMILY NAME	CAAB CODE	SCIENTIFIC NAME	COMMON NAME	SOURCE
BP	Teleost	Oplegnathidae	37369002	*Oplegnathus woodwardi*	Knifejaw	AFMA
BP	Teleost	Pentacerotidae	37367005	*Zanclistius elevatus*	Blackspot boarfish	AFMA
BP	Teleost	Pentacerotidae	37367001	*Paristiopterus gallipavo*	Yellowspotted boarfish	AFMA
BP	Teleost	Pentacerotidae	37367004	*Pentaceros decacanthus*	Bigspine boarfish	AFMA
BP	Teleost	Polyprionidae	37311006	*Polyprion oxygeneios*	Hapuku	AFMA
BP	Teleost	Sebastidae	37287001	*Helicolenus percoides*	Reef ocean perch	AFMA
BP	Teleost	Sebastidae	37287093	*Helicolenus barathri*	Bigeye ocean perch	AFMA
BP	Teleost	Sparidae	37353001	*Chrysophrys auratus*	Snapper	AFMA
BP	Teleost	Trachichthyidae	37255009	*Hoplostethus atlanticus*	Orange roughy	AFMA
BP	Teleost	Triglidae	37288001	*Chelidonichthys kumu*	Red gurnard	AFMA
BP	Teleost	Triglidae	37288006	*Pterygotrigla polyommata*	Latchet	AFMA
BP	Teleost	Uranoscopidae	37400002	*Ichthyscopus barbatus*	Fringe stargazer	AFMA
BP	Teleost	Uranoscopidae	37400003	*Kathetostoma laeve*	Common stargazer	AFMA
BP	Teleost	Uranoscopidae	37400005	*Pleuroscopus pseudodorsalis*	Scaled stargazer	AFMA
BP	Teleost	Veliferidae	37269001	*Metavelifer multiradiatus*	Common veilfin	AFMA
BP	Teleost	Zeidae	37264004	*Zeus faber*	John dory	AFMA

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 effected) 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. Bycatch species are divided, for management purposes, into:

- *General bycatch species* (i.e. species of fish, sharks, invertebrates, etc. that are never retained for sale).

Table 2.5. Bycatch (BC) species list for the SESSF GAB Otter trawl sub-fishery. AFMA: refers to AFMA Logbook, Observer and/or Electronic Monitoring data.

ROLE IN FISHERY	TAXA NAME	FAMILY NAME	CAAB CODE	SCIENTIFIC NAME	COMMON NAME	SOURCE
BC	Chondrichthyan	Acropomatidae	37311053	*Verilus anomalus*	Three-spined cardinalfish	AFMA
BC	Chondrichthyan	Arhynchobatidae	37031001	*Irolita waitii*	Southern round skate	AFMA
BC	Chondrichthyan	Callorhinchidae	37043001	*Callorhinchus milii*	Elephantfish	AFMA
BC	Chondrichthyan	Centrophoridae	37020003	*Deania calceus*	Brier shark	AFMA
BC	Chondrichthyan	Centrophoridae	37020004	*Deania quadrispinosa*	Longsnout dogfish	AFMA
BC	Chondrichthyan	Centrophoridae	37020011	*Centrophorus zeehaani*	Southern dogfish	AFMA
BC	Chondrichthyan	Chimaeridae	37042001	*Chimaera ogilbyi*	Ogilby's ghostshark	AFMA
BC	Chondrichthyan	Dalatiidae	37020002	*Dalatias licha*	Black shark	AFMA
BC	Chondrichthyan	Dasyatidae	37035001	*Bathytoshia brevicaudata*	Short-tail stingray	AFMA
BC	Chondrichthyan	Dasyatidae	37035002	*Bathytoshia lata*	Brown stingray / Black stingray	AFMA
BC	Chondrichthyan	Etmopteridae	37020005	*Etmopterus lucifer*	Blackbelly lanternshark	AFMA
BC	Chondrichthyan	Etmopteridae	37020022	*Etmopterus unicolor*	Bristled lanternshark	AFMA
BC	Chondrichthyan	Heterodontidae	37007001	*Heterodontus portusjacksoni*	Port Jackson shark	AFMA
BC	Chondrichthyan	Hexanchidae	37005002	*Notorynchus cepedianus*	Broadnose shark	AFMA
BC	Chondrichthyan	Hexanchidae	37005001	*Heptranchias perlo*	Sharpnose sevengill shark	AFMA
BC	Chondrichthyan	Hypnidae	37028001	*Hypnos monopterygius*	Coffin ray	AFMA
BC	Chondrichthyan	Orectolobidae	37013001	*Orectolobus ornatus*	Banded wobbegong	AFMA
BC	Chondrichthyan	Parascylliidae	37013005	*Parascyllium ferrugineum*	Rusty carpetshark	AFMA
BC	Chondrichthyan	Pristiophoridae	37023001	*Pristiophorus nudipinnis*	Southern sawshark	AFMA

ROLE IN FISHERY	TAXA NAME	FAMILY NAME	CAAB CODE	SCIENTIFIC NAME	COMMON NAME	SOURCE	
BC	Chondrichthyan	Rajidae	37031003	*Dentiraja cerva*	Whitespotted skate	AFMA	
BC	Chondrichthyan	Rajidae	37031006	*Spiniraja whitleyi*	Melbourne skate	AFMA	
BC	Chondrichthyan	Rajidae	37031010	*Dipturus gudgeri*	Bight skate	AFMA	
BC	Chondrichthyan	Rajidae	37031028	*Dipturus canutus*	Grey skate	AFMA	
BC	Chondrichthyan	Rajidae	37031035	*Dipturus acrobelus*	Deepwater skate	AFMA	
BC	Chondrichthyan	BC	Chondrichthyan	Scyliorhinidae	37015020	*Apristurus australis*	Apristurus sp G
BC	Chondrichthyan	Scyliorhinidae	37015013	*Cephaloscyllium albipinnum*	Whitefin swellhark	AFMA	
BC	Chondrichthyan	Scyliorhinidae	37015024	*Asymbolus occiduus*	Western spotted catshark	AFMA	
BC	Chondrichthyan	Somniosidae	37020019	*Centroscymnus owstonii*	Owston's dogfish	AFMA	
BC	Chondrichthyan	Sphyrnidae	37019004	*Sphyrna zygaena*	Smooth hammerhead shark	AFMA	
BC	Chondrichthyan	Squalidae	37020006	*Squalus megalops*	Piked spurdog; Spikey dogfish	AFMA	
BC	Chondrichthyan	Squalidae	37020048	*Squalus cholorculus*	Greeneye spurdog	AFMA	
BC	Chondrichthyan	Torpedinidae	37028003	*Torpedo macneilli*	Short-tail torpedo ray	AFMA	
BC	Chondrichthyan	Triakidae	37017003	*Furgaleus macki*	Whiskery shark	AFMA	
BC	Chondrichthyan	Triakidae	37017008	*Galeorhinus galeus*	School shark	AFMA	
BC	Chondrichthyan	Trygonorrhinidae	37027001	*Aptychotrema vincentiana*	Western shovelnose ray	AFMA	
BC	Chondrichthyan	Trygonorrhinidae	37027006	*Trygonorrhina fasciata*	Eastern fiddler ray	AFMA	
BC	Chondrichthyan	Trygonorrhinidae	37027011	*Trygonorrhina dumerilii*	Southern fiddler ray	AFMA	
BC	Chondrichthyan	Urolophidae	37038008	*Urolophus expansus*	Wide stingaree	AFMA	
BC	Invertebrate	Hypothalassiidae	28916002	*Hypothalassia armata*	Champagne crab	AFMA	
BC	Invertebrate	Menippidae	28915002	*Pseudocarcinus gigas*	Giant crab	AFMA	
BC	Invertebrate	Palinuridae	28820001	*Jasus edwardsii*	Southern rock lobster	AFMA	
BC	Invertebrate	Portunidae	28911005	*Portunus armatus*	Blue swimmer crab	AFMA	
BC	Invertebrate	Volutidae	24207001	*Livonia mammilla*	False Bailer shell	AFMA	
BC	Teleost	Argentinidae	37097001	*Argentina australiae*	Silverside	AFMA	
BC	Teleost	Aulopidae	37117001	*Latropiscis purpurissatus*	Sergeant baker	AFMA	
BC	Teleost	Berycidae	37258002	*Beryx splendens*	Alfonsino	AFMA	
BC	Teleost	Berycidae	37258005	*Centroberyx lineatus*	Swallowtail	AFMA	
BC	Teleost	Berycidae	37258006	*Centroberyx australis*	Yelloweye redfish	AFMA	

ROLE IN FISHERY	TAXA NAME	FAMILY NAME	CAAB CODE	SCIENTIFIC NAME	COMMON NAME	SOURCE
BC	Teleost	Callanthiidae	37311055	*Callanthias australis*	Splendid perch	AFMA
BC	Teleost	Carangidae	37337002	*Trachurus declivis*	Common jack mackerel	AFMA
BC	Teleost	Carangidae	37337007	*Seriola hippos*	Samsonfish	AFMA
BC	Teleost	Carangidae	37337003	*Trachurus novaezelandiae*	Yellowtail scad	AFMA
BC	Teleost	Centrolophidae	37445001	*Hyperoglyphe antarctica*	Blue-eye trevalla	AFMA
BC	Teleost	Centrolophidae	37445005	*Seriolella brama*	Blue warehou	AFMA
BC	Teleost	Centrolophidae	37445006	*Seriolella punctata*	Silver warehou	AFMA
BC	Teleost	Chauliodontidae	37111001	*Chauliodus sloani*	Sloane's viperfish	AFMA
BC	Teleost	Clupeidae	37085002	*Sardinops sagax*	Australian sardine	AFMA
BC	Teleost	Congridae	37067002	*Gnathophis longicaudus*	Little conger	AFMA
BC	Teleost	Congridae	37067007	*Conger verreauxi*	Southern conger	AFMA
BC	Teleost	Cyttidae	37264002	*Cyttus australis*	Silver dory	AFMA
BC	Teleost	Diodontidae	37469002	*Allomycterus pilatus*	Australian burrfish	AFMA
BC	Teleost	Emmelichthyidae	37345001	*Emmelichthys nitidus*	Redbait	AFMA
BC	Teleost	Emmelichthyidae	37345002	*Plagiogeneion macrolepis*	Bigscale rubyfish	AFMA
BC	Teleost	Emmelichthyidae	37345003	*Plagiogeneion rubiginosum*	Cosmopolitan rubyfish	AFMA
BC	Teleost	Engraulidae	37086001	*Engraulis australis*	Australian anchovy	AFMA
BC	Teleost	Gempylidae	37439001	*Thyrsites atun*	Barracouta	AFMA
BC	Teleost	Gempylidae	37439003	*Ruvettus pretiosus*	Oilfish	AFMA
BC	Teleost	Gerreidae	37349001	*Parequula melbournensis*	Silverbelly	AFMA
BC	Teleost	Hoplichthyidae	37297001	*Hoplichthys haswelli*	Deepsea flathead	AFMA
BC	Teleost	Macroramphosidae	37279001	*Centriscops humerosus*	Banded bellowsfish	AFMA
BC	Teleost	Macroramphosidae	37279002	*Macroramphosus scolopax*	Common bellowsfish	AFMA
BC	Teleost	Macrouridae	37232001	*Coelorinchus australis*	Southern whiptail	AFMA
BC	Teleost	Macrouridae	37232002	*Coelorinchus fasciatus*	Banded whiptail	AFMA
BC	Teleost	Macrouridae	37232003	*Coelorinchus mirus*	Gargoyle fish	AFMA
BC	Teleost	Macrouridae	37232004	*Lepidorhynchus denticulatus*	Toothed whiptail	AFMA

ROLE IN FISHERY	TAXA NAME	FAMILY NAME	CAAB CODE	SCIENTIFIC NAME	COMMON NAME	SOURCE
BC	Teleost	Molidae	37470001	*Mola ramsayi*	Short sunfish	AFMA
BC	Teleost	Monacanthidae	37465003	*Eubalichthys mosaicus*	Mosaic leatherjacket	AFMA
BC	Teleost	Monacanthidae	37465005	*Meuschenia scaber*	Velvet leatherjacket	AFMA
BC	Teleost	Monacanthidae	37465032	*Eubalichthys quadrispinis*	Fourspine leatherjacket	AFMA
BC	Teleost	Monacanthidae	37465039	*Eubalichthys bucephalus*	Black reef leatherjacket	AFMA
BC	Teleost	Moridae	37224003	*Pseudophycis barbata*	Bearded rock cod	AFMA
BC	Teleost	Moridae	37224006	*Pseudophycis bachus*	Red cod	AFMA
BC	Teleost	Moridae	37224010	*Lepidion microcephalus*	Smallhead cod	AFMA
BC	Teleost	Mullidae	37355029	*Upeneichthys vlamingii*	Bluespotted goatfish	AFMA
BC	Teleost	Neosebastidae	37287002	*Neosebastes nigropunctatus*	Blackspotted gurnard perch	AFMA
BC	Teleost	Neosebastidae	37287003	*Neosebastes pandus*	Bighead gurnard perch	AFMA
BC	Teleost	Neosebastidae	37287004	*Neosebastes bougainvillii*	Gulf gurnard perch	AFMA
BC	Teleost	Neosebastidae	37287006	*Neosebastes thetidis*	Thetis fish	AFMA
BC	Teleost	Ophidiidae	37228008	*Genypterus tigerinus*	Rock ling	AFMA
BC	Teleost	Orectolobidae	37013020	*Orectolobus halei*	Gulf wobbegong	AFMA
BC	Teleost	Oreosomatidae	37266001	*Neocyttus rhomboidalis*	Spikey oreodory	AFMA
BC	Teleost	Oreosomatidae	37266003	*Pseudocyttus maculatus*	Smooth oreodory	AFMA
BC	Teleost	Ostraciidae	37466010	*Anoplocapros lenticularis*	Whitebarred boxfish	AFMA
BC	Teleost	Ostraciidae	37466011	*Capropygia unistriata*	Spiny boxfish	AFMA
BC	Teleost	Ostraciidae	37466014	*Caprichthys gymnura*	Rigid boxfish	AFMA
BC	Teleost	Paraulopidae	37120001	*Paraulopus nigripinnis*	Blacktip cucumberfish	AFMA
BC	Teleost	Pentacerotidae	37367003	*Pentaceropsis recurvirostris*	Longsnout boarfish	AFMA
BC	Teleost	Pinguipedidae	37390023	*Parapercis naevosa*	Western barred grubfish	AFMA
BC	Teleost	Platycephalidae	37296001	*Platycephalus richardsoni*	Tiger flathead	AFMA
BC	Teleost	Platycephalidae	37296035	*Platycephalus aurimaculatus*	Toothy flathead	AFMA
BC	Teleost	Priacanthidae	37326001	*Priacanthus macracanthus*	Spotted bigeye	AFMA

ROLE IN FISHERY	TAXA NAME	FAMILY NAME	CAAB CODE	SCIENTIFIC NAME	COMMON NAME	SOURCE
BC	Teleost	Sciaenidae	37354001	*Argyrosomus japonicus*	Mulloway	AFMA
BC	Teleost	Scombridae	37441001	*Scomber australasicus*	Blue mackerel	AFMA
BC	Teleost	Scombridae	37441005	*Thunnus alalunga*	Albacore	AFMA
BC	Teleost	Scorpididae	37361002	*Neatypus obliquus*	Footballer sweep	AFMA
BC	Teleost	Scorpididae	37361003	*Tilodon sexfasciatus*	Moonlighter	AFMA
BC	Teleost	Sebastidae	37287046	*Trachyscorpia eschmeyeri*	Deepsea ocean perch	AFMA
BC	Teleost	Sebastidae	37287103	*Trachyscorpia carnomagula*	Deepsea scorpionfish	AFMA
BC	Teleost	Serranidae	37311052	*Lepidoperca occidentalis*	Slender orange perch	AFMA
BC	Teleost	Serranidae	37311175	*Lepidoperca filamenta*	Western orange perch	AFMA
BC	Teleost	Sillaginidae	37330001	*Sillaginodes punctatus*	King George whiting	AFMA
BC	Teleost	Synaphobranchidae	37070001	*Diastobranchus capensis*	Basketwork eel	AFMA
BC	Teleost	Tetraodontidae	37467002	*Omegophora armilla*	Ringed toadfish	AFMA
BC	Teleost	Trachichthyidae	37255001	*Hoplostethus intermedius*	Blacktip sawbelly	AFMA
BC	Teleost	Trachichthyidae	37255003	*Paratrachichthys macleayi*	Sandpaper fish	AFMA
BC	Teleost	Trachichthyidae	37255004	*Gephyroberyx darwinii*	Darwin's roughy	AFMA
BC	Teleost	Trichiuridae	37440002	*Lepidopus caudatus*	Southern frostfish; frostfish	AFMA
BC	Teleost	Triglidae	37288003	*Lepidotrigla vanessa*	Butterfly gurnard	AFMA
BC	Teleost	Triglidae	37288007	*Lepidotrigla modesta*	Cocky gurnard	AFMA
BC	Teleost	Uranoscopidae	37400004	*Kathetostoma nigrofasciatum*	Deepwater stargazer	AFMA
BC	Teleost	Zeidae	37264003	*Zenopsis nebulosa*	Mirror dory	AFMA

Protected species

A protected species[2] refers to all species listed/covered under the EPBC Act 1999, which include Protected[3] species (listed threatened species i.e. vulnerable, endangered or critically endangered), cetaceans, listed migratory species and listed marine species.

Protected species that occur in the area of the sub-fishery. Protected species are often 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 sub-fishery and included in the PSA and SAFE (chondrichthyans) species list. This list was initially provided by AFMA which was further validated and reviewed using information on EPBC Act List of Threatened Fauna website; http://www.environment.gov.au/cgi-bin/sprat/public/publicthreatenedlist.pl and available literature on protected species occurrence and distribution such as Expert Panel on a Declared Commercial Fishing Activity (2014); marine birds: Menkhorst et al. (2017), Reid et al. (2002); marine mammals: Woinarski et al. (2014), Jefferson et al. (2015); teleosts: Atlas of Living Australia Fishmap http://fish.ala.org.au/, CAAB http://www.marine.csiro.au/caab/index.html, Fishes of Australia http://fishesofaustralia.net.au/). Species from higher order family categories that were considered to have potential to interact with fishery (based on geographic range and proven/perceived susceptibility to the fishing gear/methods and examples from other similar fisheries across the globe) were also included.

Table 2.6. Protected species (PS) list for the SESSF GAB Otter trawl sub-fishery. AFMA: refers to AFMA Logbook, Observer and/or Electronic Monitoring data.

ROLE IN FISHERY	TAXA	FAMILY NAME	CAAB CODE	SCIENTIFIC NAME	COMMON NAME	SOURCE(S)
PS	Teleost	Syngnathidae	37282001	*Phycodurus eques*	Leafy seadragon	AFMA - expanded from Syngnathidae
PS	Teleost	Syngnathidae	37282002	*Phyllopteryx taeniolatus*	Weedy seadragon, Common seadragon	AFMA -expanded from Syngnathidae
PS	Teleost	Syngnathidae	37282004	*Solegnathus robustus*	Robust pipehorse	AFMA
PS	Teleost	Syngnathidae	37282008	*Urocampus carinirostris*	Hairy pipefish	AFMA - expanded from Syngnathidae
PS	Teleost	Syngnathidae	37282009	*Lissocampus runa*	Javelin pipefish	AFMA - expanded from Syngnathidae
PS	Teleost	Syngnathidae	37282010	*Hippocampus bleekeri*	Pot bellied seahorse	AFMA - expanded from Syngnathidae

[2] 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.

[3] 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).

ROLE IN FISHERY	TAXA	FAMILY NAME	CAAB CODE	SCIENTIFIC NAME	COMMON NAME	SOURCE(S)
PS	Teleost	Syngnathidae	37282011	*Histiogamphelus briggsii*	Briggs' crested pipefish, Briggs' pipefish	AFMA - expanded from Syngnathidae
PS	Teleost	Syngnathidae	37282012	*Hypselognathus rostratus*	Knife-snouted pipefish	AFMA - expanded from Syngnathidae
PS	Teleost	Syngnathidae	37282013	*Leptoichthys fistularius*	Brushtail pipefish	AFMA - expanded from Syngnathidae
PS	Teleost	Syngnathidae	37282014	*Kaupus costatus*	Deep-bodied pipefish	AFMA - expanded from Syngnathidae
PS	Teleost	Syngnathidae	37282016	*Lissocampus caudalis*	Australian smooth pipefish, Smooth pipefish	AFMA - expanded from Syngnathidae
PS	Teleost	Syngnathidae	37282017	*Stigmatopora argus*	Spotted pipefish	AFMA - expanded from Syngnathidae
PS	Teleost	Syngnathidae	37282018	*Stigmatopora nigra*	Wide-bodied pipefish, Black pipefish	AFMA - expanded from Syngnathidae
PS	Teleost	Syngnathidae	37282019	*Stipecampus cristatus*	Ring-backed pipefish	AFMA - expanded from Syngnathidae
PS	Teleost	Syngnathidae	37282021	*Pugnaso curtirostris*	Pug-nosed pipefish	AFMA - expanded from Syngnathidae
PS	Teleost	Syngnathidae	37282023	*Vanacampus phillipi*	Port Phillip pipefish	AFMA - expanded from Syngnathidae
PS	Teleost	Syngnathidae	37282024	*Vanacampus poecilolaemus*	Australian Long-snout pipefish, Long-snouted pipefish	AFMA - expanded from Syngnathidae
PS	Teleost	Syngnathidae	37282026	*Hippocampus breviceps*	Short-head seahorse, Short-snouted seahorse	AFMA -expanded from Syngnathidae
PS	Teleost	Syngnathidae	37282064	*Filicampus tigris*	Tiger pipefish	AFMA - expanded from Syngnathidae
PS	Teleost	Syngnathidae	37282071	*Heraldia nocturna*	Upside-down pipefish	AFMA - expanded from Syngnathidae
PS	Teleost	Syngnathidae	37282083	*Kimblaeus bassensis*	Trawl pipefish, Kimbla pipefish	AFMA - expanded from Syngnathidae
PS	Teleost	Syngnathidae	37282085	*Maroubra perserrata*	Sawtooth pipefish	AFMA - expanded from Syngnathidae
PS	Teleost	Syngnathidae	37282095	*Notiocampus ruber*	Red pipefish	AFMA - expanded from Syngnathidae
PS	Teleost	Syngnathidae	37282100	*Syngnathoides biaculeatus*	Double-ended pipehorse, Alligator pipefish	AFMA - expanded from Syngnathidae
PS	Teleost	Syngnathidae	37282102	*Vanacampus margaritifer*	Mother-of-pearl pipefish	AFMA - expanded from Syngnathidae
PS	Teleost	Syngnathidae	37282130	*Heraldia sp. 1* [in Kuiter, 2000]	Western upsidedown pipefish	AFMA - expanded from Syngnathidae
PS	Teleost	Clinidae	37416013	*Heteroclinus perspicillatus*	Common weedfish	AFMA - expanded from Syngnathidae
PS	Marine mammal	Otariidae	41131001	*Arctocephalus forsteri*	Longnosed fur seal	AFMA
PS	Marine bird	Procellariidae	40041038	*Puffinus carneipes*	Flesh-footed shearwater	AFMA - expanded from Procellaridae; Menkhorst et al. 2017
PS	Marine bird	Procellariidae	40041040	*Puffinus gavia*	Fluttering shearwater	AFMA - expanded from Procellaridae; Menkhorst et al. 2017
PS	Marine bird	Procellariidae	40041042	*Puffinus griseus*	Sooty shearwater	AFMA - expanded from Procellaridae; Menkhorst et al. 2017
PS	Marine bird	Procellariidae	40041043	*Puffinus huttoni*	Hutton's shearwater	AFMA expanded from Procellaridae; Menkhorst et al. 2017

ROLE IN FISHERY	TAXA	FAMILY NAME	CAAB CODE	SCIENTIFIC NAME	COMMON NAME	SOURCE(S)
PS	Marine bird	Procellariidae	40041047	*Puffinus tenuirostris*	Short-tailed shearwater	AFMA - expanded from Procellaridae; Menkhorst et al. 2017
PS	Marine bird	Diomedeidae	40040002	*Thalassarche cauta*	Shy albatross	AFMA

Scoping Document S2B1. Benthic Habitats

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 (Hobday et al. 2011a; Pitcher et al. 2015, 2016; Williams et al. 2009, 2010a, b, c, 2011). This has culminated in Pitcher et al. (2016), redefining much of the Australian seafloor based on meso-scale surrogates collated from data from biological surveys, environmental data, protected area/fishery closure data. The temporal range of the fishery effort data of Pitcher et al. (2016) was from 1985 -2012 which is immediately prior to this current assessment period and was considered relevant. The new data and methodology are not directly mappable to the original analyses, but these assessments are more comprehensive than the previous ones and will therefore be used in preference to the original scoping of habitats.

Although the new assessment was conducted for the trawl fisheries, the identification of vulnerable habitats within assemblages is also relevant when assessing other fishing methods in the region. By overlaying the fishery footprint over the assemblage distribution maps of Pitcher et al. (2016), we identified those containing vulnerable habitats that might be at particular risk. For this assessment of the GAB trawl, we used the region identified from Pitcher et al. (2016) (Figure 2.1). The GAB area is protected from trawling by CMR and fishery closures reducing avaialble area by nearly 22%. The actual footprint of the fishery is less than 4% and less than 5% compiled over several years.

The most vulnerable type of habitat was identified in Williams et al. (2011) and Pitcher et al. (2016) as:

- Habitat – forming benthos (GAB assemblage 8).

This habitat was the most exposed habitat type with over 34% being swept annually and nearly 60% swept overall (Pitcher et al. 2016).

The lack of evidence to prove direct impact from trawling impedes further analysis. Furthermore, using the more recent assessments by Pitcher et al. (2016) ideally need to be incorporated into the ERAEF protocol. Consequently, the SICA is preliminary and further assessment at Level 2 is not possible at this time.

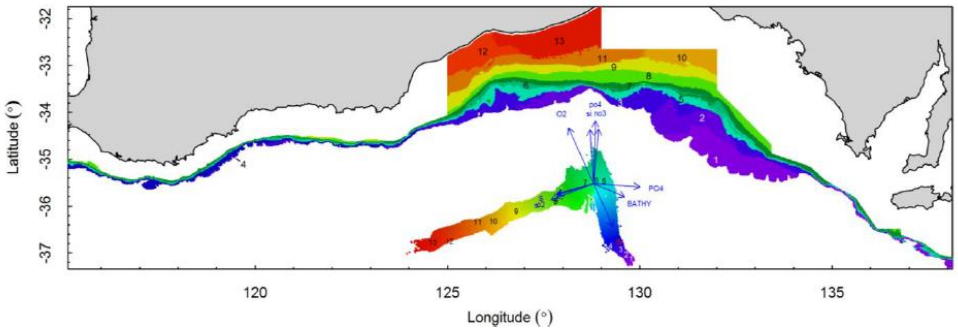


Figure 2.1. Map of the SESSF GAB region showing 13 assemblages derived by Pitcher et al. (2016). Excerpt from Pitcher et al. 2016.

The previous ERAEF assessment of the GAB trawl (Daley et al. 2007) found that "of the high-risk habitats identified during the last assessment, none were found on the inner shelf (0-100m), eight were on the outer shelf (100-200 m), five were on the upper slope (200-700 m), and eight were on the mid slope (700-1500 m)." Their high-risk habitats on the outer shelf were soft sediment seabed types characteristically dominated by large sponges and mixed epifauna, with bryozoan communities at the shelf break; and sedimentary, sub-cropping rock with communities of large sponges. These habitat types now comprise the habitat-forming benthos of assemblage eight that was rated the third highest risk by its exposure to trawling in Pitcher et al. (2016).

Upper slope habitats included types of low-relief hard bottom dominated by large sponges; soft bottom habitats characterized by octocorals and sedentary animals, and one based on bryozoan communities restricted to a narrow shelf break zone; and canyons (Daley et al. 2007). Mid slope habitats included hard and soft bottom types with large, erect, or delicate epifauna such as octocorals, and sedentary animals; and seamount habitats (Daley et al. 2007). But combined these habitats had very low exposure to trawling (~4 % in total) and considered low risk by Pitcher et al. (2016).

Table 2.7. Benthic habitats that occur within the jurisdictional boundary of the GAB Otter trawl sub-fishery. Shaded cells are those in which fishing occurs. The details of these assemblages were not available at the time of assessment.

BIOME	ASSEMBLAGE	HABITAT TYPE
GAB	1	
	2	
	3	
	4	
	5	
	6	
	7	
	8	Habitat–forming benthos
	9	
	10	
	11	
	12	
	13	

Scoping Document S2B2. Pelagic Habitats

Table 2.8. Pelagic habitats for the SESSF GAB otter trawl sub-fishery which overlay the demersal communities in which fishing occurs.

ERAEF PELAGIC HABITAT NO.	PELAGIC HABITAT TYPE	DEPTH (M)	COMMENTS	SOURCE
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

Scoping Document S2C1. Demersal Communities

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

The data used to determine the communities came from the AFMA logbook data but contained obviously erroneous records of fishing in northwest of Australia in this fishery (possibly a mis-reporting of latitude) and so were deemed to be in the Southern community in this assessment.

Table 2.9. Demersal communities in which fishing activity occurred in the GAB Otter trawl sub-fishery (x).Shaded cells indicate all communities within the province.

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

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

[1] Four inner shelf communities occur in the Timor Transition (Arafura, Groote, Cape York and Gulf of Carpentaria) and three inner shelf communities occur in the Southern (Eyre, Eucla and South West Coast). At Macquarie Is: [2]inner and outer shelves (0-250m), and [3]upper and midslope communities combined (250-1100m). At Heard/McDonald Is: [4]outer and upper slope plateau communities combined to form four communities: Shell Bank, inner and outer Heard Plateau (100-500m) and Western Banks (200-500m), [5]mid and upper plateau communities combined into 3 trough (Western, North Eastern and South Eastern), southern slope and North Eastern plateau communities (500-1000m), and [6] 3 groups at Heard Is: Deep Shell Bank (>1000m), Southern and North East Lower slope/abyssal, [7]Great Barrier Reef in the North Eastern Province and Transition and [8] Rowley Shoals in North Western Transition.

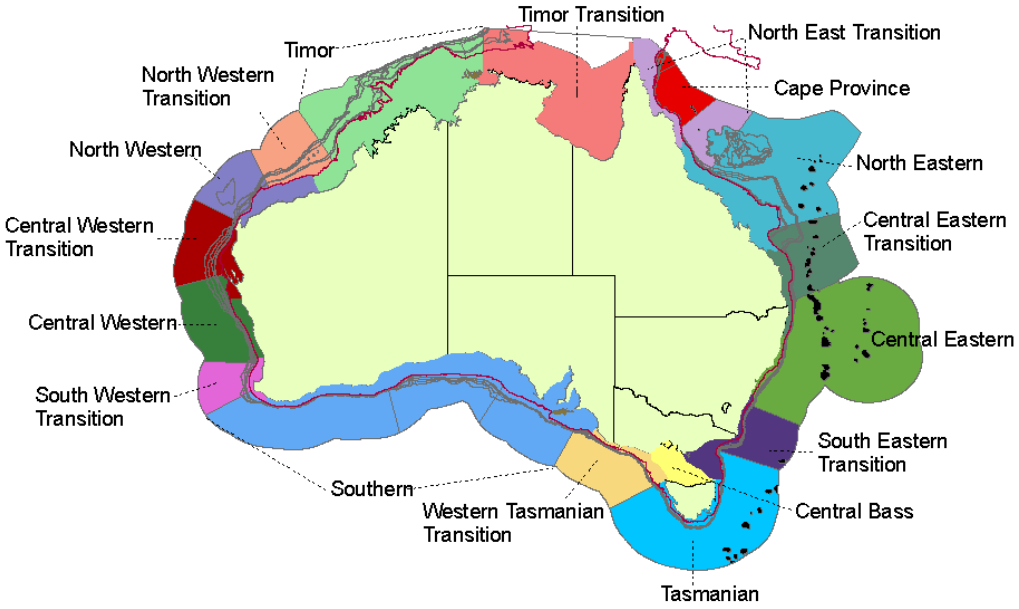
Scoping Document S2C2. Pelagic Communities

Table 2.10. Pelagic communities overlaying demersal communities in which fishing activity occurs in the SESSF GAB Otter trawl sub-fishery (x). Shaded cells indicate all communities that exist in the province.

PELAGIC COMMUNITY	NORTHEASTERN	EASTERN	SOUTHERN	WESTERN	NORTHERN	NORTHWESTERN	HEARD AND MCDONALD IS[2]	MACQUARIE IS
Coastal pelagic 0-200m[1,2]			x					
Oceanic (1) 0 – 600m			x					
Oceanic (2) >600m			x					
Seamount oceanic (1) 0 – 600m								
Seamount oceanic (2) 600–3000m								
Oceanic (1) 0 – 200m								
Oceanic (2) 200-600m								
Oceanic (3) >600m								
Seamount oceanic (1) 0 – 200m								
Seamount oceanic (2) 200 – 600m								
Seamount oceanic (3) 600–3000m								
Oceanic (1) 0-400m								
Oceanic (2) >400m								
Oceanic (1) 0-800m								
Oceanic (2) >800m								
Plateau (1) 0-600m								
Plateau (2) >600m								
Heard Plateau 0-1000m[3]								
Oceanic (1) 0-1000m								
Oceanic (2) >1000m								
Oceanic (1) 0-1600m								
Oceanic (2) >1600m								

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

(a)



(b)

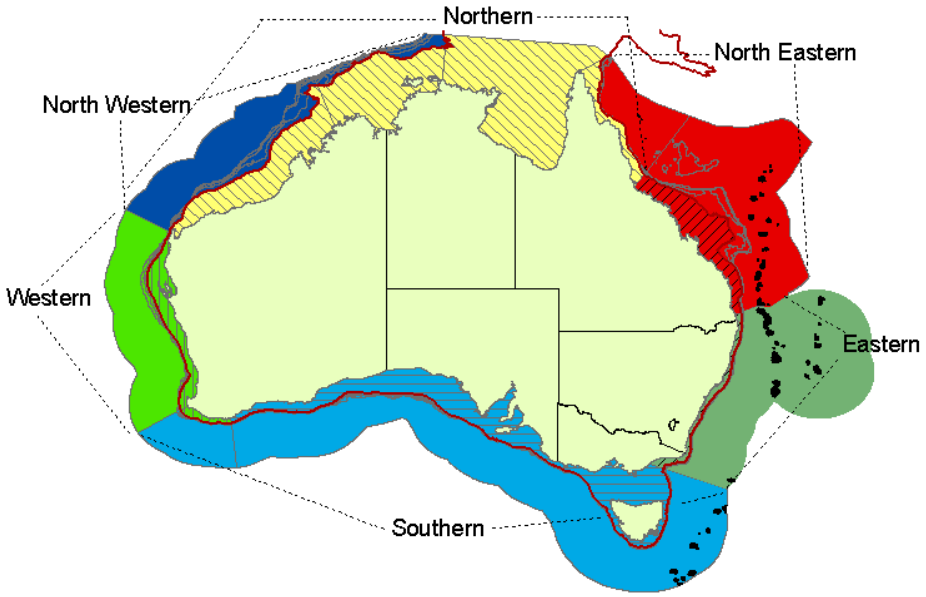


Figure 2.2 (a) Demersal communities around mainland Australia based on bioregionalisation schema. Some inshore (0-110 m) communities comprise more than one community e.g. Timor Transition comprises 4 distinct communities. (b) Australian pelagic provinces. Hatched areas indicate coastal epipelagic zones overlying the shelf. Offshore (oceanic) provinces comprise two or more overlaying pelagic zones as indicated in Table 2.10. Seamounts (black) and plateaux (light green) are illustrated in their demersal or pelagic provinces.

2.2.3 Identification of objectives for components and sub-components (Step 3)

Objectives are identified for each sub-fishery for the five ecological components (target, 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:

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

For fisheries that have completed 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; EMOs), those should be used (e.g. Strategic Assessment Reports). The objectives need not be exactly specified, regarding numbers or fractions of removal/impact but should indicate that an impact in the sub-component is of concern/interest to the sub-fishery. The rationale for including or discarding an operational objective is a crucial part of the table and must explain why the particular objective has or has not been selected for in the (sub) fishery. Only the operational objectives selected for inclusion in the (sub) fishery are used for Level 1 analysis (**Level 1 SICA Document L1.1**).

Scoping Document S3. Components and sub-components identification of objectives

Table 2.11. Components and sub-components identification of operational objectives and rationale. Operational objectives that are eliminated are shaded out. EMO: Existing Management Objective; AMO: Existing AFMA Objective.

COMPONENT	CORE OBJECTIVE	SUB-COMPONENT	EXAMPLE OPERATIONAL OBJECTIVES	EXAMPLE INDICATORS	RATIONALE
Key Commercial and secondary commercial species	Avoid recruitment failure of the key/secondary commercial species Avoid negative consequences for species or population sub-components	1. Population size	1.1 No trend in biomass 1.2 Maintain biomass above a specified level 1.3 Maintain catch at specified level 1.4 Species do not approach extinction or become extinct	Biomass, numbers, density, CPUE, yield	1.1 Increases in biomass of the key/secondary commerical species would be acceptable. 1.2. To ensure that population at acceptable level by the assessment. 1.3. TAC levels are specified. 1.4. This is a general objective for all AFMA fisheries as per Fisheries Management Act 1991 (objective (b)). In general these objectives underlie the sustainable management of the Fishery, for both target bait and target 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 the known distribution range	2.1 Not currently monitored. No specific management objective based on the geographic range of key/secondary commercial species.
		3. Genetic structure	3.1 Genetic diversity does not change outside acceptable bounds	Frequency of genotypes in the population, effective population size (N_e), number of spawning units	3.1 Genetic studies not currently monitored.
		4. Age/size/ sex structure	4.1 Age/size/ sex structure does not change outside acceptable bounds (e.g. more than X% from reference structure)	Biomass, numbers or relative proportion in age/size/sex classes Biomass of spawners Mean size, sex ratio	4.1 Covered in general by 1.2 EMO and AMO. The size range of Patagonian toothfish suggests that the fishery is not targeting recruitment or spawning grounds.
		5. Reproductive capacity	5.1 Fecundity of the population does not change outside acceptable bounds (e.g. more than X% of reference population fecundity) 2 Recruitment to the	Egg production of population Abundance of recruits	5.1 Covered by 1.2 EMO and AMO. Reproductive capacity in terms of egg production may be easier to monitor via changes in Age/size/sex structure. 5.2 Covered by 1.2 EMO and AMO. May be easier to monitor via changes in Age/size/sex structure in the fishery.

COMPONENT	CORE OBJECTIVE	SUB-COMPONENT	EXAMPLE OPERATIONAL OBJECTIVES	EXAMPLE INDICATORS	RATIONALE
			population does not change outside acceptable bounds		
		6. Behaviour /movement	6.1 Behaviour and movement patterns of the population do not change outside acceptable bounds	Presence of population across space, movement patterns within the population (e.g. attraction to bait, lights)	6.1. Changes behaviour that are deleterious to the species and populations are to be avoided. Covered by 1.2 EMO and AMO.
Byproduct and Bycatch	Avoid recruitment failure of the byproduct and bycatch species Avoid negative consequences for species or population sub-components	1. Population size	1.1 No trend in biomass 1.2 Species do not approach extinction or become extinct 1.3 Maintain biomass above a specified level 1.4 Maintain catch at specified level	Biomass, numbers, density, CPUE, yield	1.1 Increases in biomass of the byproduct/bycatch species would be acceptable. 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. TAC levels are specified. EMO/AMO - annual reviews of all information on bycatch species with the aim of developing species specific bycatch limits. Use of 'move on provisions' to limit exploitation of bycatch stocks in localised areas. 1.4. This is a general objective for all AFMA fisheries as per Fisheries Management Act 1991 (objective (b)). Maintaining bycatch/byproduct levels not a specific objective. The protection of bycatch by TACs based on precautionary principles is the preferred method. "Move on provisions" are enforced if bycatch exceeds set limits.
		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. No specific management objective based on the geographic range of bycatch/byproduct species.
		3. Genetic structure	3.1 Genetic diversity does not change outside acceptable bounds	Frequency of genotypes in the population, effective population size (N_e), number of spawning units	3.1 Not currently monitored. No reference levels established. No specific management objective based on the genetic structure of 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	4.1 EMO – move on provisions require that if bycatch in any one haul exceeds set limits then the vessel must not use that fishing method within 5 nm of that site for at least 5 days.

COMPONENT	CORE OBJECTIVE	SUB-COMPONENT	EXAMPLE OPERATIONAL OBJECTIVES	EXAMPLE INDICATORS	RATIONALE
				Mean size, sex ratio	
		5 Reproductive capacity	5.1 Fecundity of the population does not change outside acceptable bounds (e.g. more than X% of reference population fecundity) Recruitment to the population does not change outside acceptable bounds	Egg production of population Abundance of recruits	5.1 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.
		6. Behaviour /movement	6.1 Behaviour and movement patterns of the population do not change outside acceptable bounds	Presence of population across space, movement patterns within the population (e.g. attraction to bait, lights)	6.1 Trawling does not appear to attract bycatch species or alter their behaviour and movement patterns, resulting in the attraction of species to fishing grounds.
Protected species	Avoid recruitment failure of protected species Avoid negative consequences for protected species or population sub-components Avoid negative impacts on the population from fishing	1. Population size	1.1 Species do not further approach extinction or become extinct 1.2 No trend in biomass 1.3 Maintain biomass above a specified level 1.4 Maintain catch at specified level	Biomass, numbers, density, CPUE, yield	1.1 EMO - The fishery is conducted in a manner that avoids mortality of, or injuries to, endangered, threatened or protected species. 1.2 A positive trend in biomass is desirable for protected species. 1.3 Maintenance of protected species biomass above specified levels not currently a fishery operational objective. 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 (N_e), 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	Biomass, numbers or relative proportion in	4.1 Monitoring the age/size/sex structure of protected species populations is a useful management tool allowing the identification

COMPONENT	CORE OBJECTIVE	SUB-COMPONENT	EXAMPLE OPERATIONAL OBJECTIVES	EXAMPLE INDICATORS	RATIONALE
			acceptable bounds (e.g. more than X% from reference structure)	age/size/sex classes Biomass of spawners Mean size, sex ratio	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) 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 to this fishery because potential fishery induced changes in reproductive ability (e.g. reduction in prey items may critically affect seabird brooding success) may have immediate impact on the population size of protected species.
		6. Behaviour /movement	6.1 Behaviour and movement patterns of the population do not change outside acceptable bounds	Presence of population across space, movement patterns within the population (e.g. attraction to bait, lights)	6.1 Trawling operations may attract protected species and alter behaviour and movement patterns, resulting in the habituation of protected species to fishing vessels. The overall effect may be to prevent juveniles from learning to fend for themselves therefore increasing the animals' reliance on fishing vessels. Subsequently this could substantially increase the risk of injury/mortality by collision, entrapment or entanglement with a vessel or fishing gear.
		7. Interactions with fishery	7.1 Survival after interactions is maximised 7.2 Interactions do not affect the viability of the population or its ability to recover	Survival rate of species after interactions Number of interactions, biomass or numbers in population	7.1, 7.2, EMO – The fishery is conducted in a manner that avoids mortality of, or injuries to, endangered, threatened or protected species. Includes the prohibition on discarding offal (bycatch, fish processing waste, unwanted dead fish), gear restrictions and reduced lighting levels to minimise interactions and attraction of the vessel to protected species.
Habitats	Avoid negative impacts on quality of environment Avoid reduction in the amount and quality of habitat	1. Water quality	1.1 Water quality does not change outside acceptable bounds	Water chemistry, noise levels, debris levels, turbidity levels, pollutant concentrations, light pollution from artificial light	1.1 EMO 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	2.1 Not currently perceived as an important habitat sub-component, trawling operations not believed to strongly influence air quality.

COMPONENT	CORE OBJECTIVE	SUB-COMPONENT	EXAMPLE OPERATIONAL OBJECTIVES	EXAMPLE INDICATORS	RATIONALE
				from artificial light	
		3. Substrate quality	3.1 Sediment quality does not change outside acceptable bounds	Sediment chemistry, stability, particle size, debris, pollutant concentrations	3.1 EMO – The fishery is conducted, in a manner that minimises the impact of fishing operations on benthic habitat. Controls on bobbin and disc size requirements to minimise benthic impacts (EA Assessment 2002). The current MPA and conservation areas reserve large areas of the known habitat types from fishing disturbance.
		4. Habitat types	4.1 Relative abundance of habitat types does not vary outside acceptable bounds	Extent and area of habitat types, % cover, spatial pattern, landscape scale	4.1 Trawling activities may result in changes to the local habitat types on fishing grounds. The current MPA and conservation areas reserve large areas of the known habitat types from fishing disturbance.
		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 Trawling activities may result in local disruption to pelagic and benthic processes.
Communities	Avoid negative impacts on the composition/function/distribution/structure of the community	1. Species composition	1.1 Species composition of communities does not vary outside acceptable bounds	Species presence/ absence, species numbers or biomass (relative or absolute) Richness Diversity indices Evenness indices	1.1 EMO – The fishery is conducted, in a manner that minimises the impact of fishing operations on the ecosystem generally.
		2. Functional group composition	2.1 Functional group composition does not change outside acceptable bounds	Number of functional groups, species per functional group (e.g. autotrophs, filter feeders, herbivores, omnivores, carnivores)	2.1 The presence/abundance of 'functional group' members may fluctuate widely, however in terms of maintenance of ecosystem processes it is important that the aggregate effect of a functional group is maintained.
		3. Distribution of the community	3.1 Community range does not vary outside acceptable bounds	Geographic range of the community, continuity of range, patchiness	3.1 Demersal trawling operations have unknown impacts on the benthos in the fishing grounds. The current MPA and conservation areas reserve large areas of the known habitat types from fishing disturbance.
		4. Trophic/ size structure	4.1 Community size spectra/ trophic structure does not vary outside	Size spectra of the community Number of octaves, biomass/	4.1 Trawling activities for key/secondary commercial species have the potential to remove a significant component of the predator functional group. Increased abundance of the prey groups may then allow

COMPONENT	CORE OBJECTIVE	SUB-COMPONENT	EXAMPLE OPERATIONAL OBJECTIVES	EXAMPLE INDICATORS	RATIONALE
			acceptable bounds	number in each size class Mean trophic level Number of trophic levels	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 Trawling operations not perceived to have a detectable effect on bio and geochemical cycles but other activities might e.g. aquaculture.

2.2.4 Hazard Identification (Step 4)

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

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

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

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

Scoping Document S4. Hazard Identification Scoring Sheet

This table is completed once for each sub-fishery. See Table 2.13 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: Southern Eastern Shark and Scalefish Fishery (CTS Sector)

Sub-fishery name: GAB Otter trawl (GABT)

Date completed: June 2018

Table 2.12. Hazard identification, score and rationale(s) for the SESSF GABT sub-fishery.

DIRECT IMPACT OF FISHING	FISHING ACTIVITY	SCORE (0/1)	DOCUMENTATION OF RATIONALE
Capture	Bait collection	0	Not required by this fishery method.
	Fishing	1	Actual fishing, i.e. capture of species resulting from deployment and retrieval of trawl including key commercial, bycatch, byproduct and protected species caught but not landed.
	Incidental behaviour	0	Activities such as recreational fishing do not occur
Direct impact without capture	Bait collection	0	Not required for this fishery method.
	Fishing	1	Fishing is most likely to impact benthic habitats and animals as the gear contacts seafloor. Unknown mortality on fish arising from net escapement. Birds, seals and dolphins may also interact with gear at times resulting in injury or mortality.
	Incidental behaviour	0	Activities such as recreational fishing are not permitted or occur rarely.
	Gear loss	1	Major gear loss reported rarely and no information on minor components but likely to occur.
	Anchoring/ mooring	0	None occurs

DIRECT IMPACT OF FISHING	FISHING ACTIVITY	SCORE (0/1)	DOCUMENTATION OF RATIONALE
	Navigation/steaming	1	Steaming/navigation to fishing grounds may result in collisions (e.g. seabirds or whales vessel interactions), seabird collisions with night-time lights/navigation lights.
Addition/ movement of biological material	Translocation of species	0	No bait used but vessels travel throughout the fishery potentially translocation via hull, or net-cleaning but no known reports
	On board processing	0	FMP generally prohibits processing at sea unless specifically authorised and all fish must be landed whole or gilled, headed and gutted, with special conditions for sharks and rays. Offal and offcuts would be discharged when appropriate. No known reports.
	Discarding catch	1	Discarding is common.
	Stock enhancement	0	None occurs
	Provisioning	0	None occurs
	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	0	MARPOL regulations via Protection of the Sea (Prevention of Pollution from Ships) Act 1983 prohibits rubbish generated during general fishing vessel operations to be discharged at sea. Rubbish must be collected onboard and disposed of ashore.
	Chemical pollution	0	MARPOL regulations via Protection of the Sea (Prevention of Pollution from Ships) Act 1983 prohibits domestic and operational waste discharge from vessels. Leakage of substances such as fuel, oil, bilge discharges, natural decay of antifouling agents may occur in normal course of operations.
	Exhaust	1	Vessel introduces exhaust into the environment.
	Gear loss	1	MARPOL regulations via Protection of the Sea (Prevention of Pollution from Ships) Act 1983 prohibits fishing gear to be discharged at sea. Accidental gear losses of whole nets rare and usually retrieved. Little information on minor components loss.
	Navigation/ steaming	1	Navigation to and from fishing grounds introduces noise and visual stimuli into the environment. Depth sounders/ acoustic net positioning systems have potential to disturb marine species.
	Activity/ presence on water	1	Vessel introduces noise and visual stimuli into the environment.
Disturb physical processes	Bait collection	0	Bait not required by fishery.
	Fishing	1	Fishing may disturb seabed sediments and structure and trawling has a higher impact on seafloor than many other methods
	Boat launching	0	Not applicable. Vessels in fishery come from designated ports.
	Anchoring/ mooring	0	None occurs
	Navigation/ steaming	1	Navigation /steaming may affect the physical processes on the benthos and the pelagic by turbulent action of propellers or wake formation.
External Hazards (specify the particular example within each activity area)	Other capture fishery methods	1	Other fisheries operating in the GAB Trawl sector area and/or adjacent areas: SESSF - CTS otter, shark gillnet, shark hook, scalefish auto-longline; SPF, WTBF, SBT, SSJ; SA fisheries- sardine, marine scalefish, rock Lobster, recreational; WA South Coast purse seine
	Aquaculture	1	Mollusc aquaculture along the Western Eyre Peninsula and fish farming in the Spencer Gulf adjacent to the fishery jurisdiction. May change the water chemistry by adding nutrients and attract predators to the local regions.

DIRECT IMPACT OF FISHING	FISHING ACTIVITY	SCORE (0/1)	DOCUMENTATION OF RATIONALE
	Coastal development	1	Sewage discharge, agricultural runoff, pollution from ports and coastal towns could impact shelf fisheries and may affect breeding grounds and nursery areas for some of the species in the fishery
	Other extractive activities	1	Potential development oil and gas exploration and extraction drilling indeepwater, and seismic surveys for further oil and gas exploration occurs across southern Australia.
	Other non-extractive activities	1	Major coastal shipping activity from Melbourne-Adelaide and to Perth.
	Other anthropogenic activities	1	Tourist activities and charter fishing occurs in the fishery.

Table 2.13. 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.
	Anchoring/mooring	Direct impact (damage or mortality) that occurs and when anchoring or mooring. This includes damage/mortality due to physical contact of the anchor, chain or rope with organisms, e.g. An anchor damaging live coral.
	Navigation/steaming	Direct impact (damage or mortality) without capture may occur while vessels are navigating or steaming. This includes collisions with marine organisms or birds.
Addition/ movement of biological material		Any activities that result in the addition or movement of biological material to the ecosystem of the fishery.
	Translocation of species (boat movements, reballasting)	The translocation and introduction of species to the area of the fishery, through transportation of any life stage. This transport can occur through movement on boat hulls or in ballast water as boats move throughout the fishery or from outside areas into the fishery.
	On board processing	The discarding of unwanted sections of target after on board processing introduces or moves biological material, e.g. heading and gutting, retaining fins but discarding trunks.

DIRECT IMPACT OF FISHING	FISHING ACTIVITY	EXAMPLES OF ACTIVITIES INCLUDE
	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	Non-biological material may be introduced in the form of debris from fishing vessels or mother ships. This includes debris from the fishing process: e.g. cardboard thrown over from bait boxes, straps and netting bags lost. Debris from non-fishing activities can also contribute to this e.g. crew rubbish – discarding plastics or other rubbish. Discarding at sea is regulated by MARPOL, which forbids the discarding of plastics.
	Chemical pollution	Chemicals can be introduced to water, sediment and atmosphere through: oil spills, detergents other cleaning agents, any chemicals used during processing or fishing activities.
	Exhaust	Exhaust can be introduced to the atmosphere and water through operation of fishing vessels
	Gear loss	The loss of gear will result in the addition of non-biological material, this includes hooks, line, sinkers, nets, otter boards, light sticks, buoys etc.
	Navigation/steaming	The navigation and steaming of vessels will introduce noise and visual stimuli into the environment. Boat collisions and/or sinking of vessels. Echo-sounding may introduce noise that may disrupt some species (e.g. whales, orange roughy)
	Activity/presence on water	The activity or presence of fishing vessels on the water will noise and visual stimuli into the environment.
Disturb physical processes		Any activities that will disturb physical processes, particularly processes related to water movement or sediment and hard substrate (e.g. boulders, rocky reef) processes.
	Bait collection	Bait collection may disturb physical processes if the gear contacts seafloor-disturbing sediment, or if the gear disrupts water flow patterns.
	Fishing	Fishing activities may disturb physical processes if the gear contacts seafloor-disturbing sediment, or if the gear disrupts water flow patterns.
	Boat launching	Boat launching may disturb physical processes, particularly in the intertidal regions, if dredging is required, or the boats are dragged across substrate. This would also include foreshore impacts where fishers drive along beaches to reach fishing locations and launch boats. Impacts of boat launching that occurs within established marinas are outside the scope of this assessment.

DIRECT IMPACT OF FISHING	FISHING ACTIVITY	EXAMPLES OF ACTIVITIES INCLUDE
	Anchoring/mooring	Anchoring/mooring may affect the physical processes in the area that anchors and anchor chains contact the seafloor.
	Navigation/steaming	Navigation /steaming may affect the physical processes on the benthos and the pelagic by turbulent action of propellers or wake formation.
External hazards		Any outside activities that will result in an impact on the component in the same location and period that the fishery operates. The particular activity as well as the mechanism for external hazards should be specified.
	Other capture fishery methods	Take or habitat impact by other commercial, indigenous, or recreational fisheries operating in the same region as the fishery under examination.
	Aquaculture	Capture of feed species for aquaculture. Impacts of cages on the benthos in the region.
	Coastal development	Sewage discharge, ocean dumping, agricultural runoff.
	Other extractive activities	Oil and gas pipelines, drilling, seismic activity.
	Other non-extractive activities	Defense, shipping lanes, dumping of munitions, submarine cables.
	Other anthropogenic activities	Recreational activities, such as scuba diving leading to coral damage, power boats colliding with whales, dugongs, turtles. Shipping, oil spills.

2.2.5 Bibliography (Step 5)

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

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

- Management Plan and Regulation Guidelines
- Bycatch Action Plans
- Data Summary Reports (logbook and observer)

Other publications that provided information include:

- ABARES Fishery Status Reports
- Strategic Plans

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

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

In this case, 12 out of 26 possible internal activities were identified as occurring in this sub-fishery. All six external scenarios were also identified. Thus, a total of 18 activity-component scenarios will be considered at Level 1. This results in 89 (excluding the key commercial x direct impact by capture activity) total scenarios (of 160 possible) to be developed and evaluated using the unit lists (Key commercial/secondary, byproduct/bycatch, protected species, habitats, communities).

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

Level 1 aims to identify which hazards lead to a significant impact on any species, habitat, or community. Analysis at Level 1 is for whole components (key/secondary commercial; bycatch and byproduct; protected species; habitat; and communities), not individual sub-components. Since Level 1 is used mainly as a rapid screening tool, a "worst case" approach is used to ensure that elements screened out as low risk (either activities or components) are genuinely low risk. Analysis at Level 1 for each component is accomplished by considering the most vulnerable sub-component and the most vulnerable unit of analysis (e.g. most vulnerable species, habitat type or community). This is known as credible scenario evaluation (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. Scale, intensity, and consequence analysis (SICA) consists of thirteen steps. The first ten steps are performed for each activity and component and correspond to the columns of the SICA table. The final three steps summarise the results for each component.

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

Step 2. Score spatial scale of the activity

Step 3. Score temporal scale of the activity

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

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

Step 6. Select the most appropriate operational objective

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

Step 8. Score the consequence resulting from the intensity for that 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

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, habitat and communities). Only those activities that scored a 1 (presence) will be analysed at Level 1.

2.3.2 Score spatial scale of activity (Step 2)

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

Table 2.14. Spatial scale score of activity.

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

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

2.3.3 Score temporal scale of activity (Step 3)

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

Table 2.15. Temporal scale score of activity.

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

It may be more logical for some activities to consider the aggregate number of days that an activity occurs. For example, if the activity “fishing” was undertaken by 10 boats during the

same 150 days of the year, the score is 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 that a score of 3 is appropriate.

The temporal scale score at Step 3 is not used directly, but the analysis is used in making judgments about level of intensity at Step 7. Obviously, two activities can score the same with regard to temporal scale, but the intensity of each can differ vastly. The reasons for the score are recorded in the rationale column.

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

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

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

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

2.3.6 Select the most appropriate operational objective (Step 6)

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

2.3.7 Score the intensity of the activity for the component (Step 7)

The score for 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 below.

Table 2.16. Intensity score of activity (Modified from Fletcher et al. 2002).

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

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

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

The consequence of the activity is a measure of the likelihood of not achieving the operational objective for the selected sub-component and unit of analysis. It considers the flow on effects of the direct impacts from Step 7 for the relevant indicator (e.g. decline in biomass below the selected threshold due to direct capture). Activities are scored as per consequence scores defined below. 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 (Table 2.17).

Table 2.17. Consequence score for ERAEF activities (Modified from Fletcher et al. 2002).

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

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

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

The information used at this level is qualitative and each step is based on expert (fishers, managers, conservationists, scientists) judgment. The confidence rating for the consequence score is rated as 1 (low confidence) or 2 (high confidence) for the activity/component. The score is recorded on the SICA Document and the rationale documented. The confidence will reflect the levels of uncertainty for each score at steps 2, 3, 7 and 8 (see description; Table 2.18).

Table 2.18. 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

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

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

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 Table above)

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

DIRECT IMPACT OF FISHING	FISHING ACTIVITY	PRESENCE (1) ABSENCE (0)	SPATIAL SCALE OF HAZARD (1-6)	TEMPORAL SCALE OF HAZARD (1-6)	SUB-COMPONENT	UNIT OF ANALYSIS	OPERATIONAL OBJECTIVE (S2.1)	INTENSITY SCORE (1-6)	CONSEQUENCE SCORE (1-6)	CONFIDENCE SCORE (1-2)	RATIONALE
Capture	Bait collection	0									
	Fishing	1	4	6	Population size						There are no key or secondary commercial species that are not assessed. No further action required for this activity.
	Incidental behaviour	0									
Direct impact without capture	Bait collection	0									
	Fishing	1	4	6	Population size	Deepwater flathead	1.2	3	1	1	Population size is likely to be affected before the other sub-components. This species comprises the largest catch component within this assessment period mostly in the Central Zone over the outer shelf (110-250 m). Intensity: moderate as small fish may be injured as they pass through the nets across a broad spatial scale. Consequence: negligible because fishing effectively targets spawning adults. Thus smaller fish will not be vulnerable and will have minimal impact on the stock. Confidence: low, due to lack of information on indirect mortality.
	Incidental behaviour	0									

DIRECT IMPACT OF FISHING	FISHING ACTIVITY	PRESENCE (1) ABSENCE (0)	SPATIAL SCALE OF HAZARD (1-6)	TEMPORAL SCALE OF HAZARD (1-6)	SUB-COMPONENT	UNIT OF ANALYSIS	OPERATIONAL OBJECTIVE (S2.1)	INTENSITY SCORE (1-6)	CONSEQUENCE SCORE (1-6)	CONFIDENCE SCORE (1-2)	RATIONALE
	Gear loss	1	1	3	Population size	Bight redfish	1.2	2	1	2	Gear loss rarely occurs. Lost gear resulting in damage/mortality most likely to affect population size of this species, as lost gear may occur over areas where this species occurs (i.e. rocky reefs and muddy substrates). Intensity: minor, lost gear is considered to occur in a few restricted locations. Consequence: negligible as impact considered unlikely to be measurable at the scale of this stock. Confidence: high because it is known that very little gear is lost, and if so, most are retrieved.
	Anchoring/mooring	0									
	Navigation/steaming	1	4	6	Population size	Bight redfish	1.2	3	1	2	This activity is widespread within the GABT sector. Direct impact (damage or mortality) without capture due to navigation/steaming was considered to affect population size. Intensity: moderate, as this activity is a large component of fishing operations. Consequence: negligible, unlikley to be detectable at the scale of the stock. Confidence: high as it is considered unlikely for there to be strong interactions between navigation/steaming and damage or mortality to this species.
Addition/ movement of biological material	Translocation of species	0									
	On board processing	0									
	Discarding catch	1	4	6	Population size	Deepwater flathead	1.2	3	2	1	Discarding is common over the GABT and occurs frequently mostly likely along the outer shelf of the Central Zone. This activity will most likely affect behaviour/movement of this species if scavengers are attracted. These species is considered most likely that could scavenge and feed on discarded catch as they are piscivorous and vivacious. Intensity: moderate because these species are widespread. Consequence: minor as impact is likely to be minimal. Confidence: low due to lack of available data on movement behaviour of these species based on this activity.
	Stock enhancement	0									

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	6	Population size	Deepwater flathead	1.2	1	1	2	If uncontaminated, food wastes may be discharged into the sea while the fishing vessel is in transit (MARPOL regulations). This is likely to occur daily. Disposal of organic waste occurs over small spatial scale. Intensity: negligible as impact area is only within metres of the vessel. Consequence: negligible, unlikely to affect the population size of this species. Confidence: high, logical consideration.
Addition of non-biological material	Debris	0									
	Chemical pollution	0									
	Exhaust	1	4	6	Behaviour/ movement	Bight redfish	6.1	1	1	2	Fishing activity hence exhaust emissions occur over central zone of the GABT sector. Exhaust emission is expected to pose greatest potential risk for the behaviour/movement of this species due to repulsion. This species considered most vulnerable as juveniles may occur in estuaries and shallow coastal waters. Intensity: negligible because although the hazard occurs over a large range/scale, impact area is only within metres of the vessel. Consequence: negligible as most exhaust fumes enters the atmosphere, or immediately below the water from engines, dissolved gases and particulates not believed to greatly affect water and hence this demersal target species. Confidence: high due to localised exhaust unlikely to impact the behaviour/movement of this species.
	Gear loss	1	1	3	Population size	Deepwater flathead	1.2	2	1	2	Fishing occurs throughout the year over the Central zone of the GABT sector mostly over the outer shelf (110 - 250 m). Gear loss believed to occur rarely. Lost gear not resulting in damage/mortality most likely to affect population size of this species. Intensity: minor because lost gear–species interactions (if they occur) are considered to be rare. Consequence: negligible, considered unlikely to be measurable at the

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
											scale of this stock. Confidence: high because it is known that very little gear is lost, and interaction with species is considered unlikely.
	Navigation/steaming	1	4	6	Behaviour/ movement	Deepwater flathead	6.1	3	1	1	Navigation/steaming of fishing vessels was expected to pose greatest potential risk for the Behaviour/movement of target species resulting in disruption to feeding by introducing noise to the environment. Intensity: moderate, as activity occurs over a broad spatial scale. Consequence: negligible, as introduction of noise from navigation/steaming considered unlikely to impact bottom-dwelling species or be measurable for this species. Confidence: low because addition of non-biological material due to navigation/steaming to impact and have consequences for the behaviour/movement of this species is unlikely, but not known.
	Activity/presence on water	1	4	6	Behaviour/ movement	Bight redfish	6.1	3	2	1	Presence of vessels on water may change the behaviour, as vessels do attract or deter animals. Intensity: moderate as occurs over a broad spatial area. Consequence: minor, possible detectable change in behaviour/movement but minimal impact on population dynamics. Time to return to original behaviour/movement on the scale of days. Confidence: low because available data on acoustic disturbance from vessels on spawning on the behaviour/movement of this species is unknown.
Disturb physical processes	Bait collection	0									
	Fishing	1	4	6	Population size	Deepwater flathead	1.2	3	2	1	Deepwater flathead are bottom-dwellers and fishing may disturb sediments. Disturbance of physical processes due to fishing considered most likely to affect population size of this species. Intensity: moderate as disturbance of sediments may occur over broad spatial area. Consequence: minor as sediment disturbance not likely to affect population size of this species. Confidence: low because little information is available.

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
	Boat launching	0									
	Anchoring/ mooring	0									
	Navigation/steaming	1	4	6	Behaviour/ movement	Deepwater flathead	6.1	3	1	2	Disturbance to physical processes due to Navigation/steaming of fishing vessels was expected to pose greatest potential risk for the Behaviour/movement of this species resulting in disruption to feeding. Intensity: moderate as the hazard was considered over a large range/scale, but navigation/steaming considered to only impact a small area (< 1 nm). Consequence: negligible with any impact of navigation/steaming unlikely to be measurable for this species. Confidence: high because navigation/steaming unlikely to impact and have consequences for the behaviour/movement of this species.
External impacts	Other fisheries: SESSF - CTS otter, shark gillnet, shark hook, scalefish auto-longline; SPF, WTBF, SBT, SSJ; SA fisheries - sardine, marine scalefish, rock lobster, recreational; WA South Coast purse seine	1	6	6	Population size	Deepwater flathead	1.2	3	3	2	Commonwealth and State fisheries occur within or adjacent to the GABTF Central Zone outer shelf fishing grounds - not all with current effort or overlapping effort. This species was chosen as the most vulnerable because it is also caught by other fisheries and mostly caught in the SESSF-CTS: ~217 t retained (Commonwealth Logbooks) within this assessment period. Intensity: moderate, as it occurs over a broad spatial scale. Consequence: moderate, other fisheries may cause a reduction in recruitment dynamics or population size. Confidence: high, as information on catch of other Commonwealth fisheries is known.
	Aquaculture -abalone, oyster, mussels, SBT, Yellowtail kingfish	1	4	6	Behaviour/ movement	Bight redfish	6.1	2	2	1	Aquaculture occurs at sites on western Eyre Peninsula and Spencer Gulf (State waters) adjacent to inner shelf habitats. Nutrient depletion effects possible leading to alteration of behaviour/movement of this species locally but likely to be rapidly dispersed in inshore waters. This species selected as juveniles are known to occur in estuaries and coastal waters which could coincide with aquaculture sites. Intensity: minor as co-location of aquaculture sites and juveniles could occur rarely.

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
											Consequence: minor as impacts on behvaiour/movement of this species is minimal and variability unlikley to be detected against natural variability. Confidence: low as there is little data on the co-location of aquaculture sites and juvenile bight redfish.
	Coastal development	1	5	6	Behaviour/ movement	Bight redfish	6.1	3	2	1	Coastal development mostly localised within Gulfs and eastern GAB. Frequent, local impacts at small spatial scales should have most obvious impact on the behaviour/movement of this species. Intensity: moderate, both broad coastal development and localised centres. Consequence: minor as coastal development expected to have minimal impact on bight redfish behaviour/movement. Confidence: low as there is little data available.
	Other extractive activities	1	4	6	Behaviour/ movement	Deepwater flathead	6.1	2	2	2	Ongoing development and expansion of oil and gas pipelines, oil and gas exploration and extraction drilling, and seismic surveys most likely to affect the behaviour/movement of this species. The auditory and lateral line sensory acuity of this species could be affected by seismic survey. Oil and gas extraction and exploration occurs at a variety of sites throughout the GABTF in central and eastern GAB. Extraction occurs daily throughout the year in a few locations. Two seismic surveys occurred in 2015 and more seismic activities planned. Evidence that seismic surveys affect fish behaviour possibly causing them to migrate out of fishing grounds. Intensity: minor, local effects are potentially severe but confined to small areas, surveys infrequent. Consequence: minor, possible detectable change in behaviour/movement but minimal impact on behaviour/movement of species. Confidence: high, evidence for effects now being documented.
	Other non extractive activities	1	6	6	Behaviour/ movement	Deepwater flathead	6.1	3	2	1	Ongoing shipping, naval activities and ocean dumping is likely to have minor effects on the movement and behaviour of this species. Intensity: moderate, as activity occurs over a broad spatial scale. Consequence:

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
											minor, as detectability is considered to be rare. Confidence: low, little information on potential effects.
	Other anthropogenic activities	1	4	6	Behaviour/ movement	Deepwater flathead	6.1	2	2	1	Tourism (e.g. whale watching, fishing tours, diving, charter trips), recreational boating are likely to have minor effects on the behaviour/movement of this species. These effects are considered to be localized and only impact a small proportion of the population. Intensity: minor, activities could impact a wide range. Consequence: minor, as restricted area rare event short term effects. Confidence: low, limited available information.

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	6	Population size	Latchet; skates and rays - unspecified	1.2	3	3	1	Fishing occurs throughout the year in the Central Zone mostly over the outer shelf (110-250 m). Latchets and chondrichthyans comprising a combination of skates, rays, stingrays and stingarees recorded as generic groups were chosen because they were mostly discarded within this assessment period, i.e. latchet: ~809 t (Commonwealth Logbooks); chondrichthyans - combination of skates, rays, stingrays and stingarees: ~688 t discarded (Commonwealth Logbooks). In addition, there are no quota limits for latchet species or species of skates, rays, stingrays or stingarees. Intensity: moderate as fishing occurs over broad spatial scale. Consequence: moderate, as this activity may cause a reduction in recruitment dynamics or population size. Confidence: low, as stock status is unknown for latchet and these chondrichthyans.
	Incidental behaviour	0									
Direct impact without capture	Bait collection	0									
	Fishing	1	4	6	Population size	Latchet	1.2	3	2	1	Fishing occurs throughout the year in the Central Zone mostly over the outer shelf (110-250 m). Injury/mortality to this species as a result of passing through the net is expected to have highest potential risk for the population size sub-component. This species chosen as units of analysis because small ones are known to pass through nets (AFMA Observer, pers. comm). Intensity: moderate as small fish escape the net and activity occurs over a broader spatial scale. Consequence: minor as impact unlikely to affect long-term recruitment dynamics, but could affect population size. Confidence: low because of lack of data on mortality of these fish species after they have escaped net.

DIRECT IMPACT OF FISHING	FISHING ACTIVITY	PRESENCE (1) ABSENCE (0)	SPATIAL SCALE OF HAZARD (1-6)	TEMPORAL SCALE OF HAZARD (1-6)	SUB-COMPONENT	UNIT OF ANALYSIS	OPERATIONAL OBJECTIVE (S2.1)	INTENSITY SCORE (1-6)	CONSEQUENCE SCORE (1-6)	CONFIDENCE SCORE (1-2)	RATIONALE
	Incidental behaviour	0									
	Gear loss	1	1	3	Population size	Latchet	1.2	2	1	2	Gear loss rarely occurs. This species was chosen as it is the most discarded and if gear is lost it is likely to occur nearby fishery operations. Lost gear resulting in damage/mortality most likely to affect population size of ths species. Intensity: minor as lost gear is considered rare and localized. Consequence: negligible as impact considered unlikely to be measurable at the scale of this stock. Confidence: high because it is known that very little gear is lost, and if so retrieved (AFMA Observer manager, pers. comm.) and interaction with this species is considered unlikely.
	Anchoring/mooring	0									
	Navigation/steaming	1	4	6	Population size	Latchet	1.2	3	1	2	Navigation/steaming occurs throughout the year in the Central Zone mostly over the outer shelf (110-250 m). Direct impact (damage or mortality) without capture due to navigation/steaming was considered most likely to affect population size of this species. Juveniles are more often found in shallow coastal waters, so may be close to surface. Intensity: moderate, navigation/steaming is a large component of the GABT fishery operations. Consequence: negligible as it is unlikely to be measurable. Confidence: high because it was considered unlikely for there to be strong interactions between navigation/steaming and damage or mortality of this species.
Addition/ movement of biological material	Translocation of species	0									
	On board processing	0									
	Discarding catch	1	4	6	Behaviour/ movement	Latchet	6.1	3	2	1	Discarding is common over GABT sector (within the Central Zone mostly over the outer shelf: 110-250 m) and occurs frequently and is most likely to affect behaviour/movement of this species if scavengers

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
											are attracted. This species considered most likely species that could be attracted to discards. Intensity: moderate because discarding occurs over broad spatial scale and this species is widespread. Consequence scored as minor as impact is likely to be minimal. Confidence: low due to lack of available data on movement behaviour of these species based on this activity.
	Stock enhancement	0									
	Provisioning	0									
	Organic waste disposal	1	4	6	Population size	Latchet	1.2	1	1	2	If uncontaminated, food wastes may be discharged into the sea while the fishing vessel is in transit (MARPOL regulations). This is likely to occur daily. This species was chosen since it was discarded the most. Disposal of organic waste occurs over small spatial scale. Intensity: negligible as impact area is only within metres of the vessel. Consequence: negligible, unlikely to affect the population size of this species. Confidence: high, logical consideration.
Addition of non-biological material	Debris	0									
	Chemical pollution	0									
	Exhaust	1	4	6	Behaviour/ movement	Latchet	6.1	1	1	2	Fishing activity hence exhaust emissions occur over GABT sector. Exhaust emission is expected to pose greatest potential risk for the behaviour/movement of this species due to repulsion. Most exhaust enters the atmosphere, or immediately below the water from engines, dissolved gases and particulates not believed to be of consequence to benthic species. However, this species considered most vulnerable as juveniles are more often found in shallow waters. Intensity: negligible because although the hazard occurs over a large range/scale, impact area is only within metres of the vessel. Consequence: negligible as any

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
											consequence on this species unlikely to be measurable. Confidence: high because localised exhaust unlikely to impact on behaviour/movement of this species.
	Gear loss	1	1	3	Population size	Latchet	1.2	2	1	2	Fishing occurs throughout the year over the GABT sector. Gear loss believed to occur rarely. Lost gear not resulting in damage/mortality most likely to affect population size of this species. Intensity: minor because lost gear–species interactions (if they occur) are considered to be rare. Consequence: negligible, considered unlikely to be measurable at the scale of this stock. Confidence: high because it is known that very little gear is lost, and interaction with species is considered unlikely.
	Navigation/steaming	1	4	6	Behaviour/ movement	Latchet	6.1	3	1	1	Navigation/steaming of fishing vessels was expected to pose greatest potential risk for the Behaviour/movement of species resulting in disruption to feeding and/or movement. Introduction of noise from navigation/steaming considered unlikely to impact bottom-dwelling species. Intensity: moderate as this activity occurs over a broader spatial scale. Consequence: negligible as impact of Navigation/steaming unlikely to be measurable. Confidence: low because addition of non-biological material due to navigation/steaming to impact and have consequences for the behaviour/movement of this species is unlikely, but not known.
	Activity/presence on water	1	4	6	Behaviour/ movement	Latchet	6.1	3	2	1	Activity/presence on water occurs over the GABT sector. Vessels in the area do attract (or avoid) animals. This species could have an avoidance reaction to acoustic signals, and could use echo-location. Intensity: moderate as presence of vessels occurs over broad spatial scale within the SESSF. Consequence: minor as any spawning aggregations could be disturbed. Confidence: low because available data on acoustic disturbance on a spawning on the behaviour/movement of this species is unknown.

DIRECT IMPACT OF FISHING	FISHING ACTIVITY	PRESENCE (1) ABSENCE (0)	SPATIAL SCALE OF HAZARD (1-6)	TEMPORAL SCALE OF HAZARD (1-6)	SUB-COMPONENT	UNIT OF ANALYSIS	OPERATIONAL OBJECTIVE (S2.1)	INTENSITY SCORE (1-6)	CONSEQUENCE SCORE (1-6)	CONFIDENCE SCORE (1-2)	RATIONALE
Disturb physical processes	Bait collection	0									
	Fishing	1	4	6	Population size	Latchet; skates and rays - unspecified	1.2	3	2	1	Fishing activity hence disturbance of physical processes occurs throughout the year over the GABT sector. Disturbance of physical processes due to fishing considered most likely to affect population size of this species. These species considered most likely to be affected as they are bottom-dwellers and fishing may disturb sediments. Intensity: moderate as disturbance of sediment may occur often over broad spatial scale. Consequence: minor as sediment disturbance not likely to affect population size or dynamics of this species. Confidence: low because little information is available.
	Boat launching	0									
	Anchoring/mooring	0									
	Navigation/steaming	1	4	6	Behaviour/ movement	Latchet	6.1	3	1	2	Navigation/steaming occurs throughout the year over the GABT sector. Disturbance to physical processes due to Navigation/steaming of fishing vessels was expected to pose greatest potential risk for the Behaviour/movement of this species resulting in disruption to feeding. This species considered most vulnerable as juveniles are pelagic. Intensity: moderate because the hazard was considered over a broad range/scale, navigation/steaming considered to only impact a small area (< 1 nm). Consequence: negligible with any impact of navigation/steaming unlikely to be measurable for this species. Confidence: high because navigation/steaming unlikely to impact and have consequences for the behaviour/movement of this species.

DIRECT IMPACT OF FISHING	FISHING ACTIVITY	PRESENCE (1) ABSENCE (0)	SPATIAL SCALE OF HAZARD (1-6)	TEMPORAL SCALE OF HAZARD (1-6)	SUB-COMPONENT	UNIT OF ANALYSIS	OPERATIONAL OBJECTIVE (S2.1)	INTENSITY SCORE (1-6)	CONSEQUENCE SCORE (1-6)	CONFIDENCE SCORE (1-2)	RATIONALE
External impacts	Other fisheries: SESSF - CTS otter, shark gillnet, shark hook, scalefish auto-longline; SPF, WTBF, SBT, SSJ; SA fisheries - sardine, marine scalefish, rock lobster, recreational; WA South Coast purse seine	1	6	6	Population size	Latchet	1.2	3	3	2	Commonwealth and State fisheries occur within or adjacent to the GABT fishery Central Zone outer shelf fishing grounds - not all with current effort or overlapping effort. This species was chosen as the most vulnerable because it is also caught by other fisheries and mostly caught in the SESSF-CTS: ~593 t retained (Commonwealth Logbooks) within this assessment period. Intensity: moderate, as it occurs over a broad spatial scale. Consequence: moderate, other fisheries may cause a reduction in recruitment dynamics or population size. Confidence: high, as information on catch of other Commonwealth fisheries is known.
	Aquaculture - abalone, oyster, mussels, SBT, yellowtail kingfish	1	4	6	Behaviour/ movement	Latchet	6.1	2	2	1	Aquaculture occurs at sites on western Eyre Peninsula and Spencer Gulf (State waters) adjacent to inner shelf habitats. Nutrient depletion effects possible leading to alteration of behaviour/movement of this species locally but likely to be rapidly dispersed in inshore waters. This species selected as they are known to occur in estuaries and coastal waters which could coincide with aquaculture sites. Intensity: minor as co-location of aquaculture sites and latchet could occur rarely. Consequence: minor as impacts on behvaiour/movement of this species is minimal and variability unlikley to be detected against natural variability. Confidence: low as there is little data on the co-location of aquaculture sites and latchet.
	Coastal development	1	5	6	Behaviour/ movement	Latchet	6.1	3	2	1	Coastal development mostly localised within Gulfs and eastern GAB. Frequent, local impacts at small spatial scales should have most obvious impact on the behaviour/movement of this species. Intensity: moderate, both broad coastal development and localised centres. Consequence: minor as coastal development expected to have minimal impact on latchet behaviour/movement. Confidence: low as there is little data available.

DIRECT IMPACT OF FISHING	FISHING ACTIVITY	PRESENCE (1) ABSENCE (0)	SPATIAL SCALE OF HAZARD (1-6)	TEMPORAL SCALE OF HAZARD (1-6)	SUB-COMPONENT	UNIT OF ANALYSIS	OPERATIONAL OBJECTIVE (S2.1)	INTENSITY SCORE (1-6)	CONSEQUENCE SCORE (1-6)	CONFIDENCE SCORE (1-2)	RATIONALE
	Other extractive activities	1	4	6	Behaviour/ movement	Latchet	6.1	2	2	2	Ongoing development and expansion of oil and gas pipelines, oil and gas exploration and extraction drilling, and seismic surveys most likely to affect the behaviour/movement of this species. The auditory and lateral line sensory acuity of this species could be affected by seismic survey. Oil and gas extraction and exploration occurs at a variety of sites throughout the GABT fishery in central and eastern GAB. Extraction occurs on a daily basis throughout the year in a few locations. Two seismic surveys were conducted in 2015 and more are planned. Evidence that seismic surveys affect fish behaviour possibly causing them to migrate out of fishing grounds. Intensity: minor, local effects are potentially severe but confined to small areas, surveys infrequent. Consequence: minor, possible detectable change in behaviour/movement but minimal impact on behaviour/movement of species. Confidence: high, evidence for effects now being documented.
	Other non extractive activities	1	6	6	Behaviour/ movement	Latchet	6.1	3	2	1	Ongoing shipping, naval activities and ocean dumping is likely to have minor effects on the movement and behaviour of this species. Intensity: moderate, as activity occurs over a broad spatial scale. Consequence: minor, as detectability is considered to be rare. Confidence: low, little information on potential effects.
	Other anthropogenic activities	1	4	6	Behaviour/ movement	Latchet	6.1	2	2	1	Tourism (e.g. whale watching, fishing tours, diving, charter trips), recreational boating are likely to have minor effects on the behaviour/movement of this species. These effects are considered to be localized and only impact a small proportion of the population. Intensity: minor, activities could impact a wide range. Consequence: minor, as restricted area rare event short term effects. Confidence: low, limited available information.

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	6	Population size	Shy albatross	1.2	3	1	2	Fishing occurs mostly on the Central Zone outer shelf of GABT fishery on a daily basis throughout the year. Shy Albatross most vulnerable to decline in population size from fishing, habitat loss and disease - population about 15000 pairs. Intensity: moderate fishing in localised area, although catch rate of birds reportedly rare ($F=2x10^{-5}$) Consequence: negligible, two mortalities in 5 years. Confidence: high, data are available.
	Incidental behaviour	0									
Direct impact without capture	Bait collection	0									
	Fishing	1	4	6	Population size	Longnosed fur seals	1.2	3	1	2	Fishing occurs mostly on the Central Zone outer shelf of GABT fishery on a daily basis throughout the year. Fur seals are known to scavenge around fishing vessels and do become entangled during trawling operations but only one reportedly caught and released alive during assessment period. Intensity: moderate. Consequence: negligible, no fatalities, no impact on populatiion size. Confidence high: data on interactions mortality recorded.
	Incidental behaviour	0									
	Gear loss	1	1	3	Population size	Longnosed fur seals	1.2	2	1	2	Major gear loss is a rare event and lost gear can usually be recovered. Population size of longnosed fur seals might be affected if they become entangled in ropes or netting associated with the lost gear causing fatality. Intensity: minor, loss of gear is rare and potential incidents of entanglements would only occur in a few restricted locations offshore. Consequence: negligible, the impact of entanglement fatality unlikely to be detected on any spatial or temporal scale. Confidence: high, data exists on reported gear losses.

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	0									
	Navigation/steaming	1	4	6	Population size	Shearwaters	1.2	3	2	2	Vessels steam to/from and within fishing grounds on GABT fishery central zone outer shelf. Population size of seabirds most likely to be affected by fatal collision with infrastructure of vessels. Intensity: moderate, steaming/navigation operations localised but fatal collisions occur infrequently. Consequence: minor, interactions are unlikely, and impact on bird populations is unlikely to be measurable against background variability, one non-fatal reported collision of shearwater. Confidence: high, consensus and logical consideration, limited data.
Addition/ movement of biological material	Translocation of species	0									
	On board processing	0									
	Discarding catch	1	4	6	Behaviour/ movement	Shy albatross	6.1	3	2	2	Discarding of non-commercial bycatch occurs across the GABT fishery. Movement/behaviour of albatrosses could be affected as they are olefactory sensing animals and known to be attracted fishing vessels to scavenge. Intensity: moderate, discarding could occur at a moderate level across a broad spatial scale. Consequence: minor, although it may be detectable, normal behaviour would resume once event had finished within hours. Confidence: high, observer data exists and logical consideration.
	Stock enhancement	0									
	Provisioning	0									
	Organic waste disposal	1	4	6	Behaviour/ movement	Shy albatross	6.1	1	1	2	Organic waste disposal most likely to attract scavengers thus affecting movement/behaviour of seabirds such as shy albatross. Intensity: negligible, due to small volumes and rapid dispersal. Consequence: negligible, normal behaviour would resume within hours. Confidence: high, logical consideration.
	Debris	0									

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	Chemical pollution	0									
	Exhaust	1	4	6	Behaviour/ movement	Shy albatross	6.1	1	1	2	Exhaust would occur daily throughout the year. Movement/behaviour of seabirds is likely to be affected in their effort to avoid exhaust fumes. Intensity: negligible, exhaust would be quickly dispersed. Conequence: negligible, birds can avoid immediate vicinity. Confidence: high, logical consideration.
	Gear loss	1	1	3	Population size	Shy albatross	1.2	2	1	1	Gear loss is a rare event and lost gear can usually be recovered. Population size of shy albatross most likely affected if fatal entanglement with small wuantities of lost gear such as ropes or small mesh pieces. Intensity: minor, major loss of gear is rare but unknown how small offcuts are lost, but even so potential incidents of entanglements would only occur in a few restricted locations. Consequence: negligible, fatal entanglements of albatross have occurred twice in 5 years, although mortality due to non-fatal entanglemnt not known. Confidence: low logical consideration and knowledge of low loss of gear
	Navigation/steaming	1	4	6	Behaviour/ movement	Longnosed fur seals	6.1	3	1	2	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 particualry marine mammals such as longnosed fur seals. Intensity: moderate. Consequence: negligible, behavioural changes detectable only over course of ours or days. Confidence: high, observer data exists.
	Activity/presence on water	1	4	6	Behaviour/ movement	Shy albatross	6.1	3	1	2	Physical presence of vessel introduces noise and visual stimuli into the environment. Shy albatross movement/behaviour most likely to be affected. Intensity: moderate although catch rate of birds very low. Consequence: negligible, one mortality in 5 years very low mortality rate. Confidence: high, data exists.
	Bait collection	0									

DIRECT IMPACT OF FISHING	FISHING ACTIVITY	PRESENCE (1) ABSENCE (0)	SPATIAL SCALE OF HAZARD (1-6)	TEMPORAL SCALE OF HAZARD (1-6)	SUB-COMPONENT	UNIT OF ANALYSIS	OPERATIONAL OBJECTIVE (S2.1)	INTENSITY SCORE (1-6)	CONSEQUENCE SCORE (1-6)	CONFIDENCE SCORE (1-2)	RATIONALE
Disturb physical processes	Fishing	1	4	6	Behaviour/ movement	Syngnathids	6.1	3	2	1	Fishing may disturb seabed sediments and structure and trawling has a higher impact on seafloor than many other methods. Syngnathids likely to be more affected than other species as they are more benthos associated although few species live in outer shelf depths. Intensity: moderate, demersal trawling may degrade small reef patches and impact associated small scale hydrodynamics across a broad spatial scale. Consequence: minor, may move away from the trawl impact zone but recovery of normal behaviour would occur within days. Confidence: low, little data exists.
	Boat launching	0									
	Anchoring/mooring	0									
	Navigation/steaming	1	4	6	Behaviour/ movement	Longnosed fur seals	6.1	3	1	2	Navigation/steaming may affect the physical processes on the benthos and the pelagic by turbulent action of propellers or wake formation. Seals potentially most vulnerable to effects of water turbulence. Intensity: moderate. Consequence: negligible, unlikley to detect variation. Confidence: high, observer data exists and logical.
External impacts	Other fisheries: SESSF - CTS otter, shark gillnet, shark hook, scalefish auto-longline; SPF, WTBF, SBT, SSJ; SA fisheries - sardine, marine scalefish, rock lobster, recreational; WA South Coast purse seine	1	6	6	Population size	Shy albatross	1.2	3	2	2	Commonwealth and State Fisheries occur within or adjacent to the GABT fishery Central Zone outer shelf fishing grounds - not all with current effort or overlapping effort. Shy albatross most affected as they are olefactory sensing animals and known to scavenge around fishing vessels. Shy albatross most vulnerable to decline from capture from fishing, also habitat loss and disease, population about 15,000 pairs. Intensity: moderate fishing in localised area and more broadly. Consequence: minor, one mortality in 5 years very low mortality rate. Confidence: high, data exists.

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 - abalone, oyster, mussels, SBT, Yellowtail kingfish	1	4	6	Behaviour/ movement	Longnosed fur seals	6.1	2	2	2	Aquaculture occurs at sites on western Eyre Peninsula, Spencer Gulf (State waters), Port Lincoln (SBT), Kangaroo Is, coastal bays etc. and inlets (oysters). Operations may attract seals scavenging excess feed or escaped fish. Intensity: minor. Consequence: minor, possible habituation but these effects are coastal and not within GABT fishery. Confidence: high, logical.
	Coastal development	1	5	6	Behaviour/ movement	Longnosed fur seals	6.1	2	1	2	Coastal development mostly localised within Gulfs and eastern GAB. Modifications to beaches, rivers and other coastal land features may disturb physical habitat of the coastal environement and potentially haul out sites for seals altering their behaviour and movement. Intensity: minor, coastal development occurs at localized sites across a broad spatial extent. Consequence: negligible, restricted to a small proportion of the coastal area not overlapping with seal colonies. Confidence: high, data exists.
	Other extractive activities	1	4	6	Behaviour/ movement	Longnosed fur seals	6.1	2	2	2	Ongoing development and expansion of oil and gas pipelines, oil and gas exploration and extraction drilling, and seismic surveys most likely to affect movement and behaviour of marine mammals. Fur seals are known to forage around pipelines. Evidence that seismic surveys affect fish and invertebrate (scallop) behaviour possibly causing them to migrate out of fishing grounds. Intensity: minor, local effects of seismic surveys potentially severe but confined to small areas and currently infrequent. Consequence: minor, possible detectable change movement and behaviour but likely return to normal within days. Confidence: high, a few studies underway.
	Other non extractive activities	1	6	6	Behaviour/ movement	Shy albatross	6.1	3	1	2	Shipping occurs throughout the area daily - eastern and western routes to and from major South Australian ports. Movement and behaviour of shy albatross may be affected due to temporary attraction to vessels. Intensity: moderate. Consequence: negligible, interactions unlikely to be detectable against natural variation, normal behaviour resumes within hours. Confidence: high, logical.

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	4	6	Behaviour/ movement	Longnosed fur seals	6.1	2	1	2	Fur seals are attracted by fishing activities by charter boats associated with general recreational activities, and tourism in coastal areas (e.g. whale watching, fishing tours, anchoring, recreational diving etc.). Most activities occur commonly off GAB Southern inner and outer shelf. Intensity: minor, occurs in localised area. Consequence: negligible, interactions which affect the long-nosed furseal behaviour and movement unlikely to be detectable against natural variation. Confidence: high, logical.

Level 1 (SICA) Document L1.4 - Habitat Component (demersal)

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	6	Habitat structure and function	Habitat forming benthos (GAB assemblage 8)	5.1	3	4	1	Greatest effort is spent in outer shelf depths where habitat types in GAB assemblage 8 most vulnerable to impact Pitcher et al. (2016). Demersal trawl gears have a relatively large footprint and contact the bottom heavily, which can remove and damage large erect inflexible faunas. Sponge habitat on coarse sediments is considered most at risk in this region, replaced by the fragile bryozoan (lace coral) matrix dominant at the shelf edge/upper slope depths. Function within this habitat type will be altered, both by removal and damage of fauna, attraction of mobile scavenging invertebrate species, and disturbance of substratum and substratum processes. Intensity: moderate, effects may be concentrated. Consequence: major, but despite large footprint in this asemblage it is unknown how affected the vulnerable habitat types are (Pitcher et al. 2016). Removal of complex structure may take periods greater than a decade to recover in these depths. Confidence: low.
	Incidental behaviour	0									
Direct impact without capture	Bait collection	0									
	Fishing	1	4	6	Habitat structure and function	Habitat forming benthos (GAB assemblage 8)	5.1	3	4	1	Greatest effort is spent in outer shelf depths. Habitat types in GAB assemblage 8 most vulnerable to impact Pitcher et al. (2016). In the process of fishing without capture, bottom may be dragged repeatedly damaging habitat structure even if not retained by gear. Octocoral and bryozoan-dominant habitat structures are altered when the removal of delicate, inflexible structural forms results in the conversion of lower relief 'hard' bottom, to soft bottom, on sediments. Function within this habitat type will be altered, both by removal and damage of fauna,

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
											attraction of mobile scavenging invertebrate species, and disturbance of substratum and substratum processes. Intensity: major, effects may be concentrated. Consequence: major, regeneration of sponges may take between months to years if large or more complex. Sponges in these depths expected to be resilient to disturbance. Confidence: low, lack of data that shows actual impact.
	Incidental behaviour	0									
	Gear loss	1	1	3	Habitat structure and function	Habitat forming benthos (GAB assemblage 8)	5.1	2	1	2	Gear loss can occur if gear hooks up on exposed/subcropping rock, but loss is rarely reported. Fishery management plan requires operators to take all reasonable steps to minimise loss of gear, though retrieval may be impossible. Lost gear may change habitat structure by virtue of damaging existing structure during attempted retreival or by creating new structure, and eventually become habitat. Intensity: minor, uncommon and highly localised. Consequence: negligible. Confidence high as little gear is lost.
	Anchoring/mooring	0									
	Navigation/steaming	1	4	6	Water quality	Southern Pelagic provinces - coastal P7	1.1	3	1	2	Steaming/navigation to fishing grounds results in disruption of water quality by introduction of pollutants or chemicals, noise, light and changes to water chemistry or turbidity. Intensity: moderate, steaming occurs over a broad spatial scale. Consequence: negligible because it was considered unlikely that there would be detectable impacts. Confidence: high, logical considerations.
Addition/ movement of	Translocation of species	0									
	On board processing	0									

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
biological material	Discarding catch	1	4	6	Substrate quality	Habitat forming benthos (GAB assemblage 8)	3.1	3	2	2	Discarding occurs regulalry throughout the fishery. Substrate quality on the shelf assemblages was considered most likely to be impacted because discarding of catch may result in accumulation of carcasses, leading to altered sediment chemistry in and above substrate, fine sediments can be disturbed, and bioturbators and filter feeders smothered. Intensity: moderate over the scale of the fishery, waste expected to be taken up quickly by opportunistic scavengers. Consequence: minor because measurable impacts were considered to only be detectable at localised scales. Confidence: high, because operators generally discard waste over the course of fishing operations leading to no localised accumulations of waste.
	Stock enhancement	0									
	Provisioning	0									
	Organic waste disposal	1	4	6	Water quality	Habitat forming benthos (GAB assemblage 8)	1.1	1	1	2	Discharge of organic waste (e.g. uncontaminated food waste) likely to occur daily although relatively small amounts. Intensity: negligible, unlikely to detect due to small volumes and rapid dispersal. Consequence: negligible, unlikely to be measurable or persistent for more than a few hours. Confidence: high, localised short term increases in nutrient not expected to adversely affect water column.
Addition of non-biological material	Debris	0									
	Chemical pollution	0									
	Exhaust	1	4	6	Air quality	Southern Pelagic provinces - coastal P7	2.1	1	1	2	Exhaust from running engines may impact the air quality within Southern Oceanic Pelagic habitat. 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 even over

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
											very short time frames. Confidence: high because effect of exhaust was considered to be very localised.
	Gear loss	1	1	3	Habitat structure and function	Habitat forming benthos (GAB assemblage 8).	5.1	2	1	2	Fishing occurs throughout the year over the outer shelf GAB assemblage 8 but gear loss is infrequent. Fishery management plan requires operators to take all reasonable steps to minimise loss of gear, but retrieval may be impossible in some cases but rare. Trawl gear most likely to be lost by being caught up on rocky outcrops. Lost gear may change habitat structure by creating new structure or smothering damaging existing vulnerable types. Intensity: minor, gear loss rare. Consequence: negligible as caught up gear likely to become habitat over time. Confidence: high as lost gear events are usually recorded.
	Navigation/steaming	1	4	6	Habitat structure and function	Southern Pelagic provinces - coastal P7	5.1	3	1	2	Navigation to and from fishing grounds introduces noise and visual stimuli most likely to affect pelagic habitat structure and function. Intensity: moderate, over broad spatial scale. Consequence: negligible, impact would be undetectable beacuse activity temporary. Confidence: high, logical.
	Activity/presence on water	1	4	6	Habitat structure and function	Southern Pelagic provinces - coastal P7	5.1	3	1	2	Fishing occurs throughout the fishery impacting on the habitat and function by introduction of noise and visual stimuli and birds and seals may be attracted to fishing operations. Intensity: moderate, broad spatial scale. Consequence: negligible, impact would be undetectable beacuse activity temporary. Confidence: high, logical.
Disturb physical processes	Bait collection	0									
	Fishing	1	4	6	Substrate quality	Habitat forming benthos (GAB assemblage 8).	3.1	3	3	1	Greatest effort is spent in outer shelf depths therefore habitat types in GAB assemblage 8 most vulnerable to impact (Pitcher et al. 2016). Demersal trawl gears contact the bottom heavily and can disturb sediments and sediment processes. Disturbed sediments may be

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
											translocated by currents, smother bioturbators, and filter feeding fauna and disrupt the biogeochemical cycle in and above substratum. Intensity: moderate, effects may be concentrated. Consequence: moderate, can change 'hard' grounds to 'soft', removing surface attachment for some fauna. Confidence: low, footprint in assemblage quite high but % of vulnerable habitat affected unknown.
	Boat launching	0									
	Anchoring/mooring	0									
	Navigation/steaming	1	4	6	Water quality	Southern Pelagic provinces - coastal P7	1.1	3	1	2	Fishing activity hence navigation/steaming occurs throughout the year over the entire SESSF. Disturbance of physical processes will occur during the normal course of steaming throughout the fishing zone. Turbulence and disturbance of pelagic water quality is unlikely to affect normal water column processes for long. Any disruption to these processes can therefore be expected to alter habitat function only briefly. Intensity: moderate, occurs over broad spatial scale. Consequence: negligible, remote likelihood of detection of impact against natural variation. Confidence: high, logical.
External impacts	Other fisheries: SESSF - CTS otter, shark gillnet, shark hook, scalefish auto-longline; SPF, WTBF, SBT, SSJ; SA fisheries - sardine, marine scalefish, rock lobster, recreational; WA South Coast purse seine	1	6	6	Habitat structure and function	Habitat forming benthos (GAB assemblage 8)	5.1	3	1	2	Other fisheries operate over the same grounds. No other benthic-impacting fisheries overlap within the GABT fishery. Fishing activity of these fisheries occurs over a large spatial range, over which there can be daily fishing activity. Intensity: moderate. Consequence: negligible as benthos is rarely involved with pelagic methods and tends to be more inshore inner shelf where it does (e.g. inadvertent net groundings in SPF, feed accumulation in SBT during transporting/ caging). Confidence: high, data on overlaps exists.

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 - abalone, oyster, mussels, SBT, yellowtail kingfish	1	4	6	Water quality, substrate quality	Southern Pelagic provinces-coastal P7, Inner shelf assemblages of fine sediments, unrippled, large sponges (not identified by Pitcher et al. 2016)	1.1, 3.1	2	1	2	Aquaculture occurs at sites on western Eyre Peninsula, Spencer Gulf (State waters), Port Lincoln (SBT), Kangaroo Is, coastal bays etc and inlets (oysters). Nutrient depletion effects possible but likely to be rapidly dispersed in inshore waters. Intensity: minor, in adjacent state waters and localised areas. Consequence: minor, impacts of nutrient depletion unlikley to be detectable against natural variability except on seagrass habitats important to different life stages of various species. Confidence: high, studies on nutrient inputs into estuaries are quickly dispersed but impacts if any difficult to measure against other anthopogenic sources (Wild-Allen and Andrewartha 2016). Confidence: high.
	Coastal development	1	5	6	Water quality, substrate quality	Southern Pelagic provinces-coastal P7, Inner shelf assemblages of fine sediments, unrippled, large sponges (not identified by Pitcher et al. 2016)	1.1, 3.1	3	2	2	Coastal development, particualry in Gulfs where the largest population centres occur, could affect non-overlapping habitats which may be important as nursery grounds for some species. Frequent, local impacts at small spatial scales are likely to have most obvious impact on the habitat water and substrate quality of these areas. Intensity: moderate, range of activities restricted spatial scale and the relatively low level of development in this area. Consequence: minor, impacts most likely to be inshore including waters less than 25m (and not within fishery jurisdiction) and likely undetectable within jurisdiction. Confidence: high, logical consideration.
	Other extractive activities	1	4	6	Habitat type, structure and function	Assemblages 1 to 8	4.1, 5.1	2	2	2	Oil and gas extraction and exploration occurs at a variety of sites throughout the GABT fishery in central and eastern GAB. Extraction occurs daily throughout the year in a few locations. Two seismic surveys were conducted in 2015 and more are planned. Habitat types may be affected if this activity concentrates on particular geomorphology supporting similar forms and ultimately alteration of habitat structure and function. Intensity: minor, restricted spatial scale and the relatively low level of development in this area. Consequence: minor. Confidence: high, data exists, consensus and logical consideration.

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	Water quality	Southern Oceanic Pelagic provinces - coastal and oceanic (P7 and 8)	1.1	3	2	2	Shipping occurs throughout the area daily - eastern and western routes to and from major South Australian ports and considered to impact the water quality of the pelagic habitat through introduction of pollutants or chemicals, noise, light and changes to water chemistry or turbidity. Intensity: moderate. Consequence: minor, area of disturbances confined to immediate area of vessels, and unlikley to detect impact. Confidence: high, logical.
	Other anthropogenic activities	1	4	6	Water quality	Inner shelf assemblages of fine sediments, unrippled, large sponges (not identified by Pitcher et al. 2016)	1.1	2	2	2	Tourism and recreational activity could increase noise, pollutants, into the pelagic habitat particularly. Some activities could impact habitats such as recreational fishing/diving with certain gear. Intensity: minor although difficult to assess cumulative effects. Consequence: minor, unlikely to detect impacts although no information to assess cumulative effects. Confidence: high, logical.

Level 1 (SICA) Document L1.5 - Community Component.

DIRECT IMPACT OF FISHING	FISHING ACTIVITY	PRESENCE (1) ABSENCE (0)	SPATIAL SCALE OF HAZARD (1-6)	TEMPORAL SCALE OF HAZARD (1-6)	SUB-COMPONENT	UNIT OF ANALYSIS	OPERATIONAL OBJECTIVE (S2.1)	INTENSITY SCORE (1-6)	CONSEQUENCE SCORE (1-6)	CONFIDENCE SCORE (1-2)	RATIONALE
Capture	Bait collection	0									
	Fishing	1	4	6	Species composition	Southern outer shelf	1.1	3	3	2	Fishing occurs daily throughout the year on southern outer shelf effort primarily, but effort has significantly reduced since last assessment (to about 30%). Species composition is most likely to be affected. Community abundance indices will be altered by removal of wide range of fish captured in southern outer shelf trawls. Intensity: moderate, broad but impact could be severe at a local scale. Consequence: moderate, changes to community species composition without a major change in function (no loss of function) occurring detectable i.e. redfish @63% B_0, Dw flathead declining cpue and predicted cpue > observed cpue, W gemfish improving but discarding high (GABRAG 2015). Confidence: high, data exists (GABRAG 2015).
	Incidental behaviour	0									
Direct impact without capture	Bait collection	0									
	Fishing	1	4	6	Species composition	Southern outer shelf	1.1	3	2	1	Fishing occurs daily throughout the year on Southern outer shelf effort primarily, but effort has significantly reduced since last assessment (to about 30%). Direct impact without captures most likely to affect species composition from post-capture mortality. SET outer shelf has the highest proportion of area fished, highest average catch amd logically highest escapement and post-capture mortality. Intensity: moderate as fishing occurs in broadly across the shelf. Consequence: minor as most key species populations are stable and further impact from post-capture mortality undetectable. Confidence: low, cannot demonstrate changes due to post-escapement mortality.
	Incidental behaviour	0									

DIRECT IMPACT OF FISHING	FISHING ACTIVITY	PRESENCE (1) ABSENCE (0)	SPATIAL SCALE OF HAZARD (1-6)	TEMPORAL SCALE OF HAZARD (1-6)	SUB-COMPONENT	UNIT OF ANALYSIS	OPERATIONAL OBJECTIVE (S2.1)	INTENSITY SCORE (1-6)	CONSEQUENCE SCORE (1-6)	CONFIDENCE SCORE (1-2)	RATIONALE
	Gear loss	1	1	3	Species composition	Southern outer shelf	1.1	2	1	2	Most gear loss likely to occur on GAB Southern outer shelf. Sessile species composition and abundance is the most likely to be adversely affected by lost gear through smothering. Intensity: minor, gear is rarely lost. Consequence: negligible as any effect on communities due to gear loss immeasurable. Confidence: high, any gear loss must be reported.
	Anchoring/mooring	0									
	Navigation/steaming	1	4	6	Species composition	Southern coastal pelagic	1.1	3	1	2	Navigation/steaming could impact pelagic species or birds of Southern coastal pelagic community as most effort concentrated in that community. Intensity: moderate as fishing occurs over the shelf. Consequence: negligible it is unlikely to detect any measurable effect on communities. Confidence: high, logic.
Addition/ movement of biological material	Translocation of species	0									
	On board processing	0									
	Discarding catch	1	4	6	Functional group composition	Southern outer shelf; Southern coastal pelagic	2.1	3	2	1	Discarding of non-commercial bycatch occurs commonly (up to 44% by weight: Koopman et al. 2017) but varies by season and depth. Functional group composition is likely to be affected from an increase in abundance of scavenger species from enhanced food supply. This will promote scavenger species in the benthic community once they have sunk to the sea floor (including seals and sea lions in the pelagic community). Intensity: moderate, waste is discarded across a broad spatial scale. Consequence: minor, as localized accumulations of waste rapidly dispersed within weeks and minimal detectable change if any. Confidence: low, no data but logical consideration.
	Stock enhancement	0									
	Provisioning	0									

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	6	Functional group composition	Southern outer shelf	2.1	1	1	2	Organic waste disposal most likely to attract scavengers thus affecting distribution of community temporarily. Intensity: negligible, unlikely to detect due to small volumes and rapid dispersal. Consequence: negligible, unlikely to be measurable or persistent for more than a few hours. Confidence: high, logical consideration.
Addition of non-biological material	Debris	0									
	Chemical pollution	0									
	Exhaust	1	4	6	Distribution of community	Southern outer shelf		1	1	2	Exhaust emissions most likely to affect distributions of communities by affecting distribution of birds in the vicinity of vessels. GAB outer shelf chosen as most fishing occurs there. Intensity: minor, exhaust emissions occur over a large range, but impact area is only within metres of the vessel. Consequence: negligible as exhaust is rapidly dissipated and birds can avoid. Confidence: high, logical consideration.
	Gear loss	1	1	3	Distribution of community	Southern outer shelf	3.1	2	1	2	Fishing occurs throughout the year over the SET shelf. Fishery management plan requires operators to take all reasonable steps to minimise loss of gear, though evidence of gear loss does exist, and retrieval may be impossible. Lost gear may create new structure providing new refuge for species. Intensity: minor, rarely that gear is lost. Consequence: negligible as any effect on communities due to gear loss immeasurable. Confidence: high, any gear loss must be reported.
	Navigation/steaming	1	4	6	Distribution of community	Southern outer shelf	3.1	3	1	2	Navigation/steaming introduces noise such as engine noise and echosounding during fishing and considered to have most potential effect on distribution of communities by disturbing fish. Intensity: moderate, echosounders and engines of vessels would be running for duration of fishing trips and shelf communities constantly fished. Consequence: negligible as disturbance unlikely to be detected against other factors. Confidence: high, logical.

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	6	Distribution of community	Southern coastal pelagic; Southern oceanic pelagic (1)	3.1	3	1	2	Activity/ presence on water of fishing vessels widespread on GAB outer shelf. May affect the distribution of pelagic community by changing behaviour of cetaceans, scavengers, marine mammals, birds. Intensity: moderate, vessels present over broad spatial scale. Consequence: negligible, any change to community distribution would be temporary or undetectable. Confidence: high, logical consideration.
Disturb physical processes	Bait collection	0									
	Fishing	1	4	6	Distribution of community	Southern outer shelf	3.1	3	2	1	Removal and disruption of habitat (structure) and sediments could change distribution of benthic species in the community. Bio-geochemical cycles could become affected locally if trawling very frequent e.g. on shelf benthic sand/mud sediments where disturbance results in plumes that reduce light conditions in the short term and may trigger the release of toxic substances from the sediments. Intensity: moderate as fishing occurs broadly across shelf. Consequence: minor, effect on benthic communities minimal. Confidence: low, no information on actual disturbance of habitats.
	Boat launching	0									
	Anchoring/mooring	0									
	Navigation/steaming	1	4	6	Species composition	Southern coastal pelagic; Southern oceanic pelagic (1)	1.1	3	1	2	Navigation/steaming occurs regularly on the continental shelf and shelf break of GAB outer shelf. Intensity: moderate, navigation/steaming is a large component of the trawling operations that occur broadly across shelf. Consequence: negligible, localised impact within immediate vicinity of the vessel and impact considered likely undetectable against natural levels of mixing and re-mixing. Confidence: high, logical consideration.

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: SESSF - CTS otter, shark gillnet, shark hook, scalefish auto-longline; SPF, WTBF, SBT, SSJ; SA fisheries - sardine, marine scalefish, rock lobster, recreational; WA South Coast purse seine	1	6	6	Species composition	Southern outer shelf	1.1	3	2	2	A couple of SESSF fisheries overlap the GABT fishery outer shelf (autolongline, shark hook) and the SSJ, SPF, WTBF and SBT targetting different species across the whole community; other fisheries affect adjacent communities (gillnet, SASF, recreational). Likely to affect species composition. Intensity: moderate, direct overlap occurs across broad scale but very small footprint, more impact likely on adjacent inner shelf communities where GABT fishery doesn't operate. Consequence: minor, cumulative effects to this community species composition unlikely to be detectable. Confidence: high, logical, little overlapping effort.
	Aquaculture - abalone, oyster, mussels, SBT, yellowtail kingfish	1	4	6	Bio- and geo-chemical cycles	Southern coastal pelagic	5.1	2	1	2	Aquaculture occurs at sites on western Eyre Peninsula, Spencer Gulf (State waters), Port Lincoln (SBT), Kangaroo Is, coastal bays etc and inlets (oysters). Nutrient depletion effects possible leading to alteration of bio-geochemical cycles locally but likely to be rapidly dispersed in inshore waters. Intensity: minor. Consequence: negligible as impacts on community unlikley to detect variability against natural variability except where seagrass habitat important to different life stages of a variety species-no evidence. Confidence: high, studies of nutrient inputs of estuaries found impacts if any difficult to measure against other anthopogenic sources (Wild-Allen and Andrewartha 2016).
	Coastal development	1	5	6	Distribution of community	Southern inner shelf	3.1	3	2	1	Coastal development mostly localised within gulfs and eastern GAB. Sewage, runoff and modifications to beaches, rivers and other coastal/land features disturb physical habitat of coastal communities and distribution of community components. Intensity: minor, coastal development occurs at localized sites across broad spatial extent. Consequence: minor, if occur, changes to community distribution would be localised. Confidence: low, no data.

DIRECT IMPACT OF FISHING	FISHING ACTIVITY	PRESENCE (1) ABSENCE (0)	SPATIAL SCALE OF HAZARD (1-6)	TEMPORAL SCALE OF HAZARD (1-6)	SUB-COMPONENT	UNIT OF ANALYSIS	OPERATIONAL OBJECTIVE (S2.1)	INTENSITY SCORE (1-6)	CONSEQUENCE SCORE (1-6)	CONFIDENCE SCORE (1-2)	RATIONALE
	Other extractive activities	1	4	6	Distribution of community	Southern outer shelf	3.1	2	2	2	Ongoing development and expansion of oil and gas pipelines, oil and gas exploration and extraction drilling, and seismic surveys most likely to affect distribution of the community. Evidence that seismic surveys affect fish and invertebrate (scallop) behaviour possibly causing them to migrate out of fishing grounds. Intensity: minor, local effects are potentially severe but confined to small areas, surveys infrequent. Consequence: minor, possible detectable change in geographic range of communities but minimal impact on community dynamics changes in geographic range. Confidence: high, some studies exist and ongoing.
	Other non-extractive activities	1	6	6	Distribution of community	Southern coastal pelagic; Southern oceanic pelagic (1)	3.1	3	1	2	Shipping occurs throughout the area daily - eastern and western routes to and from major South Australian ports. Distribution of pelagic communities may be impacted through disturbance particularly on marine mammals. Intensity: moderate. Consequence: negligible, interactions which affect the distribution of communities unlikely to be detectable against natural variation. Confidence: high, lack of information on shipping-animal interactions but logical.
	Other anthropogenic activities	1	4	6	Distribution of community	Southern inner shelf	3.3	2	1	2	Communities may be disturbed by charter boats associated with general recreational activities, and tourism (e.g. whale watching, fishing tours, anchoring, recreational diving etc). Most common off GAB Southern inner and outer shelf. Intensity: minor, occurs in localised area. Consequence: negligible, interactions which affect the distribution of communities unlikely to be detectable against natural variation. Confidence: high, logical.

2.3.11 Summary of SICA results

Table 2.19. Level 1 (SICA) Document L1.6. Summary table of consequence scores for all activity/component combinations. Those that scored ≥3 are highlighted blue and bolded if high confidence. * existing stock assessment –assessment not required. Note: external hazards are not considered at Level 2.

DIRECT IMPACT	ACTIVITY	KEY/SECONDARY COMMERCIAL SPECIES	BYPRODUCT AND BYCATCH SPECIES	PROTECTED SPECIES	HABITATS	COMMUNITIES
Capture	Bait collection	0	0	0	0	0
	Fishing	*	3	1	4	**3**
	Incidental behaviour	0	0	0	0	0
Direct impact without capture	Bait collection	0	0	0	0	0
	Fishing	1	2	1	4	2
	Incidental behaviour	0	0	0	0	0
	Gear loss	1	1	1	1	1
	Anchoring/mooring	0	0	0	0	0
	Navigation/steaming	1	1	2	1	1
Addition/ movement of biological material	Translocation of species	0	0	0	0	0
	On board processing	0	0	0	0	0
	Discarding catch	2	2	2	2	2
	Stock enhancement	0	0	0	0	0
	Provisioning	0	0	0	0	0
	Organic waste disposal	1	1	1	1	1
Addition of non-biological material	Debris	0	0	0	0	0
	Chemical pollution	0	0	0	0	0
	Exhaust	1	1	1	1	1
	Gear loss	1	1	1	1	1
	Navigation/steaming	1	1	1	1	1
	Activity/presence on water	2	2	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	0	0	0	0	0
	Navigation/steaming	1	1	1	1	1
External Impacts	Other fisheries	3	3	2	1	2
	Aquaculture	2	2	2	1	1
	Coastal development	2	2	1	2	2
	Other extractive activities	2	2	2	2	2
	Other non-extractive	2	2	1	2	1
	Other anthropogenic	2	2	1	2	1

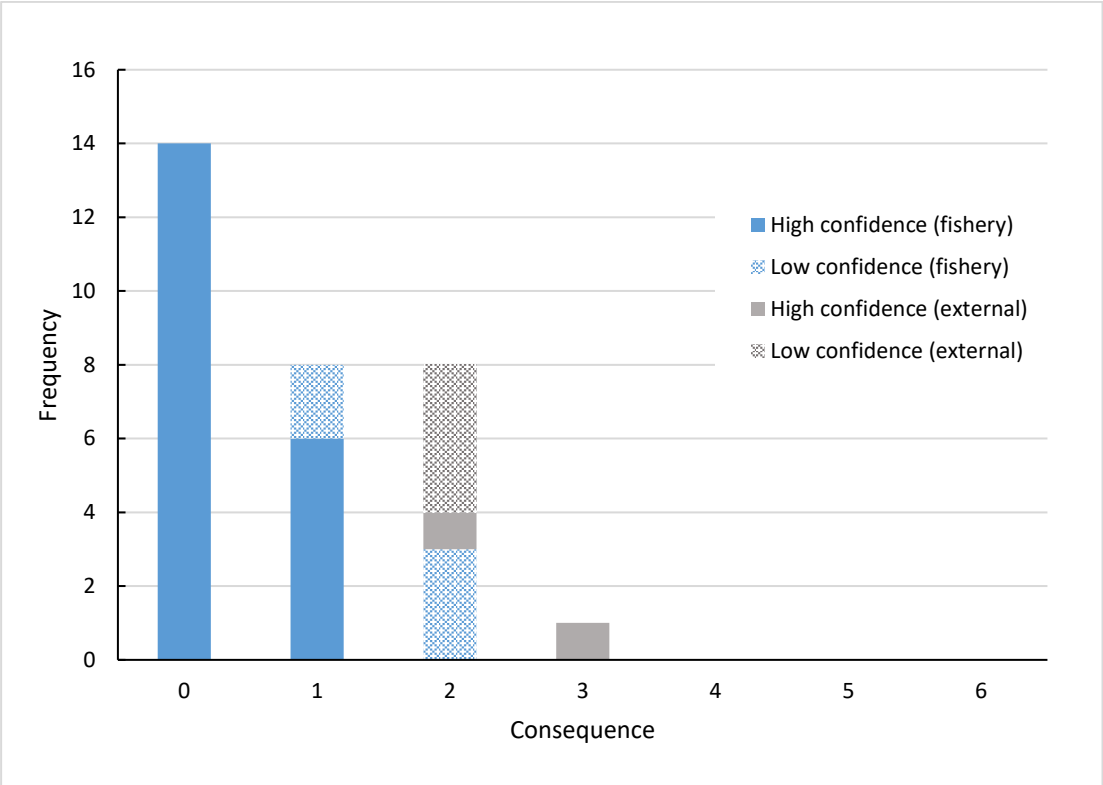


Figure 2.3. Key/secondary commercial species: Frequency of consequence score by high and low confidence.

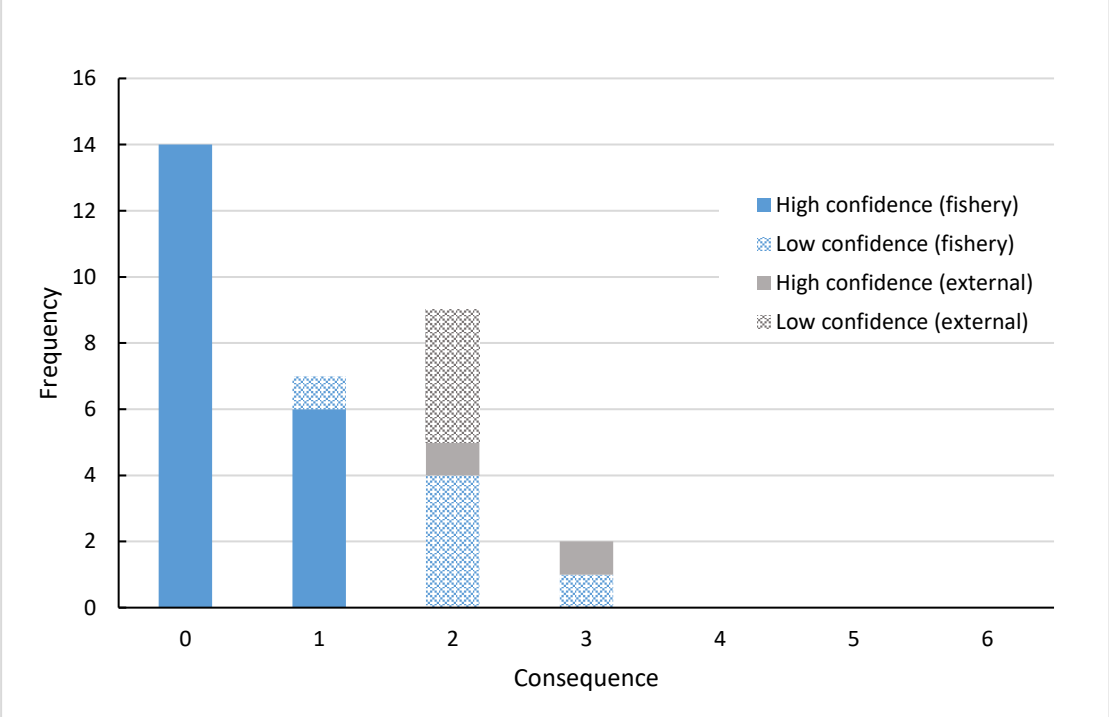


Figure 2.4. Byproduct and bycatch species: Frequency of consequence score by high and low confidence.

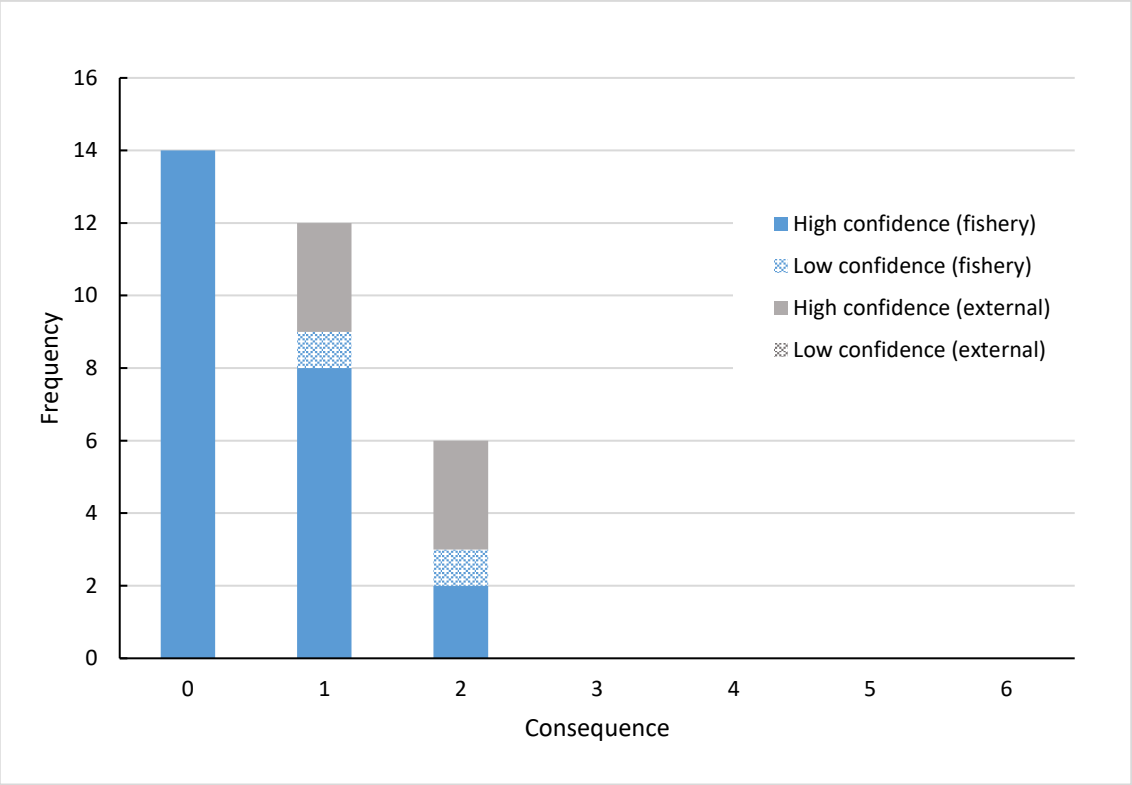


Figure 2.5. Protected species: Frequency of consequence score by high and low confidence.

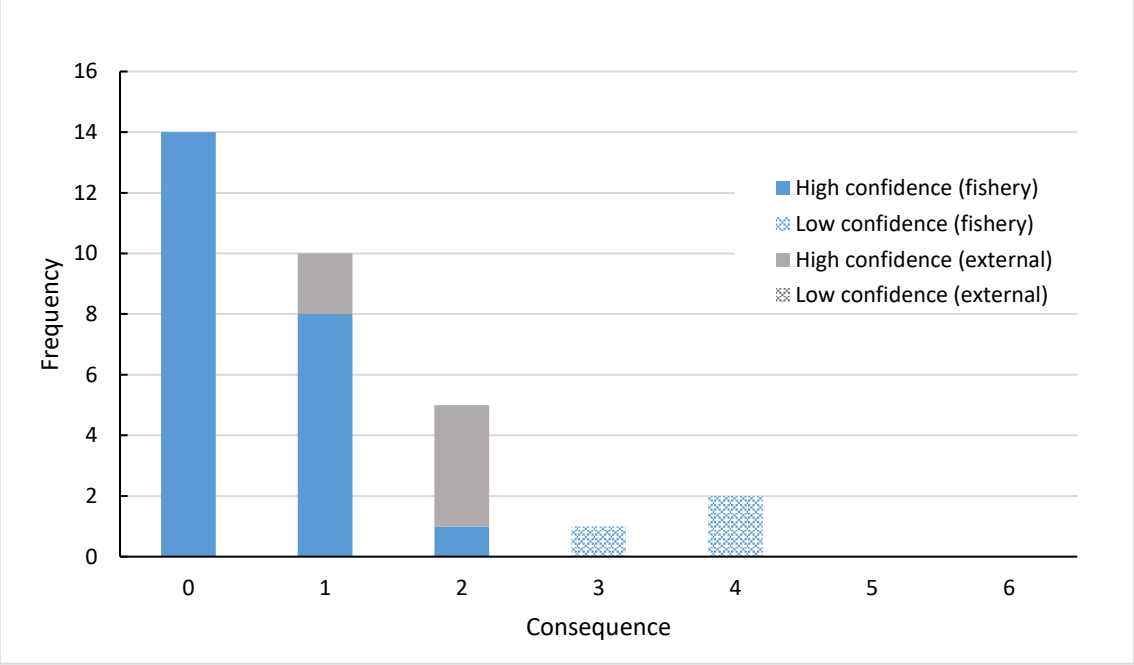


Figure 2.6. Habitat: Frequency of consequence score by high and low confidence.

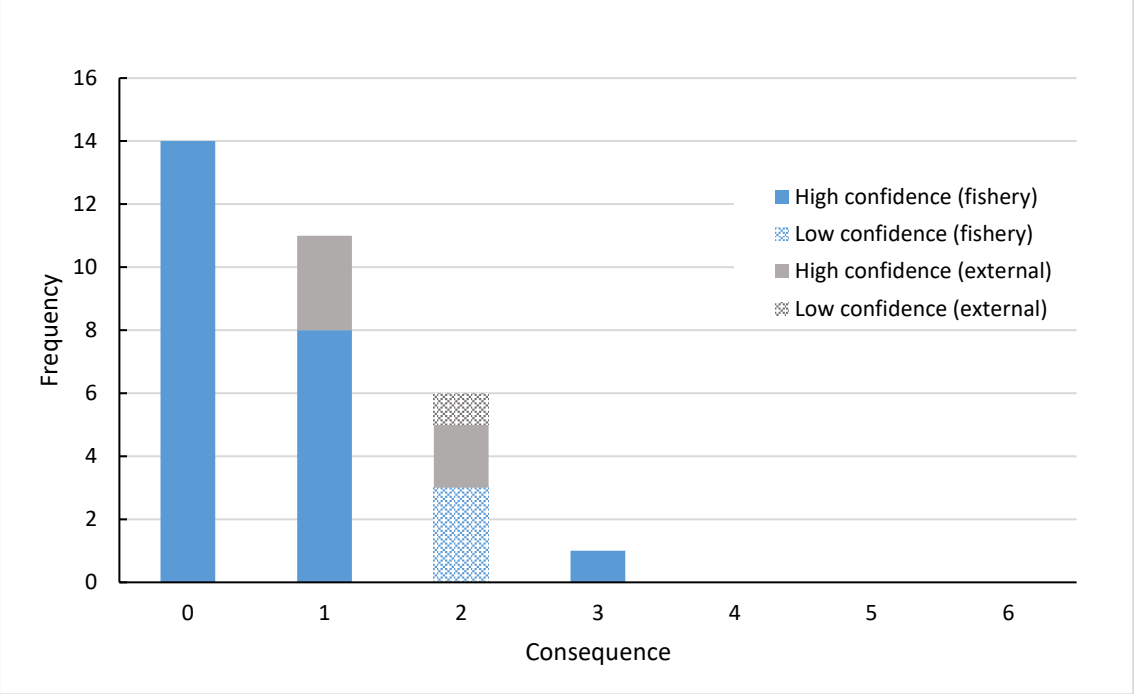


Figure 2.7. Communities: Frequency of consequence score by high and low confidence.

2.3.12 Evaluation/discussion of Level 1

Two ecological components were eliminated at Level 1 (i.e. no components with risk scores of 3 – moderate – or above): key/commercial and protected species.

A number of hazards (fishing activities) were eliminated at Level 1 (i.e. no components with risk scores of 3 – moderate – or above). Those remaining included:

- Fishing (direct capture impacts on 3 components)
- Fishing (without capture impacts on 1 component)
- Disturbance of physical processes (on 1 component)

As a result of direct capture by fishing, the most vulnerable byproduct/bycatch species, latchets, and a variety of chondrichthyans that are mostly discarded (AFMA logbooks) were assessed at moderate risk largely due to unknown population size within this assessment period.

Shy albatross was considered to be most at risk from capture although only two birds were fatally injured during the assessment period and therefore were not considered at high enough risk for further assessment. Longnosed fur seals are currently stable or increasing and were not considered at risk.

The impact of fishing represented a signficiant risk to habitats largely due to the relatively large footprint that the otter trawl has on the seafloor and the concentration within the assemblage in which the most vulnerable habitat types are known to exist (Pitcher et al. 2016).

Significant external hazards included other fisheries in the region on key commercial, and byproduct/bycatch species.

2.3.13 Components to be examined at Level 2

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

- Byproduct/bycatch

Therefore, a Level 2 examiniation is required. The habitats and community's components will not be examined at Level 2.

2.4 Level 2 Productivity and Susceptibility Analysis (PSA)

When the risk of an activity at Level 1 (SICA) on a component is moderate or higher and no planned management interventions that would remove this risk are identified, an assessment is required at Level 2. The PSA approach is a method of assessment which allows all units within any of the ecological components to be effectively and comprehensively screened for risk. The units of analysis are the complete set of species habitats or communities identified at the scoping stage. The PSA results in sections 2.4.2 and 2.4.3 of this report measure risk 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 analysis 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. (2007).

Species

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

Table 2.20. Attributes that measure productivity and suscepability.

	ATTRIBUTE
Productivity	Average age at maturity
	Average size at maturity
	Average maximum age
	Average maximum size
	Fecundity
	Reproductive strategy
	Trophic level
Susceptibility	Availability considers overlap of fishing effort with a species distribution
	Encounterability considers the likelihood that a species will encounter fishing gear that is deployed within the geographic range of that species (based on two attributes: adult habitat and bathymetry)

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

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

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

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

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

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

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

Habitats

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

Table 2.21. Description of susceptibility attributes for habitats.

ASPECT	ATTRIBUTE	CONCEPT	RATIONALE
Susceptability			
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, eg 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

Communities

There are seven steps for the PSA undertaken for each component brought forward from Level 1 analysis (see Hobday et al. 2006 for full details).

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

Step 2. Score units for productivity

Step 3. Score units for susceptibility

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

Step 5. Ranking of overall risk of each unit

Step 6. Evaluation of the PSA analysis

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

2.4.1 Units excluded from analysis (Step 1)

Table 2.22. Species/species groups/taxa excluded from the PSA and SAFE 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 assessment because they have not been observed within the fishery and/or occur outside the depth range of the fishery.

ROLE IN FISHERY	TAXA	FAMILY NAME	SCIENTIFIC NAME	COMMON NAME	CAAB CODE	RATIONALE
BP	Chondrichthyan	Brachaeluridae and related families	Brachaeluridae and related families - undifferentiated	Wobbegongs blind nurse carpet and zebra shark	37013000	Apportioned to rusty carpetshark.
BP	Chondrichthyan	Centrophoridae	*Deania calcea* and *Deania quadrispinosa*	Platypus sharks (mixed)	37020905	Apportioned to both species within species list. *Deania calcea* is *Deanis calceus*.
BP	Chondrichthyan	Pristiophoridae	Pristiophoridae - undifferentiated	Sawsharks	37023000	Apportioned to common sawshark and southern sawshark.
BP	Chondrichthyan	Squatinidae	Squatinidae - undifferentiated	Angel Sharks	37024000	Apportioned to Australian angelshark and ornate angelshark species.
BP	Chondrichthyan	Chimaeridae	Chimaeridae - undifferentiated	Ghostsharks	37042000	Apportioned this to 37042001 within list. ERA classifciation of 37042001 changed from BC to BP.
BP	Chondrichthyan	Dasyatidae, Gymnuridae, Myliobatidae and Urolophidae	Dasyatidae, Gymnuridae, Myliobatidae and Urolophidae spp	Rays	37990001	Apportioned to 4 species within species list.
BP	Invertebrate		Order Teuthoidea - undifferentiated	Squids	23615000	Apportioned to Gould's squid.
BP	Invertebrate	Loliginidae	Loliginidae - undifferentiated	Calamari	23617000	Apportioned to Southern calamari.
BP	Teleost	Congridae, Colocongridae	Congridae, Colocongridae - undifferentiated	Conger eels	37067000	Apportioned to 2 other species within list.
BP	Teleost	Zeidae	*Cyttopsis rosea*	Rosy Dory	37264010	Misidentification. Outside fishery range.
BP	Teleost	Serranidae	*Lepidoperca pulchella*	Eastern Orange Perch	37311001	Misidentification: outside fishery range. This species is inshore ocean perch (*Helicolenus percoides*; 37287001). Dan Corrie (AFMA) advice from skippers.

ROLE IN FISHERY	TAXA	FAMILY NAME	SCIENTIFIC NAME	COMMON NAME	CAAB CODE	RATIONALE
BP	Teleost	Pentacerotidae	Pentacerotidae - undifferentiated	Boarfishes	37367000	Apportioned to yellowspotted boarfish.
BP	Teleost	Pentacerotidae	*Paristiopterus labiosus*	Giant Boarfish	37367002	Misidentification: outside fishery range. This is yellow spotted boarfish (*Paristiopterus gallipavo*; 37367001). Dan Corrie (AFMA), advice from skippers.
BP	Teleost	Uranoscopidae	Uranoscopidae - undifferentiated	Stargazers	37400000	Apportioned to 4 species within list.
BP	Teleost	Balistidae, Monacanthidae	Balistidae, Monacanthidae - undifferentiated	Leatherjackets	37465000	Apportioned to leatherjacket species within list.
BP	Teleost		Mixed reef fish	Fish (mixed)	37999999	Insufficient taxonomic resolution.
BC	Chondrichthyan	Hexanchidae -	Hexanchidae - undifferentiated	Sixgill and sevengill sharks unspecified	37005000	Insufficient taxonomic resolution. No Hexanchidae within list.
BC	Chondrichthyan	Alopiidae	*Alopias* spp.	Thresher Sharks (mixed)	37012901	Insufficient taxonomic resolution. No species within list.
BC	Chondrichthyan	Orectolobidae	Orectolobidae	Wobbegong (mixed)	37013900	Apportioned to 37013001, 37013003, 37013005.
BC	Chondrichthyan		Scyliorhinidae - undifferentiated	Catsharks	37015000	Apportioned to 37015009, 37015013, 37015020, 37015026.
BC	Chondrichthyan	Scyliorhinidae	*Asymbolus analis*	Australian spotted catshark	37015027	Misidentification (Fishes of Australia); Within fishery (Fishbase).
BC	Chondrichthyan	Triakidae	Triakidae - undifferentiated	Hound Sharks	37017000	Apportioned to 3 species (37017001, 37017003, 37017008) within list.
BC	Chondrichthyan	Sphyrnidae	Sphyrnidae - undifferentiated	Hammerhead sharks	37019000	Apportioned to smooth hammerhead.
BC	Chondrichthyan	Centrophoridae, Dalatiidae, Squalidae, Somniosidae and Etmopteridae	Centrophoridae, Dalatiidae, Squalidae, Somniosidae and Etmopteridae - undifferentiated	Gulper sharks, Sleeper sharks, Dogfishes	37020000	Apportioned to 1 Dalatiidae, 2 Squalidae, 1 Somniosidae and 2 Etmopteridae species within list.
BC	Chondrichthyan	Urolophidae	Squalus chloroculus	Greeneye Dogfish	37020007	Inactive code - *Squalus mitsukurii* - is not an Australian species. It is *S. chloroculus* (CSIRO; W. White, Pers. comm).
BC	Chondrichthyan	Squalidae	*Squalus* spp	Greeneye Dogfishes (mixed)	37020901	Apportioned to 37020048 and 27020006.
BC	Chondrichthyan	Somniosidae	*Centroscymnus* spp	Sleeper Sharks (mixed)	37020906	Added 37020019.

ROLE IN FISHERY	TAXA	FAMILY NAME	SCIENTIFIC NAME	COMMON NAME	CAAB CODE	RATIONALE
BC	Chondrichthyan	Squalidae	Squalidae - undifferentiated	Dogfishes (mixed)	37020923	Apportioned to two species of Squalidae.
BC	Chondrichthyan	Pristiophoridae	*Pristiophorus* spp	Sawshark (mixed)	37023900	Apportioned to two species within list (37023001, 37023002).
BC	Chondrichthyan	Trygonorrhinidae	*Trygonorrhina* spp.	Fiddler Rays Unspecified	37027999	Apportioned to 37027006 and 37027011
BC	Chondrichthyan	Rajidae	*Raja* spp.	Skate (mixed)	37031900	No *Raja* spp within list.
BC	Chondrichthyan	Dasyatidae	Dasyatidae - undifferentiated	Stingrays	37035000	Apportioned to 37035001 and 37035002.
BC	Chondrichthyan	Urolophidae, Plesiobatidae	Urolophidae, Plesiobatidae - undifferentiated	Stingarees and giant stingarees	37038000	Apportioned to 37035001 and 37025002 within list.
BC	Chondrichthyan	Urolophidae	*Urolophus bucculentus*	Sandyback stingaree	37038001	Misidentification. Outside fishery range (Fishes of Australia).
BC	Chondrichthyan	Urolophidae	*Urolophus viridis*	Greenback stingaree	37038007	Misidentification. Outside fishery range (Fishes of Australia).
BC	Chondrichthyan	Myliobatidae	Myliobatidae - undifferentiated	Eagle rays	37039000	No Myliobatidae within list.
BC	Chondrichthyan	Chimaeridae	*Hydrolagus lemures*	Blackfin Ghostshark	37042003	This species has been superseded in 2018. It is now 37042001 - Ogilby's ghostshark, which was added to species list.
BC	Chondrichthyan	Chimaeridae	*Hydrolagus homonycteris*	Black ghostshark; Black whitefin	37042010	Misidentifcation. Outside fishery range
BC	Chondrichthyan		Sharks - other	Sharks (mixed)	37990003	Insufficient taxonomic resolution. Apportioned to shark species within list.
BC	Chondrichthyan		Skates and rays, unspecified	Skates and rays	37990018	Apportioned to 14 skate and ray species within existing list.
BC	Chondrichthyan		Order Rajiformes - undifferentiated	Skates and rays (mixed)	37990030	Apportioned to 15 skates and ray species within list across Rajidae, Dasyatidae, Trygonorrhinidae, Hypnidae, Torpedinidae, Arhynchobatidae, Arhynchobatidae.
BC	Gastropod	Cypraeidae	Cypraeidae - undifferentiated	Cowries	24155000	Insufficient taxonomic resolution.
BC	Invertebrate	Sepiidae	*Sepia* spp	Cuttlefish (mixed)	23607901	Insufficient taxonmic resolution; No species within list to apportion to. No *Sepia* spp. prior to assessment period.

ROLE IN FISHERY	TAXA	FAMILY NAME	SCIENTIFIC NAME	COMMON NAME	CAAB CODE	RATIONALE
BC	Invertebrate	Loliginidae	*Loligo opalescens*	Opalescent Inshore Squid	23617011	Misidentification. Outside fishery range.
BC	Invertebrate	Octopodidae	Octopodidae - undifferentiated	Octopuses	23659000	Insufficient taxonomic resolution.
BC	Invertebrate		Class Gastropoda - undifferentiated	Gastropods	24000000	Insufficient taxonomic resolution.
BC	Invertebrate	Crinoidea	Crinoidea - undifferentiated	Crinoids	25001000	Insufficient taxonomic resolution.
BC	Invertebrate		Class Asteroidea - undifferentiated	Starfish	25102000	Insufficient taxonomic resolution.
BC	Invertebrate		Class Echinoidea - undifferentiated	Sea urchins	25200000	Insufficient taxonomic resolution.
BC	Invertebrate		Class Holothuroidea - undifferentiated	Holothurians	25400000	Insufficient taxonomic resolution.
BC	Invertebrate	Penaeidae	*Penaeus esculentus*	Brown tiger prawn	28711044	Misidentification. Outside fishery range.
BC	Invertebrate	Nephropidae	Nephropidae - undifferentiated	Scampi	28786000	Insufficient taxonomic resolution.
BC	Invertebrate	Scyllaridae	Scyllaridae - undifferentiated	Bugs - shovel nosed and slipper lobsters	28821000	Insufficient taxonomic resolution.
BC	Invertebrate	Scyllaridae	*Ibacus peronii*	Eastern Balmain bug	28821004	Misidentifcation. Outside fishery range.
BC	Invertebrate	Scyllaridae	*Ibacus* and *Thenus* spp	Bugs (*Ibacus* and *Thenus*)	28821904	No species to apportion to. Insufficient taxonomic resolution.
BC	Invertebrate	Diogenidae	Diogenidae - undifferentiated	Hermit crabs (left-handed)	28827000	Insufficient taxonomic resolution.
BC	Invertebrate	Brachyura	Brachyura - undifferentiated	Crabs	28850000	Insufficient taxonomic resolution.
BC	Invertebrate	Hypothalassiidae	*Hypothalassia* spp	Champagne crabs (mixed)	28916901	Apportioned to 28916002.
BC	Invertebrate		Ascidiacea - undifferentiated	Ascidians	35000000	Insufficient taxonomic resolution.
BC	Teleost	Holothuriidae and Stichopodidae	Holothuriidae and Stichopodidae - undifferentiated	Beche-de-mer (sea cucumbers)	25415000	Insufficient taxonomic resolution.
BC	Teleost	Rhinidae	Rhinidae - undifferentiated	Guitarfishes, unspecified	37026000	No Rhinidae within list. Insufficient taxonomic resolution.
BC	Teleost	Rajidae	Rajidae - undifferentiated	Skates	37031000	Apportioned to 4 existing Rajidae species within list.
BC	Teleost	Chimaeridae	*Hydrolagus* spp	Ghostsharks	37042901	Apportioned to 37042001 - note the name change in 2018.

ROLE IN FISHERY	TAXA	FAMILY NAME	SCIENTIFIC NAME	COMMON NAME	CAAB CODE	RATIONALE
BC	Teleost	Anguillidae	*Anguilla reinhardtii*	Speckled longfin eel	37056002	Misidentifciation. Outside fishery range.
BC	Teleost	Muraenidae	Muraenidae - undifferentiated	Moray eels	37060000	No species to apportion to. Insufficient taxonomic resolution.
BC	Teleost	Congridae	*Conger verreauxi* and *Conger wilsoni*	Conger eel (mixed)	37067900	Apportioned to 37060000.
BC	Teleost	Clupeidae	*Clupea harengus*	Herring	37085790	Misidentification. Outside fishery range (Fishes of Australia).
BC	Teleost	Stomiidae	Stomiidae - undifferentiated	Scaly dragonfishes	37112000	Insufficient taxonomic resolution.
BC	Teleost	Chlorophthalmidae, Paraulopidae and Bathysauroididae, Bathysauropsidae	Chlorophthalmidae, Paraulopidae and Bathysauroididae, Bathysauropsidae - undifferentiated	Cucumberfishes, greeneyes and lizardfishes	37120000	Apportioned to 37120001.
BC	Teleost	Myctophidae	Myctophidae - undifferentiated	Lanternfishes	37122000	No Myctophidae in list. Insufficient taxonomic resolution.
BC	Teleost	Ceratiidae	Ceratiidae - undifferentiated	Seadevils	37220000	Insufficient taxonomic resolution.
BC	Teleost	Ophidiidae	*Ophidion muraenolepis*	Blackedge cusk	37228006	Misidentification. Outside fishery range.
BC	Teleost	Ophidiidae	*Genypterus* spp	Ling (mixed)	37228901	Apportioned to two species within list.
BC	Teleost	Ophidiidae	Ophidiidae spp.	Cusk eels (mixed)	37228999	Apportioned to 37228001, 37228008.
BC	Teleost	Macrouridae and Bathygadidae	Macrouridae and Bathygadidae - undifferentiated	Whiptails	37232000	Apportioned to 37232001, 37232002, 37232003 and 37232004.
BC	Teleost	Macrouridae	*Coelorinchus* spp	Whiptails, coelorinchid	37232900	Apportioned to 37232001, 37232002, 37232003)
BC	Teleost	Berycidae	*Centroberyx affinis*	Redfish	37258003	Misidentification. Outside fishery range. Possibly bight redfish.
BC	Teleost	Monocentrididae	Monocentrididae - undifferentiated	Pineapplefishes	37259000	Insufficient taxonomic resolution.
BC	Teleost	Cyttidae	*Cyttus novaezealandiae*	New Zealand dory	37264005	Misidentification. Outside fishery range.
BC	Teleost	Veliferidae	Veliferidae - undifferentiated	Veilfins	37269000	Aportioned to 37279001 and 37279002.
BC	Teleost	Macroramphosidae	Macroramphosidae - undifferentiated	Bellowfish	37279000	Apportioned to 37279001 and 37279002.
BC	Teleost	Synbranchidae	*Monopterus albus*	Belut	37285001	Misidentification. Outside fishery range.

ROLE IN FISHERY	TAXA	FAMILY NAME	SCIENTIFIC NAME	COMMON NAME	CAAB CODE	RATIONALE
BC	Teleost	Scorpaenidae	Scorpaenidae	Coral perch	37287900	No species within list to apportion to.
BC	Teleost	Scorpaenidae	*Scorpaena* spp	Scorpionfishes - Scorpaenid	37287904	Insufficient taxonomic resolution.
BC	Teleost	Neosebastidae	*Neosebastes* spp.	Gurnard perches, *Neosebastes*	37287927	Expanded to 5 species within list.
BC	Teleost	Triglidae and Peristediidae	Triglidae and Peristediidae - undifferentiated	Searobins and armour gurnards	37288000	Apportioned to 37288001, 37288003, 37288006 and 37288007.
BC	Teleost	Peristediidae	*Satyrichthys cf moluccense*	Blackfin armour gurnard	37288012	Misidentifciation. Outside fishery range.
BC	Teleost	Triglidae	*Lepidotrigla* spp	Butterfly gurnard (mixed)	37288901	Aportioned to two species within list.
BC	Teleost	Platycephalidae	Platycephalidae - undifferentiated	Flatheads	37296000	Apportioned to 3 existing species within list.
BC	Teleost	Hoplichthyidae	Hoplichthyidae - undifferentiated	Ghost Flatheads	37297000	Apportioned to 37297001.
BC	Teleost	Polyprionidae	*Polyprion americanus* and *Polyprion oxygeneios*	Hapuku and bass groper	37311902	Apportined to *P. oxygeneios* within list.
BC	Teleost	Priacanthidae	*Heteropriacanthus cruentatus*	Blotched bigeye	37326008	Misidentification. Outside fishery range.
BC	Teleost	Apogonidae, Dinolestidae -	Apogonidae, Dinolestidae - undifferentiated	Cardinalfishes	37327000	No Apogonidae, Dinolestidae - undifferentiated within list.
BC	Teleost	Carangidae	Carangidae - undifferentiated	Trevallies and scads	37337000	Apportioned to three species within list.
BC	Teleost	Carangidae	*Trachurus murphyi*	Chilean jack mackerel	37337077	Misidentification. Outside fishery range.
BC	Teleost	Carangidae	*Trachurus* spp	Mackerel scads	37337907	Apportioned to 37337002 and 37337003.
BC	Teleost	Carangidae	*Trachurus declivis* and *Trachurus murphyi*	Jack mackerels	37337912	Apportioned to *T. declivis* as *T. murphyi* is a mis-identification - outside fishery range.
BC	Teleost	Lutjanidae	*Etelis carbunculus*	Ruby snapper	37346014	Misidentifciation. Outside fishery range.
BC	Teleost	Lutjanidae	*Lutjanus* spp	Sea perch	37346905	No *Lutjanus* species within list. Insufficient taxonomic resolution.
BC	Teleost	Sciaenidae	*Argyrosomus hololepidotus* and *Protonibea diacanthus*	Mulloway, mixed	37354903	The *P. diacanthus* is a misidentification - outside fishery range. *A. japonicus* was added to list (note: *A. hololepidotus* is a synonym).
BC	Teleost	Pempheridídae, Leptobramidae	Pempheridídae, Leptobramidae - undifferentiated	Bullseyes and beach salmons	37357000	No species to apportion to. Insufficient taxonomic resolution.

ROLE IN FISHERY	TAXA	FAMILY NAME	SCIENTIFIC NAME	COMMON NAME	CAAB CODE	RATIONALE
BC	Teleost	Pentacerotidae	*Pseudopentaceros richardsoni*	Pelagic armourhead	37367009	Misidentification. Outside fishery range.
BC	Teleost	Oplegnathidae	Oplegnathidae - undifferentiated	Knifejaws	37369000	Apportioned to 37369002.
BC	Teleost	Cheilodactylidae	*Nemadactylus douglasii*	Grey morwong	37377002	Misidentifciation. Outside fishery range.
BC	Teleost	Cheilodactylidae	*Cheilodactylus spectabilis*	Banded morwong	37377006	Misidentifciation. Outside fishery range.
BC	Teleost	Labridae	*Epibulus insidiator*	Slingjaw wrasse	37384104	Misidentification. Outside fishery range.
BC	Teleost	Pinguipedidae	Pinguipedidae - undifferentiated	Grubfishes	37390000	No species to apportion to within list. Could be *Parapercis haackei*.
BC	Teleost	Scombridae	Scombridae spp (tribes Scomberomorini and Scombrini)	Mackerel (mixed)	37441911	Apportioned to 37445001 and 37445005 within list.
BC	Teleost	Centrolophidae	*Tubbia tasmanica*	Tasmanian rudderfish	37445002	Misidentification. Outside fishery range.
BC	Teleost	Nomeidae	Nomeidae - undifferentiated	Driftfishes	37446000	No species to apportion to. Insufficient taxonomic resolution.
BC	Teleost	Ostraciidae	Ostraciidae - undifferentiated	Boxfishes	37466000	Apportioned to 3 species: 37446010, 37446011, 37446014.
BC	Teleost	Ostraciidae	*Anoplocapros inermis*	Eastern smooth boxfish	37466002	Misidentification. Outside fishery range.
BC	Teleost	Tetraodontidae	Tetraodontidae - undifferentiated	Toadfishes unspecified	37467000	Apportioned to 37467002.
BC	Teleost	Diodontidae	Diodontidae - undifferentiated	Porcupine fish	37469000	Apportioned to 37469002.
BC	Teleost	Molidae	Molidae - undifferentiated	Ocean sunfishes	37470000	Apportioned to 37447001.
BC	Teleost	Scorpaenidae, Triglidae and Peristediidae	Scorpaenidae, Triglidae and Peristediidae - undifferentiated	Scorpionfishes, gurnards and latchets	37990084	Apportioned to 3 Triglidae species.
BC			Porifera - undifferentiated	Sponges	10000000	Insufficient taxonomic resolution.
BC		Spongiidae	Spongiidae - undifferentiated	Spongiid sponges	10114000	Insufficient taxonomic resolution.
BC			Subclass Octocorallia - undifferentiated	Octocorals - Soft corals	11169000	
BC		Coralliidae	Coralliidae - undifferentiated	Precious corals	11183000	
BC			Order Scleractinia - undifferentiated	Stony corals	11290000	
BC			Shells	Shells	23999999	Insufficient taxonomic resolution.

ROLE IN FISHERY	TAXA	FAMILY NAME	SCIENTIFIC NAME	COMMON NAME	CAAB CODE	RATIONALE
BC			Infraorder Anomura - undifferentiated	Anomurans	28825000	Insufficient taxonomic resolution.
BC			Various bits of the sea floor which may be alive	Benthos	99000001	Benthos
BC			Substrate or rocks that are non-living	Substrate or rocks	99000002	Benthos
BC			Human attributed objects (e.g. pipeline) or garbage	Human attributed objects	99000003	Insufficient taxonomic resolution.
BC			Identity unknown or bad data	Unknown or other	99999999	Insufficient taxonomic resolution.
PS	Marine bird	Procellariidae	*Pterodroma leucoptera*	Gould’s petrel	40041030	Misidentification. Mostly likely Gould's squid (AFMA; Dan Corrie pers. comm).
PS	Marine bird	Procellariidae	*Puffinus* spp. - undifferentiated	Shearwaters	40041050	Expanded
PS	Marine bird	Procellariidae	*Puffinus* spp.	Shearwaters (mixed old afma code)	40041999	Expanded
PS	Teleost	Syngnathidae	Syngnathidae - undifferentiated	Seahorses and pipefishes	37282000	Expanded

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

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

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

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

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

Observer data and observer expert knowledge are important sources of information in the PSA analyses, particularly for the bycatch and protected components. The level of observer data for this fishery is regarded as medium. An AFMA observer program has been operating since July 2003, 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 Habitat PSA results

The Habitat component was not assessed at Level 2.

Summary of Community PSA results

The Community component was not assessed at Level 2.

2.4.3 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.

2.4.4 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 regarding 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.

2.4.5 PSA results and discussion

a) Key/secondary commercial species

Under the revised ERAEF (AFMA 2017), key/secondary commercial species that undergo Tier stock assessments are not assessed at Level 2 with respect to the direct impact of capture of fishing hazard. This component was eliminated at Level 1 for other hazards and therefore not assessed at Level 2.

b) Commercial bait species

There are no commercial bait species in this sub-fishery.

c) Byproduct species

There was one medium risk teleost (Common gurnard perch - *Neosebastes scorpaenoides*), that was unassessable in bSAFE (Table 2.23).

Of the other two invertebrate byproduct species assessed in this PSA, one was high risk and one low risk (Table 2.23, Figure 2.8). The high-risk species was Gould's squid (*Nototodarus gouldi*) and therefore subject to a residual risk analysis (Table 2.23, Section 2.9).

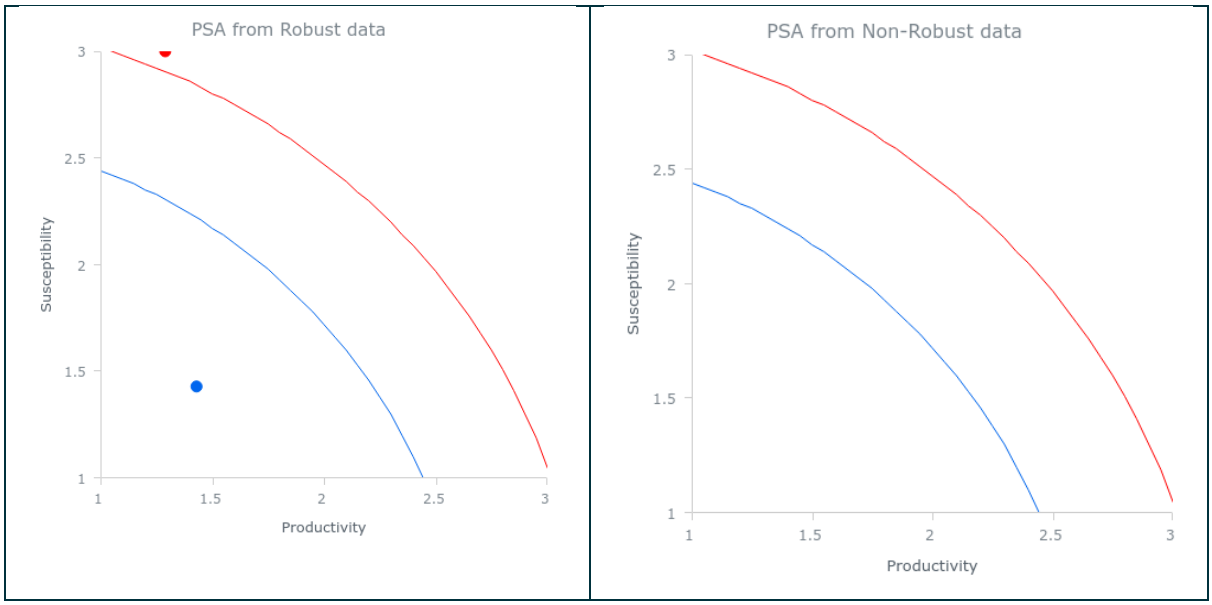


Figure 2.8. PSA plot for byproduct species in the SESSF GAB Otter trawl sub-fishery for a) robust [left] and (b) data deficient [right] species. Note many species fall on some points.

Table 2.23. Summary of the 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 2.25 (in report). Susceptibility attributes (S1-S4) are listed in Susceptibility attributes Table 2.26 (in report). Missing attributes are highlighted (red). Productivity score (Prod. score); Susceptibility score (Susc. score). No. interactions (No. Int) or catch (2012-2016) reported for extreme or high risk scores only (source: Commonwealth logbook (Log) and observer (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 at the foot of this table. R: retained. NE: not entered.

CAAB CODE	SCIENTIFIC NAME	COMMON NAME	P1	P2	P3	P4	P5	P6	P7	S1	S2	S3	S4	PROD. SCORE	SUSC. SCORE	MISSING ATTRIB-UTES	PSA 2D	RISK CATEGORY	NO. INT. OR CATCH (2012-2016)	RISK SCORE FOLLOWING RESIDUAL RISK	FINAL RISK SCORE
Following 1 BP species were unassessable in bSAFE and analysed in PSA:																					
37287005	*Neosebastes scorpaenoides*	Common gurnard perch	3	3	3	1	2	1	3	1.03	2.90	3	3	2.29	1.65	3	2.82	Medium	NE	No RR required	Medium
Other BP species:																					
23636004	*Nototodarus gouldi*	Gould's squid	1	1	1	1	1	2	2	3	3	3	3	1.29	3	1	3.27	High	122.9 t ret. (Log). Also, Squids: 85.6 t ret. (Log), 14.3 t dis. (Log).	Population status unknown. No existing tiered assessment in this fishery or SSJ fishery, but Squid resource assessment group consider this species to be sustainable. A combined catch limit of 2000 t for the SESSF- GABT and SESSF-OT	High

CAAB CODE	SCIENTIFIC NAME	COMMON NAME	P1	P2	P3	P4	P5	P6	P7	S1	S2	S3	S4	PROD. SCORE	SUSC. SCORE	MISSING ATTRIB-UTES	PSA 2D	RISK CATEGORY	NO. INT. OR CATCH (2012-2016)	RISK SCORE FOLLOWING RESIDUAL RISK	FINAL RISK SCORE
																				sectors are in place. RR remains high	
23617005	*Sepioteuthis australis*	Southern calamari	1	1	2	1	1	2	2	3	1	2	3	1.43	1.43	1	2.02	Low	NE	No RR required	Low

Risk ranking guidelines:

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

d) Bycatch species

There were 16 bycatch species analysed in this PSA comprising 11 teleosts all of which were unassessable in bSAFE and five invertebrate species (Table 2.24). Of these 16 species, three were high risk, 10 were medium risk and three were low risk. Two teleosts were assessed at high risk: three-spined cardinal fish *Verilus anomalus* and thetis fish *Neosebastes thetidis.*

Of the invertebrates, only one species was assessed at high risk champagne crab *Hypothalassia armata*, three at medium risk: giant crab *Pseudocarcinus gigas,* southern rock lobster *Jasus edwardsii* and false bailer shell *Livonia mammilla* and one at low risk: blue swimmer crab *Portunus armatus* (Table 2.24, Figure 2.9).

A residual risk analysis was performed on the three high risk species (see Section 2.9).

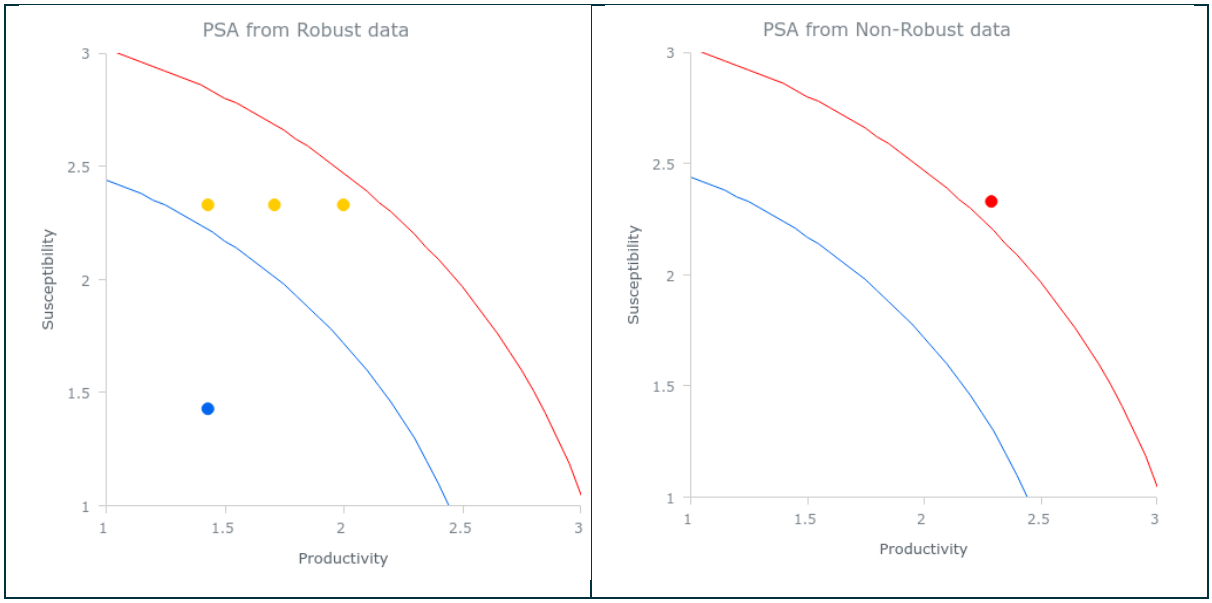


Figure 2.9. PSA plot for bycatch species in the SESSF GAB Otter trawl sub-fishery for a) robust [left] and (b) data deficient [right] species. Note many species fall on some points.

Table 2.24. Summary of the 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 2.25 (in report). Susceptibility attributes (S1-S4) are listed in Susceptibility attributes Table 2.26 (in report). Missing attributes are highlighted (red). Productivity score (Prod. score); Susceptibility score (Susc. Score). No. interactions (No. Int) or catach (2012-2016) reported for extreme or high risk scores only (source: Commonwealth logbook (Log) and observer (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 at the foot of this table. R: retained. NE: not entered.

CAAB CODE	SCIENTIFIC NAME	COMMON NAME	P1	P2	P3	P4	P5	P6	P7	S1	S2	S3	S4	PROD. SCORE	SUSC. SCORE	MISSING ATTRIB-UTES	PSA 2D	RISK CATEGORY	NO. INT. OR CATCH (2012-2016)	RISK SCORE FOLLOWING RESIDUAL RISK	FINAL RISK SCORE
Following 11 BC species were unassessable in bSAFE and analysed in PSA:																					
37311053	*Verilus anomalus*	Three-spined cardinalfish	3	3	3	3	3	3	3	1.75	3	3	3	3	2.16	9	3.70	High	13 kg dis. (Obs)	3 – Low interaction/capture. 7 productivity and 2 susceptibility attributes are not available. Between 1-4% Observer coverage. Based on low interaction/catch, risk reduced to low.	Low
37287006	*Neosebastes thetidis*	Thetis fish	3	3	3	1	1	1	3	3	3	3	3	2.14	2.14	3	3.69	High	25 kg ret. (Log). 131.9 kg ret., 975.5 kg dis. (Obs).	3 – Low interaction/capture. 3 productivity attributes are not available. Between 1-4% Observer coverage.	Low

CAAB CODE	SCIENTIFIC NAME	COMMON NAME	P1	P2	P3	P4	P5	P6	P7	S1	S2	S3	S4	PROD. SCORE	SUSC. SCORE	MISSING ATTRIB-UTES	PSA 2D	RISK CATEGORY	NO. INT. OR CATCH (2012-2016)	RISK SCORE FOLLOWING RESIDUAL RISK	FINAL RISK SCORE
																				Based on low interaction/catch, risk reduced to low.	
37287003	*Neosebastes pandus*	Bighead gurnard perch	3	3	3	1	2	1	3	1.42	3	3	3	2.29	1.93	3	2.99	Medium	NE	No RR required	Medium
37297001	*Hoplichthys haswelli*	Deepsea flathead	3	3	3	1	2	1	3	1	3	3	3	2.29	1.65	3	2.82	Medium	NE	No RR required	Medium
37466014	*Caprichthys gymnura*	Rigid boxfish	3	3	3	3	1	3	2	1.27	3	3	3	2.57	1.87	6	3.15	Medium	NE	No RR required	Medium
37067002	*Gnathophis longicaudus*	Little conger	3	3	3	1	2	3	3	1	1	3	3	2.57	1.2	4	2.84	Medium	NE	No RR required	Medium
37287004	*Neosebastes bougainvillii*	Gulf gurnard perch	3	3	3	1	2	3	3	3	1	3	3	2.57	1.65	4	3.05	Medium	NE	No RR required	Medium
37013005	*Parascyllium ferrugineum*	Rusty carpetshark	3	3	3	1	2	2	3	1.07	3	3	3	2.43	1.70	2	2.97	Medium	NE	No RR required	Medium
37466011	*Capropygia unistriata*	Spiny boxfish	3	3	3	1	1	1	2	3	3	2	3	2	2.33	3	3.07	Medium	NE	No RR required	Medium
37070001	*Diastobranchus capensis*	Basketwork eel	3	3	1	2	2	1	3	1	2.30	3	3	2.14	1.49	2	2.61	Low	NE	No RR required	Low
37466010	*Anoplocapros lenticularis*	Whitebarred boxfish	3	3	3	1	1	1	3	1.02	3	2	3	2.14	1.44	3	2.58	Low	NE	No RR required	Low
Other BC species:																					
28916002	*Hypothalassia armata*	Champagne crab	3	3	3	1	1	2	3	3	3	2	3	2.29	2.33	5	3.27	High	0 ret., 3 kg dis. (Log). Also, 148 kg dis. (Log) of	3 – Low interaction/capture. 4 productivity and 1	Low

CAAB CODE	SCIENTIFIC NAME	COMMON NAME	P1	P2	P3	P4	P5	P6	P7	S1	S2	S3	S4	PROD. SCORE	SUSC. SCORE	MISSING ATTRIB-UTES	PSA 2D	RISK CATEGORY	NO. INT. OR CATCH (2012-2016)	RISK SCORE FOLLOWING RESIDUAL RISK	FINAL RISK SCORE
																			Champagne crabs (mixed)	susceptibility attributes are not available. Based on low interaction rate, risk is reduced to low. Between 1-4% Oberver coverage.	
28915002	*Pseudocarcinus gigas*	Giant crab	2	3	1	1	1	2	2	3	3	2	3	1.71	2.33	2	2.89	Medium	NE	No RR required	Medium
24207001	*Livonia mammilla*	False bailer shell	3	3	3	1	1	2	1	3	3	2	3	2	2.33	2	3.07	Medium	NE	No RR required	Medium
28820001	*Jasus edwardsii*	Southern rock lobster	2	2	1	1	1	2	1	3	3	2	3	1.43	2.33	1	2.73	Medium	NE	No RR required	Medium
28911005	*Portunus armatus*	Blue swimmer crab	1	1	1	1	1	3	2	3	1	2	3	1.43	1.43	2	2.02	Low	NE	No RR required	Low

Risk ranking guidelines:

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

e) Protected species

There was no PSA required for the protected species component in this sub-fishery.

Productivity attributes

Table 2.25. Productivity attribute names and cutoff scores for the ERAF L2 PSA method. These cutoffs 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 years	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

Susceptibility attributes

Table 2.26. Susceptibility attribute names and cutoff scores for the ERAF L2 PSA method. These cutoffs 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)

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 2.27):

- 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 chondricthyans: score is 2
    - sygnathids: score is 1

Table 2.27. Post capture mortality attribute risk score for the GAB Otter trawl sub-fishery for the ERAEF L2 PSA and bSAFE methods. High: H; M: medium; Low: L. Risk scores that are not assigned by taxa (not specific) for each ERAEF classification are shaded.

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. sygnathids, invertebrates (if any)	Do not get hooked/trapped	L	1

2.5 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 2.28). If all reference points are categorised as 'Below', then the overall risk is low. The intensity of fishing effort and gear affected area were used to estimate F, instead of gridded effort.

Table 2.28 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

2.5.1 bSAFE – Key/secondary commercial species

Under the revised ERAEF (AFMA 2017), key/secondary commercial species that undergo Tier stock assessments are not assessed at Level 2 with respect to the direct impact of capture of fishing hazard. This component was eliminated at Level 1 for other hazards and therefore not assessed at Level 2.

2.5.2 bSAFE - Commercial bait species

There were no commercial bait species in this sub-fishery.

2.5.3 bSAFE - Byproduct species

There were 35 byproduct species analysed in this bSAFE (Table 2.29, Figure 2.10a, b). Of these, the common gurnard perch (*Neosebastes scorpaenoides*) was unassessable due to missing biological attributes and therefore assessed in a PSA (see results; Table 2.23). All remaining 34 species species were assessed at low risk.

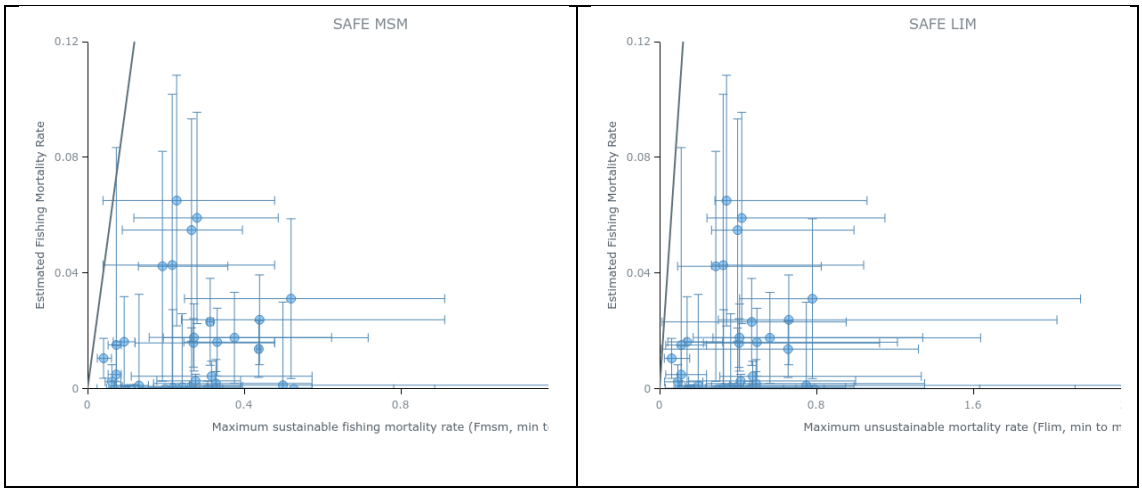


Figure 2.10. SAFE plot for Byproduct species in the SESSF GAB Otter trawl sub-fishery for (a) SAFE-MSM reference point [left] and (b) SAFE limit (LIM) reference point [right].

Table 2.29. bSAFE risk categories for byproduct species ecological component for F_MSM, F_Lim and F_Crash. A residual risk (RR) analysis conducted for extreme and high risk species. Catch from Commonwealth logbook (Log) and observer (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 at the foot of this table. NE: not entered. Ret: retained; dis: discarded. ^ Tiered species in this sub-fishery.

CAAB CODE	SCIENTIFIC NAME	COMMON NAME	SUSCEP-TIBILITY	F MSM	F MSM RISK	F LIM	F LIM RISK	F CRASH	F CRASH RISK	F OVERALL RISK	CATCH (2012-2016)	RISK SCORE FOLLOWING RESIDUAL RISK	FINAL RISK SCORE
Following 1 BP species unassessable in SAFE:													
37287005	*Neosebastes scorpaenoides*	Common gurnard perch	0.000	-	NA	-	NA	-	NA	NA	-	-	See Table 2.23
Other BP species:													
37024002	*Squatina tergocellata*	Ornate angelshark	0.015	0.07	Below	0.11	Below	0.15	Below	Low	NE	No RR required	Low
37018001	*Carcharhinus brachyurus*	Bronze whaler	0.011	0.04	Below	0.06	Below	0.08	Below	Low	NE	No RR required	Low
37377004	*Nemadactylus valenciennesi*	Blue morwong	0.065	0.23	Below	0.34	Below	0.46	Below	Low	NE	No RR required	Low
37228001	*Dannevigia tusca*	Tusk	0.000	0.23	Below	0.34	Below	0.46	Below	Low	NE	No RR required	Low
37023002	*Pristiophorus cirratus*	Common sawshark	0.016	0.09	Below	0.14	Below	0.19	Below	Low	NE	No RR required	Low
37377003	*Nemadactylus macropterus*	Jackass morwong	0.043	0.22	Below	0.32	Below	0.43	Below	Low	NE	No RR required	Low
37367001	*Paristiopterus gallipavo*	Yellowspotted boarfish	0.059	0.28	Below	0.42	Below	0.56	Below	Low	NE	No RR required	Low
37311006	*Polyprion oxygeneios*	Hapuku	0.001	0.13	Below	0.20	Below	0.26	Below	Low	NE	No RR required	Low
37228002	*Genypterus blacodes*	Pink ling	0.042	0.19	Below	0.29	Below	0.38	Below	Low	NE	No RR required	Low
37337062	*Pseudocaranx georgianus*	Silver trevally	0.016	0.27	Below	0.4	Below	0.53	Below	Low	NE	No RR required	Low

CAAB CODE	SCIENTIFIC NAME	COMMON NAME	SUSCEP-TIBILITY	F MSM	F MSM RISK	F LIM	F LIM RISK	F CRASH	F CRASH RISK	F OVERALL RISK	CATCH (2012-2016)	RISK SCORE FOLLOWING RESIDUAL RISK	FINAL RISK SCORE
37013003	*Orectolobus maculatus*	Spotted wobbegong	0.0004	0.07	Below	0.1	Below	0.14	Below	Low	NE	No RR required	Low
37017001	*Mustelus antarcticus*	Gummy shark	0.000	0.1	Below	0.15	Below	0.21	Below	Low	NE	No RR required	Low
37024001	*Squatina australis*	Australian angel shark	0.005	0.07	Below	0.11	Below	0.15	Below	Low	NE	No RR required	Low
37039001	*Myliobatis tenuicaudatus*	New Zealand eagle ray; Southern eagle ray	0.003	0.07	Below	0.11	Below	0.14	Below	Low	NE	No RR required	Low
37224002	*Mora moro*	Ribaldo	0.000	0.31	Below	0.46	Below	0.61	Below	Low	NE	No RR required	Low
37227001	*Macruronus novaezelandiae*	Blue grenadier	0.001	0.25	Below	0.37	Below	0.50	Below	Low	NE	No RR required	Low
37255009	*Hoplostethus atlanticus*	Orange roughy	0.000	0.12	Below	0.18	Below	0.24	Below	Low	NE	No RR required	Low
37264001	*Cyttus traversi*	King dory	0.001	0.5	Below	0.75	Below	1	Below	Low	NE	No RR required	Low
37264004	*Zeus faber*	John dory	0.016	0.33	Below	0.50	Below	0.67	Below	Low	NE	No RR required	Low
37269001	*Metavelifer multiradiatus*	Common veilfin	0.014	0.44	Below	0.66	Below	0.88	Below	Low	NE	No RR required	Low
37287001	*Helicolenus percoides*	Reef ocean perch	0.000	0.23	Below	0.35	Below	0.46	Below	Low	NE	No RR required	Low
37287093	*Helicolenus barathri*	Bigeye ocean perch	0.000	0.2	Below	0.3	Below	0.4	Below	Low	NE	No RR required	Low
37288001	*Chelidonichthys kumu*	Red gurnard	0.031	0.52	Below	0.78	Below	1.04	Below	Low	NE	No RR required	Low
37288006	*Pterygotrigla polyommata*	Latchet	0.024	0.44	Below	0.65	Below	0.87	Below	Low	NE	No RR required	Low
37353001	*Chrysophrys auratus*	Snapper	0.018	0.28	Below	0.41	Below	0.55	Below	Low	NE	No RR required	Low

CAAB CODE	SCIENTIFIC NAME	COMMON NAME	SUSCEP-TIBILITY	F MSM	F MSM RISK	F LIM	F LIM RISK	F CRASH	F CRASH RISK	F OVERALL RISK	CATCH (2012-2016)	RISK SCORE FOLLOWING RESIDUAL RISK	FINAL RISK SCORE
37367004	*Pentaceros decacanthus*	Bigspine boarfish	0.001	0.27	Below	0.4	Below	0.53	Below	Low	NE	No RR required	Low
37367005	*Zanclistius elevatus*	Blackspot boarfish	0.055	0.27	Below	0.4	Below	0.53	Below	Low	NE	No RR required	Low
37369002	*Oplegnathus woodwardi*	Knifejaw	0.023	0.31	Below	0.47	Below	0.63	Below	Low	NE	No RR required	Low
37384014	*Xiphocheilus typus*	Bluetooth tuskfish	0.000	0.53	Below	0.79	Below	1.06	Below	Low	NE	No RR required	Low
37400002	*Ichthyscopus barbatus*	Fringe stargazer	0.002	0.33	Below	0.49	Below	0.66	Below	Low	NE	No RR required	Low
37400003	*Kathetostoma laeve*	Common stargazer	0.004	0.33	Below	0.49	Below	0.66	Below	Low	NE	No RR required	Low
37400005	*Pleuroscopus pseudodorsalis*	Scaled stargazer	0.000	0.33	Below	0.49	Below	0.66	Below	Low	NE	No RR required	Low
37439002	*Rexea solandri*	Gemfish	0.003	0.28	Below	0.41	Below	0.55	Below	Low	NE	No RR required	Low
37465006	*Nelusetta ayraud*	Ocean jacket	0.018	0.38	Below	0.56	Below	0.75	Below	Low	NE	No RR required	Low

Risk ranking guidelines:

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

2.5.4 bSAFE - Bycatch species

There were 117 bycatch species analysed in bSAFE (Table 2.30). Eleven of these species (10 teleosts and one chondrichthyan) were unassessable due to missing biological attributes and were subsequently assessed in a PSA (see results Table 2.24). Of the 106 assessable species, one was medium risk and 105 were low risk (

Figure 2.11a, b; Table 2.30).

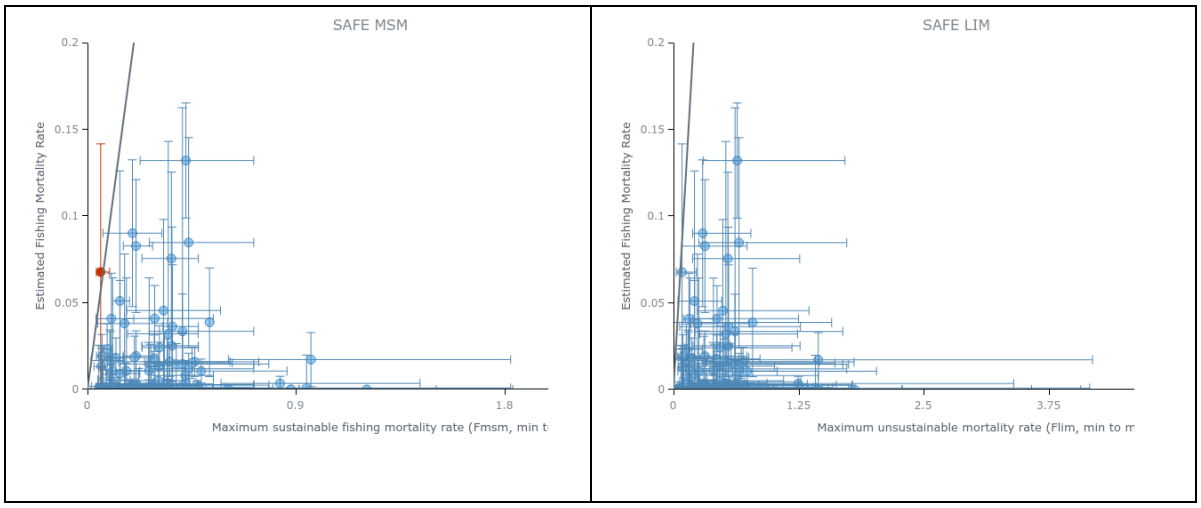


Figure 2.11. SAFE plot for Bycatch species in the SESSF GABT sub-fishery for (a) SAFE-MSM reference point [left] and (b) SAFE limit (LIM) reference point [right].

Table 2.30. bSAFE risk categories for bycatch species ecological component for F_MSM, F_Lim and F_Crash. A residual risk (RR) analysis conducted for extreme and high risk species. Catch from Commonwealth logbook (Log) and observer (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 at the foot of this table. R: retained. NE: not entered. NA: not assessable.

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	CATCH (2012-2016)	RISK SCORE FOLLOWING RESIDUAL RISK	FINAL RISK SCORE
The following 11 species have been analysed in the PSA (see Table 2.24):													
37466014	*Caprichthys gymnura*	Rigid boxfish	0.017	-	NA	-	NA	-	NA	NA	-	-	see Table 2.24
37466011	*Capropygia unistriata*	Spiny boxfish	0.045	-	NA	-	NA	-	NA	NA	-	-	see Table 2.24
37466010	*Anoplocapros lenticularis*	Whitebarred boxfish	0.008	-	NA	-	NA	-	NA	NA	-	-	see Table 2.24
37311053	*Verilus anomalus*	Three-spined cardinalfish	0.024	-	NA	-	NA	-	NA	NA	-	-	see Table 2.24
37297001	*Hoplichthys haswelli*	Deepsea flathead	0.003	-	NA	-	NA	-	NA	NA	-	-	see Table 2.24
37287006	*Neosebastes thetidis*	Thetis fish	0.091	-	NA	-	NA	-	NA	NA	-	-	see Table 2.24
37287004	*Neosebastes bougainvillii*	Gulf gurnard perch	0.004	-	NA	-	NA	-	NA	NA	-	-	see Table 2.24
37287003	*Neosebastes pandus*	Bighead gurnard perch	0.023	-	NA	-	NA	-	NA	NA	-	-	see Table 2.24
37070001	*Diastobranchus capensis*	Basketwork eel	0.000	-	NA	-	NA	-	NA	NA	-	-	see Table 2.24
37067002	*Gnathophis longicaudus*	Little conger	0.000	-	NA	-	NA	-	NA	NA	-	-	see Table 2.24
37013005	*Parascyllium ferrugineum*	Rusty carpetshark	0.013	-	NA	-	NA	-	NA	NA	-	-	see Table 2.24
Other BC species:													
37038008	*Urolophus expansus*	Wide stingaree	0.051	0.14	Below	0.21	Below	0.28	Below	Low	NE	No RR required	Low
37028003	*Torpedo macneilli*	Short-tail torpedo ray	0.011	0.11	Below	0.16	Below	0.22	Below	Low	NE	No RR required	Low
37020006	*Squalus megalops*	Piked spurdog; spikey dogfish	0.068	0.06	Above	0.09	Below	0.12	Below	Medium	NE	No RR required	Medium

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	CATCH (2012-2016)	RISK SCORE FOLLOWING RESIDUAL RISK	FINAL RISK SCORE
37017008	*Galeorhinus galeus*	School shark	0.019	0.06	Below	0.09	Below	0.13	Below	Low	NE	No RR required	Low
37031003	*Dentiraja cerva*	Whitespotted skate	0.041	0.1	Below	0.15	Below	0.21	Below	Low	NE	No RR required	Low
37031001	*Irolita waitii*	Southern round skate	0.023	0.09	Below	0.13	Below	0.17	Below	Low	NE	No RR required	Low
37031006	*Spiniraja whitleyi*	Melbourne skate	0.000	0.06	Below	0.09	Below	0.12	Below	Low	NE	No RR required	Low
37258006	*Centroberyx australis*	Yelloweye redfish	0.032	0.35	Below	0.52	Below	0.70	Below	Low	NE	No RR required	Low
37311055	*Callanthias australis*	Splendid perch	0.018	0.29	Below	0.43	Below	0.58	Below	Low	NE	No RR required	Low
37311175	*Lepidoperca filamenta*	Western orange perch	0.083	0.21	Below	0.32	Below	0.42	Below	Low	NE	No RR required	Low
37005001	*Heptranchias perlo*	Sharpnose sevengill shark	0.001	0.1	Below	0.15	Below	0.2	Below	Low	NE	No RR required	Low
37007001	*Heterodontus portusjacksoni*	Port Jackson shark	0.013	0.07	Below	0.10	Below	0.14	Below	Low	NE	No RR required	Low
37311052	*Lepidoperca occidentalis*	Slender orange perch	0.019	0.21	Below	0.32	Below	0.42	Below	Low	NE	No RR required	Low
37015013	*Cephaloscyllium albipinnum*	Whitefin swellhark	0.009	0.12	Below	0.18	Below	0.24	Below	Low	NE	No RR required	Low
37465032	*Eubalichthys quadrispinis*	Fourspine leatherjacket	0.085	0.44	Below	0.65	Below	0.87	Below	Low	NE	No RR required	Low
37031010	*Dipturus gudgeri*	Bight skate	0.001	0.06	Below	0.09	Below	0.12	Below	Low	NE	No RR required	Low
37015009	*Figaro boardmani*	Australian sawtail catshark; sawtail catshark	0.011	0.12	Below	0.18	Below	0.25	Below	Low	NE	No RR required	Low
37017003	*Furgaleus macki*	Whiskery shark	0.017	0.1	Below	0.15	Below	0.2	Below	Low	NE	No RR required	Low
37043001	*Callorhinchus milii*	Elephantfish	0.000	0.13	Below	0.19	Below	0.25	Below	Low	NE	No RR required	Low
37287002	*Neosebastes nigropunctatus*	Blackspotted gurnard perch	0.09	0.19	Below	0.29	Below	0.39	Below	Low	NE	No RR required	Low
37345001	*Emmelichthys nitidus*	Redbait	0.000	0.43	Below	0.65	Below	0.87	Below	Low	NE	No RR required	Low

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	CATCH (2012-2016)	RISK SCORE FOLLOWING RESIDUAL RISK	FINAL RISK SCORE
37255003	*Paratrachichthys macleayi*	Sandpaper fish	0.038	0.16	Below	0.24	Below	0.32	Below	Low	NE	No RR required	Low
37232003	*Coelorinchus mirus*	Gargoyle fish	0.011	0.27	Below	0.4	Below	0.53	Below	Low	NE	No RR required	Low
37020011	*Centrophorus zeehaani*	Southern dogfish	0.001	0.05	Below	0.07	Below	0.1	Below	Low	NE	No RR required	Low
37020002	*Dalatias licha*	Black shark	0.001	0.07	Below	0.11	Below	0.14	Below	Low	NE	No RR required	Low
37005002	*Notorynchus cepedianus*	Broadnose shark	0.006	0.1	Below	0.15	Below	0.2	Below	Low	NE	No RR required	Low
37013001	*Orectolobus ornatus*	Banded wobbegong	0.000	0.09	Below	0.14	Below	0.19	Below	Low	NE	No RR required	Low
37013020	*Orectolobus halei*	Gulf wobbegong	0.000	0.14	Below	0.21	Below	0.28	Below	Low	NE	No RR required	Low
37015020	*Apristurus australis*	Apristurus sp G	0.000	0.13	Below	0.19	Below	0.25	Below	Low	NE	No RR required	Low
37015024	*Asymbolus occiduus*	Western spotted catshark	0.000	0.13	Below	0.19	Below	0.25	Below	Low	NE	No RR required	Low
37019004	*Sphyrna zygaena*	Smooth hammerhead shark	0.002	0.09	Below	0.13	Below	0.18	Below	Low	NE	No RR required	Low
37020003	*Deania calceus*	Brier shark	0.001	0.06	Below	0.09	Below	0.13	Below	Low	NE	No RR required	Low
37020004	*Deania quadrispinosa*	Longsnout dogfish	0.001	0.06	Below	0.09	Below	0.12	Below	Low	NE	No RR required	Low
37020005	*Etmopterus lucifer*	Blackbelly lanternshark	0.001	0.1	Below	0.16	Below	0.21	Below	Low	NE	No RR required	Low
37020019	*Centroscymnus owstonii*	Owston's dogfish	0.000	0.05	Below	0.08	Below	0.10	Below	Low	NE	No RR required	Low
37020022	*Etmopterus unicolor*	Bristled lanternshark	0.000	0.08	Below	0.12	Below	0.16	Below	Low	NE	No RR required	Low
37020048	*Squalus cholorculus*	Greeneye spurdog	0.002	0.06	Below	0.09	Below	0.12	Below	Low	NE	No RR required	Low
37023001	*Pristiophorus nudipinnis*	Southern sawshark	0.000	0.12	Below	0.19	Below	0.25	Below	Low	NE	No RR required	Low
37027001	*Aptychotrema vincentiana*	Western shovelnose ray	0.000	0.11	Below	0.16	Below	0.21	Below	Low	NE	No RR required	Low
37027006	*Trygonorrhina fasciata*	Eastern fiddler ray	0.000	0.1	Below	0.14	Below	0.19	Below	Low	NE	No RR required	Low

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	CATCH (2012-2016)	RISK SCORE FOLLOWING RESIDUAL RISK	FINAL RISK SCORE
37027011	*Trygonorrhina dumerilii*	Southern fiddler ray	0.000	0.1	Below	0.15	Below	0.2	Below	Low	NE	No RR required	Low
37028001	*Hypnos monopterygius*	Coffin ray	0.018	0.12	Below	0.18	Below	0.25	Below	Low	NE	No RR required	Low
37031028	*Dipturus canutus*	Grey skate	0.001	0.1	Below	0.14	Below	0.19	Below	Low	NE	No RR required	Low
37031035	*Dipturus acrobelus*	Deepwater skate	0.000	0.1	Below	0.14	Below	0.19	Below	Low	NE	No RR required	Low
37035001	*Bathytoshia brevicaudata*	Short-tail stingray	0.000	0.11	Below	0.16	Below	0.21	Below	Low	NE	No RR required	Low
37035002	*Bathytoshia lata*	Brown stingray/ Black stingray	0.003	0.10	Below	0.16	Below	0.21	Below	Low	NE	No RR required	Low
37042001	*Chimaera ogilbyi*	Ogilby's ghostshark	0.000		Below		Below		Below	Low	NE	No RR required	Low
37067007	*Conger verreauxi*	Southern conger	0.000	0.23	Below	0.34	Below	0.45	Below	Low	NE	No RR required	Low
37085002	*Sardinops sagax*	Australian sardine	0.011	0.49	Below	0.74	Below	0.98	Below	Low	NE	No RR required	Low
37086001	*Engraulis australis*	Australian anchovy	0.004	0.83	Below	1.25	Below	1.66	Below	Low	NE	No RR required	Low
37097001	*Argentina australiae*	Silverside	0.005	0.42	Below	0.64	Below	0.85	Below	Low	NE	No RR required	Low
37111001	*Chauliodus sloani*	Sloane's viperfish	0.001	0.48	Below	0.72	Below	0.96	Below	Low	NE	No RR required	Low
37117001	*Latropiscis purpurissatus*	Sergeant baker	0.014	0.31	Below	0.46	Below	0.62	Below	Low	NE	No RR required	Low
37120001	*Paraulopus nigripinnis*	Blacktip cucumberfish	0.039	0.53	Below	0.79	Below	1.05	Below	Low	NE	No RR required	Low
37224003	*Pseudophycis barbata*	Bearded rock cod	0.015	0.39	Below	0.58	Below	0.78	Below	Low	NE	No RR required	Low
37224006	*Pseudophycis bachus*	Red cod	0.003	0.42	Below	0.62	Below	0.83	Below	Low	NE	No RR required	Low
37224010	*Lepidion microcephalus*	Smallhead cod	0.000	0.40	Below	0.59	Below	0.79	Below	Low	NE	No RR required	Low
37228008	*Genypterus tigerinus*	Rock ling	0.000	0.20	Below	0.30	Below	0.41	Below	Low	NE	No RR required	Low
37232001	*Coelorinchus australis*	Southern whiptail	0.041	0.29	Below	0.44	Below	0.58	Below	Low	NE	No RR required	Low

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	CATCH (2012-2016)	RISK SCORE FOLLOWING RESIDUAL RISK	FINAL RISK SCORE
37232002	*Coelorinchus fasciatus*	Banded whiptail	0.000	0.27	Below	0.4	Below	0.53	Below	Low	NE	No RR required	Low
37232004	*Lepidorhynchus denticulatus*	Toothed whiptail	0.001	0.26	Below	0.4	Below	0.53	Below	Low	NE	No RR required	Low
37255001	*Hoplostethus intermedius*	Blacktip sawbelly	0.000	0.23	Below	0.34	Below	0.45	Below	Low	NE	No RR required	Low
37255004	*Gephyroberyx darwinii*	Darwin's roughy	0.000	0.16	Below	0.24	Below	0.32	Below	Low	NE	No RR required	Low
37258002	*Beryx splendens*	Alfonsino	0.001	0.34	Below	0.52	Below	0.69	Below	Low	NE	No RR required	Low
37258005	*Centroberyx lineatus*	Swallowtail	0.004	0.29	Below	0.44	Below	0.58	Below	Low	NE	No RR required	Low
37264002	*Cyttus australis*	Silver dory	0.036	0.37	Below	0.55	Below	0.73	Below	Low	NE	No RR required	Low
37264003	*Zenopsis nebulosa*	Mirror dory	0.001	0.27	Below	0.4	Below	0.54	Below	Low	NE	No RR required	Low
37266001	*Neocyttus rhomboidalis*	Spikey oreodory	0.001	0.16	Below	0.25	Below	0.33	Below	Low	NE	No RR required	Low
37266003	*Pseudocyttus maculatus*	Smooth oreodory	0.000	0.16	Below	0.23	Below	0.31	Below	Low	NE	No RR required	Low
37279001	*Centriscops humerosus*	Banded bellowsfish	0.001	0.95	Below	1.61	Below	2.14	Below	Low	NE	No RR required	Low
37279002	*Macroramphosus scolopax*	Common bellowsfish	0.017	0.96	Below	1.45	Below	1.93	Below	Low	NE	No RR required	Low
37287046	*Trachyscorpia eschmeyeri*	Deepsea ocean perch	0.000	0.21	Below	0.31	Below	0.42	Below	Low	NE	No RR required	Low
37287103	*Trachyscorpia carnomagula*	Deepsea scorpionfish	0.000	0.18	Below	0.28	Below	0.37	Below	Low	NE	No RR required	Low
37288003	*Lepidotrigla vanessa*	Butterfly gurnard	0.000	0.61	Below	0.91	Below	1.21	Below	Low	NE	No RR required	Low
37288007	*Lepidotrigla modesta*	Cocky gurnard	0.000	0.61	Below	0.91	Below	1.21	Below	Low	NE	No RR required	Low
37296001	*Platycephalus richardsoni*	Tiger flathead	0.001	0.41	Below	0.61	Below	0.81	Below	Low	NE	No RR required	Low
37296035	*Platycephalus aurimaculatus*	Toothy flathead	0.000	0.36	Below	0.54	Below	0.72	Below	Low	NE	No RR required	Low
37326001	*Priacanthus macracanthus*	Spotted bigeye	0.000	0.86	Below	1.3	Below	1.73	Below	Low	NE	No RR required	Low

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	CATCH (2012-2016)	RISK SCORE FOLLOWING RESIDUAL RISK	FINAL RISK SCORE
37330001	*Sillaginodes punctatus*	King George whiting	0.000	0.42	Below	0.63	Below	0.84	Below	Low	NE	No RR required	Low
37337002	*Trachurus declivis*	Common jack mackerel	0.003	0.47	Below	0.71	Below	0.95	Below	Low	NE	No RR required	Low
37337003	*Trachurus novaezelandiae*	Yellowtail scad	0.016	0.46	Below	0.69	Below	0.92	Below	Low	NE	No RR required	Low
37337007	*Seriola hippos*	Samsonfish	0.016	0.45	Below	0.67	Below	0.90	Below	Low	NE	No RR required	Low
37345002	*Plagiogeneion macrolepis*	Bigscale rubyfish	0.025	0.36	Below	0.54	Below	0.72	Below	Low	NE	No RR required	Low
37345003	*Plagiogeneion rubiginosum*	Cosmopolitan rubyfish	0.076	0.36	Below	0.54	Below	0.72	Below	Low	NE	No RR required	Low
37349001	*Parequula melbournensis*	Silverbelly	0.000	1.21	Below	1.81	Below	2.41	Below	Low	NE	No RR required	Low
37354001	*Argyrosomus japonicus*	Mulloway	0.000	0.21	Below	0.32	Below	0.43	Below	Low	NE	No RR required	Low
37355029	*Upeneichthys vlamingii*	Bluespotted goatfish	0.000	0.88	Below	1.32	Below	1.76	Below	Low	NE	No RR required	Low
37361002	*Neatypus obliquus*	Footballer sweep	0.005	0.31	Below	0.46	Below	0.61	Below	Low	NE	No RR required	Low
37361003	*Tilodon sexfasciatus*	Moonlighter	0.000	0.31	Below	0.46	Below	0.61	Below	Low	NE	No RR required	Low
37367003	*Pentaceropsis recurvirostris*	Longsnout boarfish	0.018	0.2	Below	0.3	Below	0.4	Below	Low	NE	No RR required	Low
37390023	*Parapercis naevosa*	Western Barred Grubfish	0.132	0.33	Below	0.49	Below	0.65	Below	Low	NE	No RR required	Low
37400004	*Kathetostoma nigrofasciatum*	Deepwater stargazer	0.046	0.33	Below	0.49	Below	0.66	Below	Low	NE	No RR required	Low
37439001	*Thyrsites atun*	Barracouta	0.003	0.36	Below	0.54	Below	0.71	Below	Low	NE	No RR required	Low
37439003	*Ruvettus pretiosus*	Oilfish	0.002	0.34	Below	0.51	Below	0.68	Below	Low	NE	No RR required	Low
37440002	*Lepidopus caudatus*	Southern frostfish; frostfish	0.003	0.36	Below	0.54	Below	0.71	Below	Low	NE	No RR required	Low
37441001	*Scomber australasicus*	Blue mackerel	0.003	0.37	Below	0.55	Below	0.73	Below	Low	NE	No RR required	Low
37441005	*Thunnus alalunga*	Albacore	0.002	0.19	Below	0.29	Below	0.39	Below	Low	NE	No RR required	Low

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	CATCH (2012-2016)	RISK SCORE FOLLOWING RESIDUAL RISK	FINAL RISK SCORE
37445001	*Hyperoglyphe antarctica*	Blue-eye trevalla	0.003	0.21	Below	0.32	Below	0.42	Below	Low	NE	No RR required	Low
37445005	*Seriolella brama*	Blue warehou	0.024	0.31	Below	0.47	Below	0.62	Below	Low	NE	No RR required	Low
37445006	*Seriolella punctata*	Silver warehou	0.001	0.33	Below	0.50	Below	0.66	Below	Low	NE	No RR required	Low
37465003	*Eubalichthys mosaicus*	Mosaic leatherjacket	0.015	0.41	Below	0.61	Below	0.82	Below	Low	NE	No RR required	Low
37465005	*Meuschenia scaber*	Velvet leatherjacket	0.034	0.41	Below	0.61	Below	0.82	Below	Low	NE	No RR required	Low
37465039	*Eubalichthys bucephalus*	Black reef leatherjacket	0.012	0.44	Below	0.65	Below	0.87	Below	Low	NE	No RR required	Low
37467002	*Omegophora armilla*	Ringed toadfish	0.008	0.42	Below	0.63	Below	0.84	Below	Low	NE	No RR required	Low
37469002	*Allomycterus pilatus*	Australian burrfish	0.015	0.45	Below	0.68	Below	0.9	Below	Low	NE	No RR required	Low
37470001	*Mola ramsayi*	Short sunfish	0.002	0.12	Below	0.19	Below	0.25	Below	Low	NE	No RR required	Low

Risk ranking guidelines:

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

2.5.5 bSAFE - Protected species

The protected species component was not required to be assessed in this SAFE.

2.6 Habitat Component

The Habitat component was not assessed at Level 2.

2.7 Community Component

The Community component was not assessed at Level 2.

2.8 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 2.28). 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 (Figure 2.12) 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. 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.

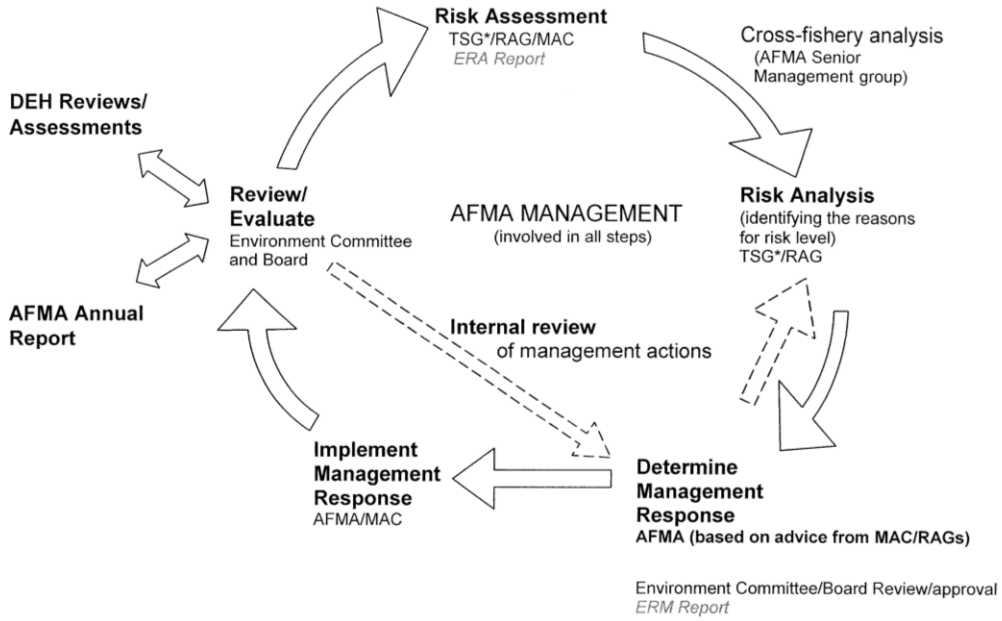


Figure 2.12. Schematic of the Ecological risk management cycle. TSG – Technical Support Group.

2.9 Extreme and high risk categorisation (Step 8) Update with Residual Risk information

PSA

Byproduct species

Following a residual risk analysis, Gould's squid *Nototodarus gouldi* remained at high risk (Table 2.23).

Bycatch species

Following a residual risk analysis on three high risk species, two teleosts: three-spined cardinalfish *Verilus anomalus* and thetis fish *Neosebastes thetidis* and one invertebrate: champagne crab *Hypothalassia armata*, were all reduced to low risk due to low capture within the assessment period (Table 2.24).

bSAFE

No residual risk analysis was required for byproduct or bycatch species.

3 General discussion and research implications

3.1 Level 1

In this case, 12 out of 26 possible internal activities were identified as occurring in this sub-fishery. All six external scenarios were also identified. Thus, a total of 18 activity-component scenarios will be considered at Level 1. This results in 89 (excluding the key commercial x direct impact by capture activity) total scenarios (of 160 possible) to be developed and evaluated using the unit lists (Key commercial/secondary, byproduct/bycatch, protected species, habitats, communities).

3.2 Level 2

3.2.1 Species at risk

A Level 2 analysis was triggered for one ecological (species) component: byproduct/bycatch species, as risk (consequence) scores were $\geq$3 in the Level 1 SICA analysis.

Gould's squid (*Nototodarus gouldi*) was assessed as high risk. It is mainly managed by effort controls in the Southern Squid Jig Fishery (SSJF), and a combined trigger limit (2000 t) exists in the GAB Trawl and SESSF Otter trawl sub-fisheries. As such, further evaluation should take place with respect to potential risk and ecological sustainability.

The ornate angelshark (*Squatina tergocellata*) was assessed at extreme risk, given its high estimated fishing mortality, mainly due to high overlap of occurrence within fishery range and encounterability with gear. There are catches of Squatinidae (257 t retained, 2.8 t discarded; Logbooks) which may also include this species. While school shark (*Galeorhinus galeus*) was also assessed at extreme risk, it is currently subject to a rebuilding strategy in the SESSF. Therefore, existing mitigation measures are in place to help protect it.

The two high or extreme risk teleost species - yellow spotted boarfish (*Paristiopterus gallipavo*) and tusk (*Dannevigia tusca*) are highly encounterable with the trawl gear and selective to the gear used. Therefore, further evaluation should take place with respect to potential risk and ecological sustainability.

The extreme overall risk score reported in this assessment for bronze whaler (*Carcharhinus brachyurus*) should be treated with caution since this largely coastal species is almost morphologically indistinguishable from the closely related pelagic dusky whaler (*C. obscurus*), and hence likely subject to misidentification by fishers. Therefore, improved training on identification methods are required to reduce this uncertainty between these species.

Both extreme risk wide stingaree and short-tail torpedo ray bycatch species, remained at extreme risk following a residual risk analysis despite small quantities discarded (Logbook or Observer databases), due to their high encounterability with the trawl gear and selectivity to

the gear used. Other skates, rays and stingarees have also been recorded as discarded: skates and rays (~256 t) or stingarees and giant stingarees (~130 t). Consequently, these species should be further evaluated with respect to potential risk and ecological sustainability.

The finding of 15 species deemed to be extreme/high risk from this assessment contrasts the previous SAFE assessment which reported no high-risk species (Zhou et al. 2012). This may be associated with (i) differences in methodology (ii) changes in the accuracy of species identifications from the last assessment; and/or (iii) changes to species categorization since the last assessment, particularly those regarded as byproduct in the present assessment, but were categorized differently (i.e., bycatch) in 2012 assessment. In addition, updates to underlying species distribution information used to calculate species overlaps, methodological differences in 'area fished' calculations, along with improved (higher) resolution bathymetry used to refine species ranges may also have contributed to differences in overall risk scores since the 2012 SAFE assessment.

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) 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 PSA 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 analyses, there will be a tendency to overestimate absolute levels of risk from fishing.

In moving from ERA to ERM, AFMA will focus scarce 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 analyses. 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 analyses, 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 analysis as it becomes available.

CSIRO and AFMA will continue to work together to include the broad set of management arrangements in Level 2 analyses, and these methods will be incorporated in future developments of the ERAEF framework. CSIRO has also undertaken some preliminary Level 3 analyses for bycatch species for several fisheries, and these or similar methods will also form part of the overall ERAEF framework into the future.

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Appendix A. Commercial species and stock status

Commercial species stock status, assessment and tier status, and ERA classification in the GAB otter trawl. NSTOF: Not subject to overfishing; NOF: Not overfished; OF: Overfished; UNC: uncertain. Note: Stock status is not assessed for non-quota species. NT: no Tier assessment within 2012-2016 (where known). Primary: C1; Secondary: C2; Byproduct: BP; Bycatch: BC. ^: based on ABARES classification. ^^ based on stock assessment.

COMMON NAME	SPECIES NAME	ERA CLASSIF-ICATION	FISHING MORTALITY^	BIOMASS^	STOCK STATUS^^	YEAR LAST ASSESSED	REFERENCE	TIER LEVEL ASSESS-MENT	COMMENT
Blue grenadier	*Macruronus novaezelandiae*	BP	NSTOF	NOF	Above limit reference	2013	Tuck 2013	1	
Tiger flathead	*Platycephalus richardsoni*	BC	NSTOF	NOF	Above limit reference	2016	Day 2016	1	
Pink ling	*Genypterus blacodes*	BP	NSTOF	NOF	Above limit reference	2015	Cordue 2015	1	
Silver warehou	*Seriolella punctata*	BC	NSTOF	NOF	Above limit reference	2015	Thompson et al. 2015	1	
Orange roughy (Albany and Esperance)	*Hoplostethus atlanticus*	BP	NSTOF	UNC	No commercial catch, no formal assessment	-	-	1	
Orange roughy (Cascade Plateau)			NSTOF	NOF	Above limit reference	2009	DeepRAG (2009)	1	
Orange roughy (Eastern)			NSTOF	NOF	Above limit reference	2016	Haddon 2017	1	
Orange roughy (Southern)			NSTOF	NOF	Negligible catches, no updated stock assessment	2000		1	
Orange roughy (Western)			NSTOF	OF	Negligible catches, no updated stock assessment	2002		1	
Jackass morwong	*Nemadactylus macropterus*	BP	NSTOF	NOF	Above limit reference	2015	Tuck et al. 2015	1	
Mirror dory	*Zenopsis nebulosus*	BC	NSTOF	NOF	Above limit reference	2017	Haddon and Sporcic 2017a	4	
Ocean jacket	*Nelusetta ayraudi*	BP	NSTOF	NOF	Above limit reference	2017	Haddon and Sporcic and (2017)^	NT	
Gould's squid	*Nototodarus gouldi*	BP	NSTOF	NOF	Above limit reference	2015	Barnes et al. (2015).	NT	Based on assessment of southern squid jig fishery
Frostfish	*Lepidopus caudatus*	BC	-	-	-	-	-	NT	
Flatheads*	*Platycephalidae* - undifferentiated	BC	NSTOF	NOF	Above limit reference**	-	-		
Leatherjackets	*Balistidae, Monacanthidae* - undifferentiated	BP	-	-	-	-	-	NT	
Eastern school whiting	*Sillago flindersi*	n/a	NSTOF	NOF	Above limit reference	2017	Day 2017	1	

COMMON NAME	SPECIES NAME	ERA CLASSIF-ICATION	FISHING MORTALITY^	BIOMASS^	STOCK STATUS^^	YEAR LAST ASSESSED	REFERENCE	TIER LEVEL ASSESS-MENT	COMMENT
Redfish	*Centroberyx affinis*	n/a	UNC	OF	Below limit reference	2017	Tuck et al. 2017	1	
Gemfish (eastern)	*Rexea solandri*	n/a	UNC	OF	Below limit reference	2011	Little and Rowling 2011	1	
Gemfish (western)		BP	NSTOF	NOF	Above limit reference	2016	Helidoniotis and Moore 2016; Haddon 2016b	¼	Tier 1 was not formally accepted by GABRAG due to uncertain abundance index. Instead, a weight of evidence approach was used to estimate RBC
Royal red prawn	*Haliporoides sibogae*	n/a	NSTOF	NOF	Above limit reference	2017	Haddon and Sporcic 2017a	4	
Reef ocean perch	*Helicolenus percoides*	BP	**NA**	**NA**	**NA**	2017	Haddon and Sporcic 2017a	4	
Silver trevally	*Pseudocaranx georgianus*	BP	NSTOF	NOF	Above limit reference	2017	Haddon and Sporcic 2017a	4	
Latchet	*Pterygotrigla polyommata*	BP	-	-	-	-	-	NT	
King dory	*Cyttus traversi*	BP	-	-	-	-	-	NT	
Red gurnard	*Chelidonichthys kumu*	BP	-	-	-	-	-	NT	
Gummy shark	*Mustelus antarcticus*	BP	NSTOF	NOF	Above limit reference	2016	Punt et al. 2016	1	
Deepwater flathead	*Platycephalus conatus*	C1	NSTOF	NOF	Above limit reference	2016	Haddon 2016a	1	
School shark	*Galeorhinus galeus*	BC	UNC	OF	Uncertain if total mortality will allow recovery in required time frame.	2012 (re-ran the 2009 assessment with additional catch data 2009-12)	Thomson and Punt 2009; Thomson 2012	1	
Bight redfish	*Centroberyx gerrardi*	C1	NSTOF	NOF	Above limit reference	2015	Haddon 2015b	1	
Alfonsino	*Beryx splendens*	BC	NSTOF	NOF	Above limit reference	2013	Klaer 2013	3	
Ribaldo	*Mora moro*	BP	NSTOF	NOF	Above limit reference	2017	Haddon and Sporcic 2017a	4	
John dory	*Zeus faber*	BP	NSTOF	NOF	Above limit reference	2017	Castillo-Jordán 2017	3	
Blue-eye trevalla	*Hyperoglyphe antarctica*	BC	NSTOF	NOF	Above limit reference	2017	Haddon and Sporcic 2017b	4	
Blue warehou	*Seriolella brama*	BC	UNC	OF	No evidence to suggest rebuilding above the limit reference	2013	Haddon 2013	4	
Elephantfish	*Callorhinchus milii*	BC	NSTOF	NOF	Above limit reference	2018	Sporcic and Haddon 2018~	4	
Oreo (smooth Cascade)	*Pseudocyttus maculatus*	BC	NSTOF	NOF	Above limit reference	2015	Haddon 2015a	4	
Oreo (smooth other)			NSTOF	NOF	Above limit reference	2015	Haddon 2015a	4	

COMMON NAME	SPECIES NAME	ERA CLASSIF-ICATION	FISHING MORTALITY^	BIOMASS^	STOCK STATUS^^	YEAR LAST ASSESSED	REFERENCE	TIER LEVEL ASSESS-MENT	COMMENT
Oreo basket	*Warty—Allocyttus verrucosus, spikey—Neocyttus rhomboidalis, rough—N. psilorhynchus, black—A. niger, other—Neocyttus spp.*	BP	NSTOF	NOF	Above limit reference	2017	Haddon and Sporcic 2017a	4	
Sawshark	*Pristiophorus cirratus and Pristiophorus nudipinnis*	BP	NSTOF	NOF	Above limit reference	2018	Sporcic and Haddon 2018~	4	
Deepwater shark (east)	*Dogfish (Squalidae), brier shark (Deania calcea), platypus shark (D. quadrispinosa), Plunket's shark (Centroscymnus plunketi), roughskin shark (species of Centroscymnus and Deania), 'pearl shark' (D. calcea and D. quadrispinosa), black shark (Centroscymnus species), lantern shark (Etmopterus species) and other sharks (Klaer et al. 2014).*	BC	NSTOF	UNC	Multispecies nature of stock makes CPUE potentially unreliable as the index of abundance .	2017	Haddon and Sporcic 2017a	4	
Deepwater shark (west)			NSTOF	UNC	Multispecies nature of stock makes CPUE potentially unreliable as the index of abundance	2017	Haddon and Sporcic 2017a	4	

^: Based on relative standardized CPUE; * Tiger flathead has a separate Tier 1 assessment. The group "flatheads (*Platycephalidae* – undifferentiated)" do not have an assessment. **: No formal assessment, but assumed to be mostly comprised of Tiger flathead, which has an assessment. ~data up to 2016.

Record of stock assessments during the ERA assessment period and their respective tier levels. Tier 1 (blue); Tier 3 (orange); Tier 4 (green).

COMMON NAME	2012	2013	2014	2015	2016
Alfonsino	3	3			
Bight Redfish				1	
Blue Eye Trevalla		4		4	4
Blue Grenadier		1			
Blue Warehou	4	4			
Deepwater Flathead	1	1			1
Deepwater shark east		4			
Deepwater shark west		4			
Elephant Fish	4	4	4	4	
Flathead	1				1
Gemfish - East					
Gemfish - west		1/4			1/4
Gummy Shark		1			1
Jackass Morwong	1	1		1	
John Dory	3	3	3		
Mirror Dory	3	4	4	4	4
Reef Ocean Perch	4	4			
Orange Roughy - south					
Orange Roughy - east			1		
Orange Roughy - west					
Orange Roughy - Cascade Plateau					
Orange Roughy - Albany & Esp					
Oreo Smooth - Cascade					
Oreo Smooth - other					
Oreo Basket	4	4			
Pink Ling	1	1		1	
Redfish	3/4	3/4	1		
Ribaldo	4	4			
Royal Red Prawn	4	4			
Saw Shark	4	4	4	4	
School Shark					
School Whiting – Tier 1					
Silver Trevally	4	4			
Silver Warehou	1			1	
Tiger Flathead		1			1

Appendix B. TAC and percent caught

		PRIMARY COMMERCIAL SPECIES	
SESSF	**TAC AND CATCH**	**DEEPWATER FLATHEAD**	**BIGHT REDFISH**
2008-09	Agreed TAC	1400000	2000000
	TAC after over/undercatch	1597444	2324939
	% TAC caught (SESSF)	51%	28%
	Logbook catch otter trawl*	786641	644106
2009-10	Agreed TAC	1400000	2000000
	TAC after over/undercatch	1518598	2200000
	% TAC caught (SESSF)	57%	22%
	Logbook catch otter trawl *	826985	475094
2010-11	Agreed TAC	1100000	1653000
	TAC after over/undercatch	1240000	1853000
	% TAC caught (SESSF)	78%	17%
	Logbook catch otter trawl *	935657	282246
2011-12	Agreed TAC	1650000	1556000
	TAC after over/undercatch	1650000	1716382
	% TAC caught (SESSF)	62%	20%
	Logbook catch otter trawl *	838196	333110
2012-13	Agreed TAC	1560000	2334000
	TAC after over/undercatch	1723000	2487600
	% TAC caught (SESSF)	57%	11%
	Logbook catch otter trawl *	841445	271195
2013-14	Agreed TAC	1150000	2358000
	TAC after over/undercatch	1301000	2588400
	% TAC caught (SESSF)	68%	8%
	Logbook catch otter trawl *	657555	182992
2014-15	Agreed TAC	1150000	2358000
	TAC after over/undercatch	1264568	2593740
	% TAC caught (SESSF)	52%	8%
	Logbook catch otter trawl *	572622	249532
2015-16	Agreed TAC	1150000	2358000
	TAC after over/undercatch	1265000	2593800
	% TAC caught (SESSF)	50%	7%
	Logbook catch otter trawl *	484368	176474
2016-17	Agreed TAC	1150000	800000
	TAC after over/undercatch	1256154	1034431
	% TAC caught (SESSF)	54%	28%
	Logbook catch otter trawl *	547814	277657

Appendix C. Commonwealth Trawl Closures

Closures legislated under the *Southern and Eastern Scalefish and Shark Fishery and Small Pelagic Fishery (Closures) Direction 2016.*

For exact coordinates of area closures refer to the relevant sections of the SESSF Closure Directions, as referenced by the map title.

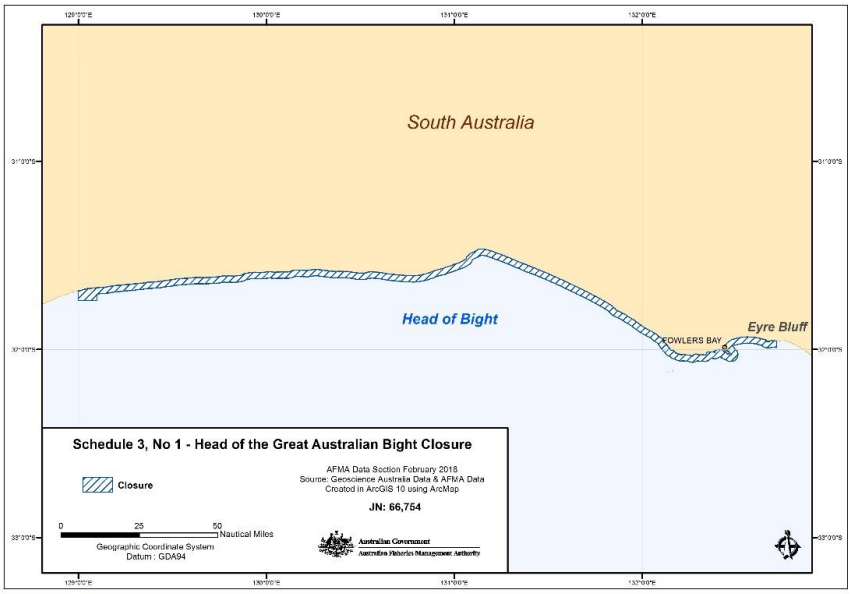
CLOSURE	DATE IMPLEMENTED
Head of the GAB	Aug-04
South Australian Shark Closure – Kangaroo Island	Jun-07
Murray Commonwealth Marine Reserves Closures	Aug-07
Commonwealth Gulper Shark Closure - Southern Dogfish	Jun-07
Central East Zone	Jun-08
Salisbury Canyon	Jun-08
Far West	Jun-08
Albany	Jun-08
Bremer	Jun-08
Humdinger West	Jun-08
Humdinger/Magic	Jun-08
Lomvar Gully	Jun-08
United Nations	Jun-08
The Knob	Jun-08
Racetrack/Hamburger	Jun-08
Kangaroo Island Hill	Jun-08
Great Australian Bight Far West Gulper Shark Closure	Jun-10
Port MacDonnell Closure	Feb-13
Murray Dogfish Closure	Feb-13

Schedule 3 - Head of the Great Australian Bight

Location: Great Australian Bight, South Australia

Reason: Protect breeding school shark and Australian sea lion populations

Prohibited: All fishing methods

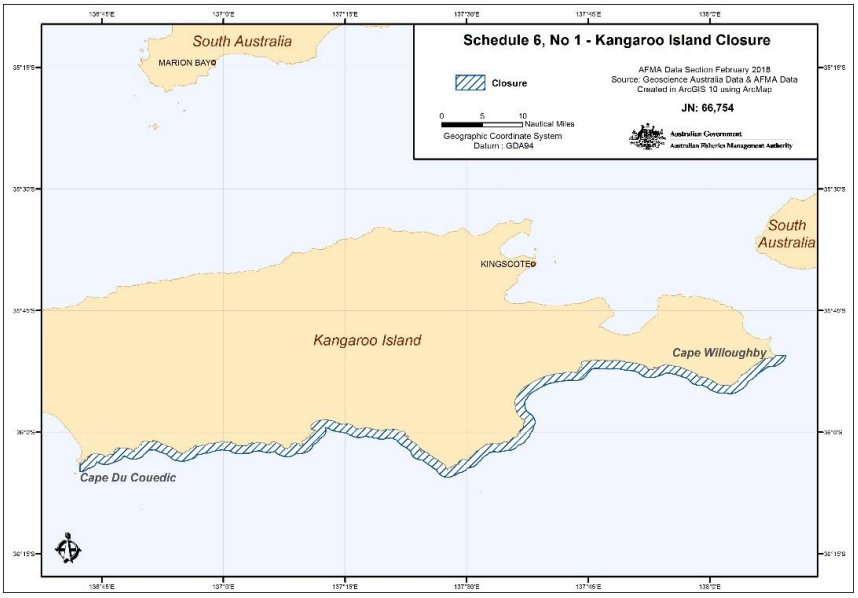


Schedule 6 - South Australian Shark Closure – Kangaroo Island

Location: Kangaroo Island, South Australia

Reason: Protect breeding school shark and Australian sea lion populations

Prohibited: All fishing methods

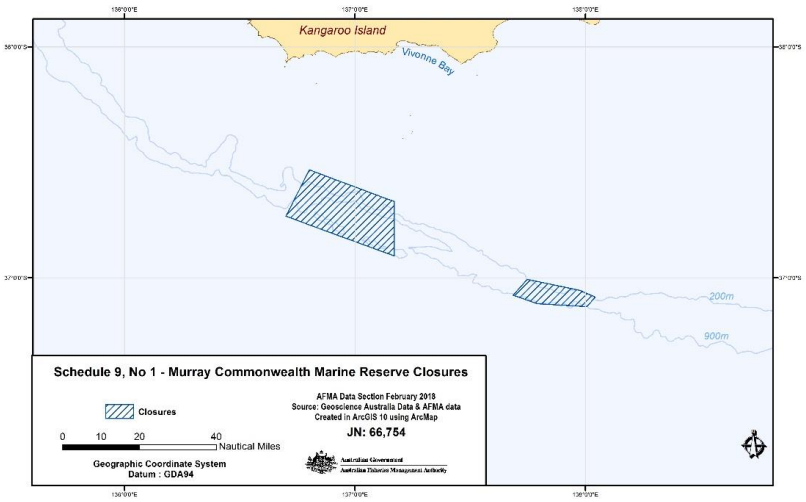


Schedule 9 - Murray Commonwealth Marine Reserves Closures

Location: Area off Kangaroo Island

Reason: Protect Upper-Slope dogfish

Prohibited: If the Harrisson's and southern dogfish triggers are met (refer to 6 (k) in the Direction) then all fishing methods (excluding hydraulic hand reel droplining) are prohibited for the concession holder for 12 months within this area. 100% observer coverage is required. Please note that Demersal (bottom) Trawl, Danish Seine and Scallop Dredge are prohibited under the Commonwealth Marine Reserve Closure. Refer to http://www.environment.gov.au/topics/marine/marine-reserves for updated information on prohibited fishing methods.

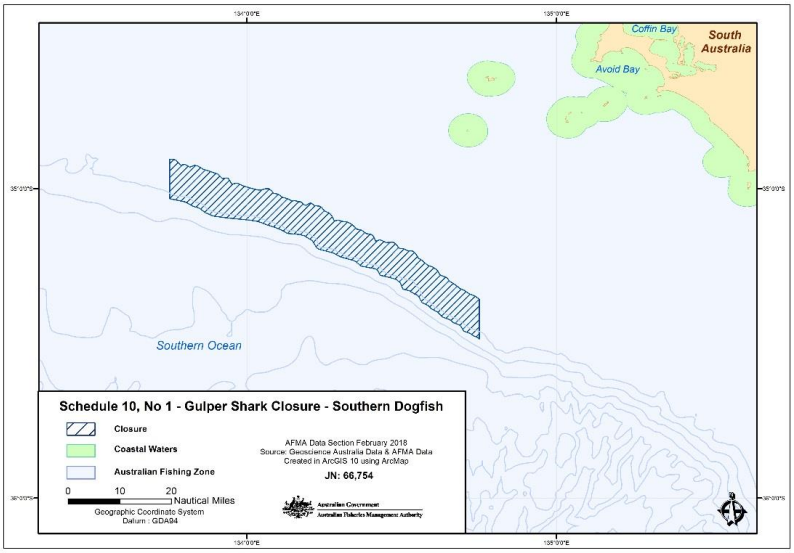


Schedule 10 - Commonwealth Gulper Shark Closure - Southern Dogfish

Location: South Australia

Reason: Protect Upper-Slope dogfish

Prohibited: Hook and Trawl methods

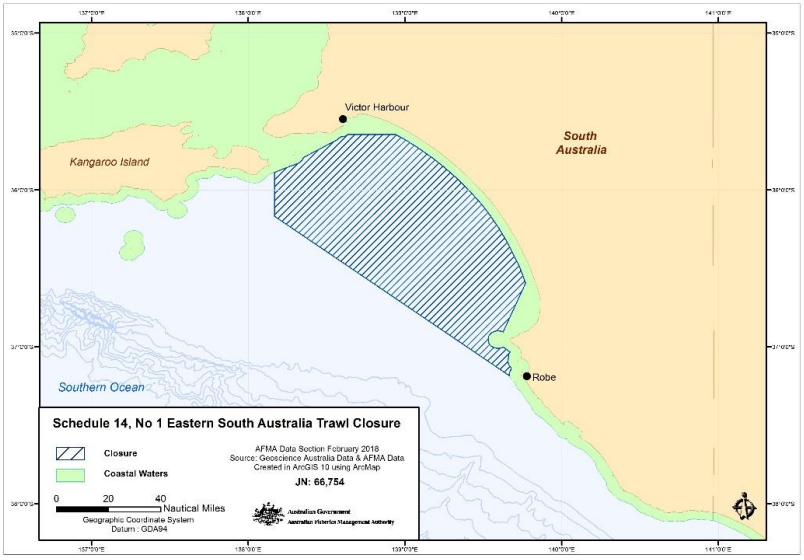


Schedule 14 - Eastern South Australia Trawl Closure

Location: Eastern South Australia

Reason: Reduce the catch of juvenile scalefish and protect structured benthic habitat

Prohibited: Demersal otter trawl method

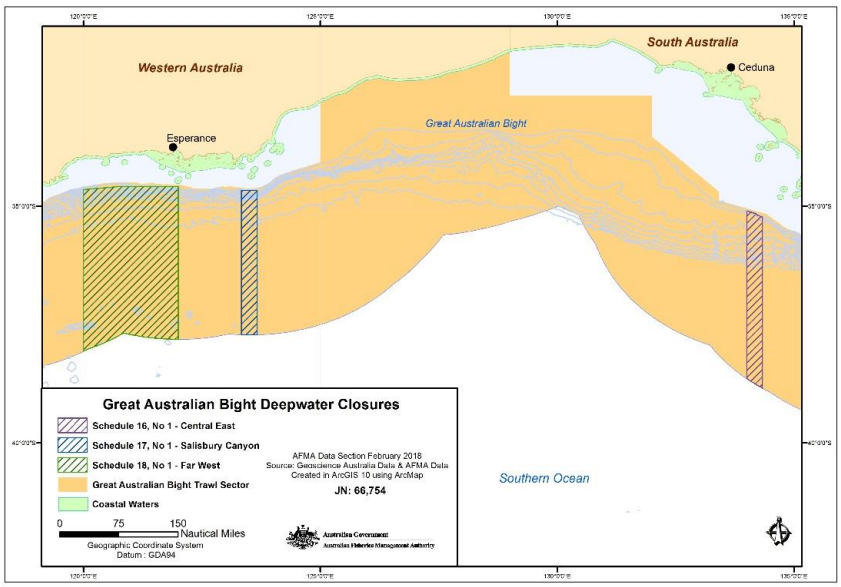


Schedule 16 - Central East Zone

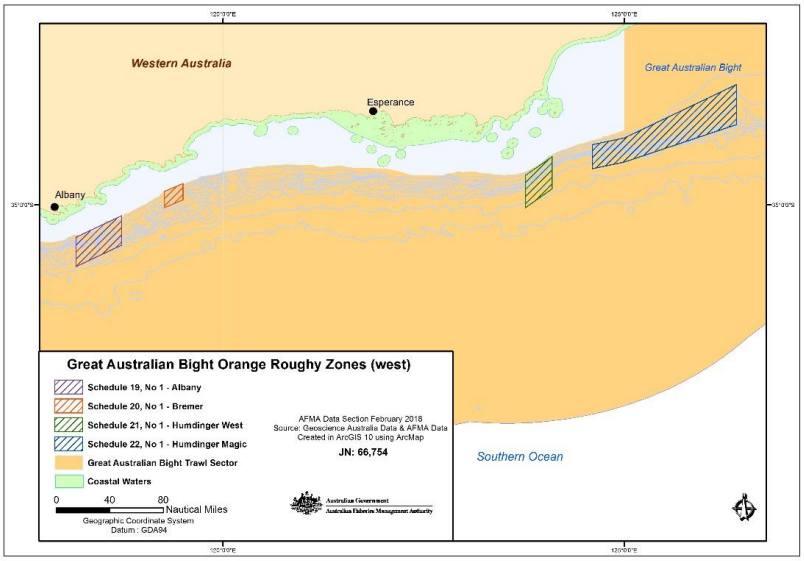
Schedule 17 - Salisbury Canyon

Schedule 18 - Far West

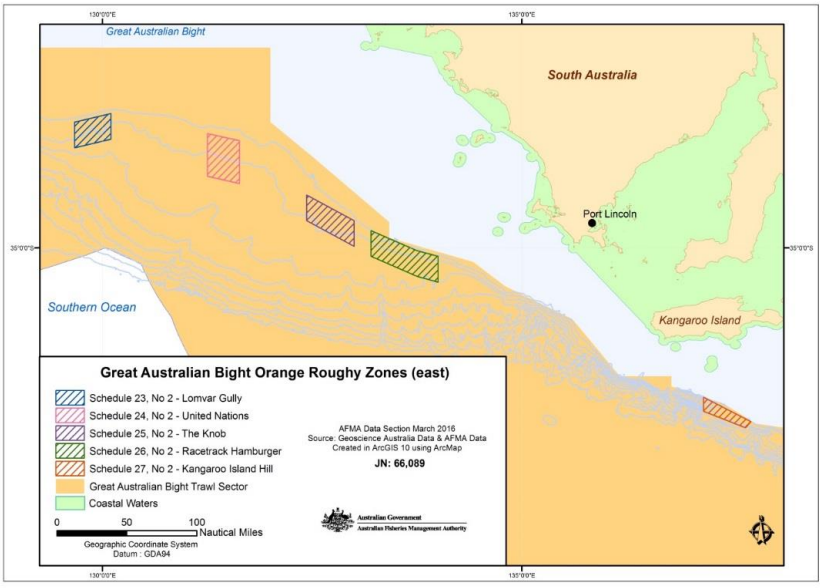
Location: Great Australian Bight, South Australia and Western Australia
Reason: Protect deep water species and orange roughy stocks
Prohibited: Demersal otter trawl methods



Schedule 19 - Albany
Schedule 20 - Bremer
Schedule 21 - Humdinger West
Schedule 22 - Humdinger/Magic
Location: Great Australian Bight (West), Western Australia
Reason: Protect orange roughy stocks
Prohibited: Trawl methods



Schedule 23 - Lomvar Gully
Schedule 24 - United Nations
Schedule 25 - The Knob
Schedule 26 - Racetrack/Hamburger
Schedule 27 - Kangaroo Island Hill
Location: Great Australian Bight (East), South Australia
Reason: Protect orange roughy stocks
Prohibited: Trawl methods

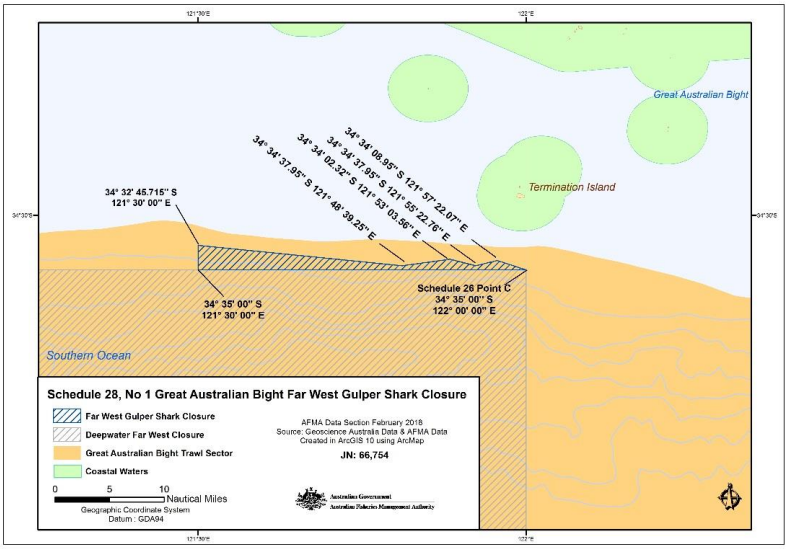


Schedule 28 - Great Australian Bight Far West Gulper Shark Closure

Location: Great Australian Bight (West), South Australia

Reason: Protect Upper-Slope dogfish

Prohibited: Trawl methods

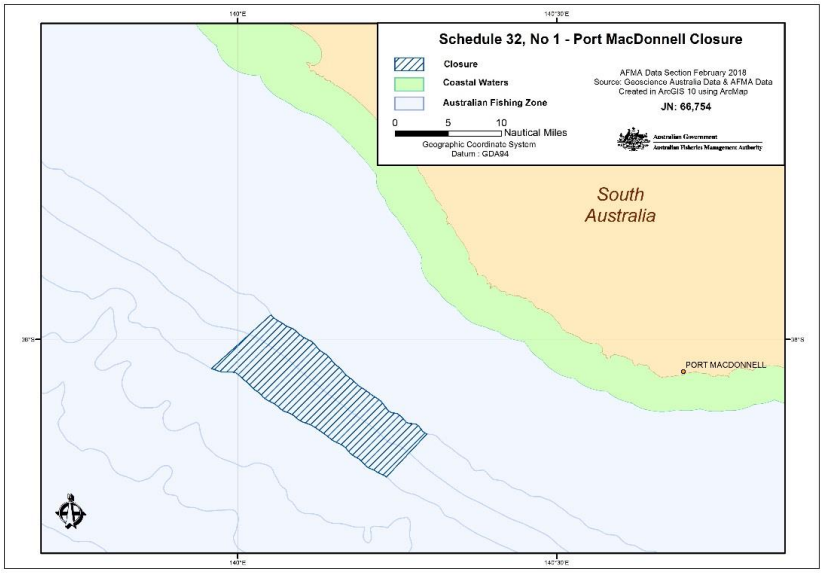


Schedule 32 - Port MacDonnell Closure

Location: Area off south eastern Australia

Reason: Protect Upper-Slope dogfish

Prohibited: All fishing methods

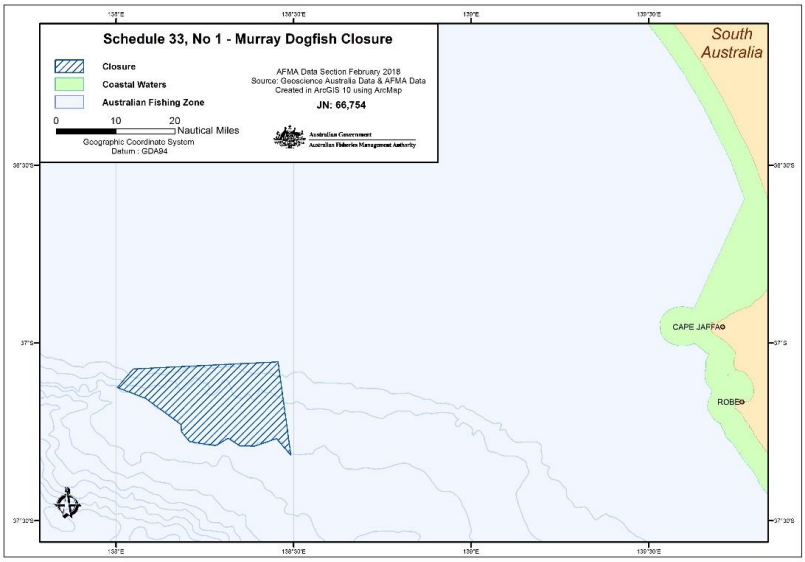


Schedule 33 - Murray Dogfish Closure

Location: Area off south eastern Australia

Reason: Protect Upper-Slope dogfish

Prohibited: Trawl methods and if the Harrisson's and southern dogfish triggers are met (refer to 6 (u) in the Direction) then all fishing methods (excluding hydraulic hand reel droplining) are prohibited for the concession holder for 12 months within this area. 100% observer coverage is required.



Area closures outside AFMA's jurisdiction

Commonwealth Marine Reserves Network

Some fishing methods are prohibited in Commonwealth marine reserves. This information can be found on the Department of the Environment and Energy's website at http://www.environment.gov.au/topics/marine/marine-reserves.

Marine Parks

Fishing is prohibited in many state based marine parks and reserves. For more information on these areas please contact the relevant state authority.

GAB Marine Park Benthic Protection Zone

Preserve a representative sample of the sediments and benthic biota of the GAB.

GAB Marine Park Mammal Protection Zone

Protect the calving area for the Southern Right Whale and colonies of the endangered Australian Sea Lion in the area, additionally offering some protection of a representative sample of the seabed in deeper waters of the Commonwealth Park.

Appendix D. Incidental catch limits for state managed species

FINFISH	South Australia		Western Australia
Australian anchovy	Prohibited		
Tunas			Prohibited
Australian salmon/Tommy ruff			
Banded morwong			
Black bream			
Billfish			Prohibited
Black cod			Prohibited
Blue sprat			
Dusky morwong			
Garfish			
Grassy (rock) flathead			
King gar			
King George whiting			
Luderick			
Magpie morwong			
Pilchard			
Red mullet			
Sea sweep			
Snook			
Sprat			
Wrasse			
Yelloweye mullet			
Yellow-finned whiting			
Great White Shark			Prohibited
Grey nurse			Prohibited
Bastard trumpeter	20 kg	Combined 200 kg trip limit	
Blue Groper	50 kg		
Leatherjackets* (black reef, chinaman & rough)	200 kg		
Mulloway	100 kg		
Parrotfish* (knifejaw)	200 kg		
Striped trumpeter	20 kg		

FINFISH	South Australia		Western Australia
Snapper	50 kg		
Yellowtail kingfish	10 individuals		
CRUSTACEANS	**South Australia**		**Western Australia**
Deepwater prawn	Trip limits do not apply		
Red prawn			
Prawn (Genus Aristeus)			Prohibited
Royal red prawn			
Scarlet prawn			
Carid prawns (family Pandalidae)			
All other prawns	No take		
Rock lobster			Prohibited
Bay bugs (family Scyllaridae)	200 kg		
Giant (king) crab (*Psuedocarincus gigas*)	5 individuals	Combined 50 kg trip limit	
Other crustaceans	50 kg trip limit		
Coral		Prohibited	Prohibited
MOLLUSCS	**South Australia**		**Western Australia**
Arrow squid	Trip limits do not apply		
Red ocean squid			
Southern ocean arrow squid			
Yellowback squid			
Scallops	Prohibited		
Abalone			
Shells & Shellfish (Class *Gastropoda*)	50 kg trip limit	Combined 500 kg limit	
Other molluscs	500 kg trip		

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 Chondricythian 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).
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. Southern and Eastern Scalefish and Shark Fishery).
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 Target Species component are individual “species”, while for Habitats, they are “biotypes”, and for Communities the units are “assemblages”.

CONTACT US

t 1300 363 400
+61 3 9545 2176
e csiroenquiries@csiro.au
w www.csiro.au

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FOR FURTHER INFORMATION

Insert Business Unit name
Insert contact name
t +61 3 6232 5222
e first.last@csiro.au
w www.csiro.au/businessunit

Insert Business Unit name
Insert contact name
t +61 0 0000 0000
e first.last@csiro.au
w www.csiro.au/businessunit

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