Australia's National
Science Agency

Ecological Risk Assessment for the Effects of Fishing

Report for the Eastern Tuna and Billfish Fishery: Pelagic Longline sub-fishery, 2018 - 2022

M. Sporcic, J. Dell, M. Fuller, C. Gerber, M. Roos
18 February 2025

Report for the Australian Fisheries Management Authority

CSIRO Environment

Castray Esplanade Hobart 7001

Citation

Sporcic, M., Dell, J., Fuller, M., Gerber, C., Roos, M. (2025). Ecological Risk Assessment for the Effects of Fishing. Report for the Eastern Tuna and Billfish Fishery: Pelagic Longline sub-fishery, 2018 - 2022. Report for the Australian Fisheries Management Authority.

Copyright

Important disclaimer

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).

Contents

Figures

Tables

Acknowledgements

We thank the AFMA data team for providing summary statistics from AFMA logbook and Electronic Monitoring data which were subsequently used in this report. Thanks to Robert Wood (AFMA) and Lachlan Farquhar (AFMA) for providing Scoping information that has been included in this report. Robert Wood (AFMA) also provided information on ETBF management. Linda Thomas (CSIRO) and Franzis Althaus (CSIRO) are thanked for their reviews of this report. We also thank TTRAG for their review of this report during TTRAG No. 40 meeting 19-21 March 2024, and the Australian Bureau of Agricultural and Resource Economics (ABARES) for providing information on the trophic level and post capture mortality of the turtle species assessed.

Executive Summary

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

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

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

This 2018-2022 ERAEF of the Eastern Tuna and Billfish Fishery - Pelagic longline consists of the following:

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

Fishery Description

Gear Pelagic longline
Area Cape York (Qld) to SA/Vic border
Depth range ~10 to ~500 m (99th percentile) *cf*. ~30 to 550 m below the surface cf. (previous ERAEF)
Fleet size 35-40 vessels fishing annually *cf*. 39 vessels fishing (previous ERAEF)
Effort 6.7 - 8.7 million hooks p.a. *cf*. 8.25 million hooks (previous ERAEF)
Landings 4807 - 5069 t p.a. of key commercial species *cf*. 5442 t (previous ERAEF)
Discard rate fishery wide estimate unavailable
Key commercial species Yellowfin Tuna, Bigeye Tuna, Broadbill Swordfish, Albacore Tuna, Striped Marlin, Southern Bluefin Tuna
Management Input and output controls
Observer program Electronic Monitoring on 1 July 2015: 100% electronic monitoring coverage for vessels operating >30 days/year. 11-12 % footage reviewed p.a.

Ecological Components Assessed

A total of 304 species across all ecological components were assessed in this ERAEF compared to 267 species in 2017 (Table 0.1).

Table 0.1: Ecological components assessed in 2025 (data from 2018 to 2022) and earlier assessments.

Ecological components assessed	2017	2025
Key/secondary commercial species	6	6
Commercial species/Bait	3	3
Byproduct species	18	25
Bycatch species	146	186
Protected species	94	84
Benthic habitats	299	96
Pelagic habitats	10	11
Demersal communities	55	73
Pelagic communities	13	13

The increase in the number of bycatch species between this and the previous assessment is due to the expansion of higher taxonomic group codes. The decrease in benthic habitats between assessments is not directly comparable, due to changes in methodology since the last assessment.

Level 1 Results and Summary

More than 90 % of all assessed hazards (fishing activities) were eliminated at Level 1 (risk scores 1 or 2; Table 3.11; Figure 3.1-Figure 3.5). Those remaining consist of:

- Direct impact/capture from fishing (byproduct & bycatch species; protected species and communities)
- Direct impact/without capture from fishing (byproduct & bycatch species; protected species)
- Addition/movement of biological material from discarding (protected species)
- Addition/movement of biological material from translocation of species (communities)
- Addition of non-biological material from navigation/steaming (protected species)
- External impacts from other fisheries (all ecological components except habitats)

The ecological components that triggered a Level 2 analysis for this current ERAEF largely matches those in the previous ERAEF (Sporcic et al., 2019). The most vulnerable byproduct species that triggered a Level 2 analysis were the Dusky Whaler *Carcharhinus obscurus*, Bronze Whaler *Carcharhinus brachyurus*, bycatch species Smooth Hammerhead Shark *Sphyrna zygaena* and the protected Shortfin Mako *Isurus oxyrinchus*. For the latter species, the major risk score from the capture from fishing was based on (i) the number of interactions with ETBF operations (7168: 2213 alive, 499 dead, 4457 unknown), (ii) low productivity (slow growth rate, late maturing and low fecundity) and (iii) post release survival rates varying between 40 % and 80 % depending on condition and handling practices. The hazard in the key/secondary commercial species ecological component was the external impacts of from other fisheries on Striped Marlin *Kajikia audax* stocks.

Translocation of species was considered a major risk (4) to communities, due to the potential for the introduction of pathogens using imported baits. Evidence of pathogens in other fishery areas has previously shown the consequence of this hazard (Gaughan, 2001). The communities component triggered a Level 2 analysis but was analysed in this assessment. This SICA has removed the Habitat component from further analysis, as it was identified as low risk based on consequence scores by the set of activities considered. Significant (i.e., risk score of at least moderate) external hazards included impacts from other fisheries in the region for all ecological components except habitats.

Since the last ERAEF on the Australian ETBF, the Western and Central Pacific Fisheries Commission (WCPFC) has continued to develop a shark research plan for the Western Pacific Ocean (WPO) shark populations. Fortunately, elements of the WCPFC shark research plan have focused on undertaking regionally relevant

stock assessments on some of the shark species recorded in the protected and byproduct & bycatch species ecological components of this current ERAEF. The WCPFC Shark research plan was developed in the context of the vulnerability of the key shark species interacting with fisheries in the Western Pacific Ocean (WPO). This has led to the completion of population assessments on the regional stocks such as the Blue Shark *Prionace glauca* (Neubauer et al., 2021, 2022) and a basin wide sustainability assessment for Bigeye Thresher Shark *Alopias superciliosus* [Fu et al. (2016); see also Table 0.3] which have determined that current catch levels for both these species are sustainable. By contrast current catch levels for the recent assessments for the Oceanic Whitetip Shark *Carcharhinus longimanus* (Rice et al., 2021; Tremblay-Boyer et al., 2019) are not sustainable but uncertain for the Shortfin Mako *Prionace glauca* (Large et al., 2022). In the context of the current ERAEF, the Blue Shark was considered as part of the byproduct & bycatch ecological components and the Oceanic Whitetip Shark and Shortfin Mako as part of the fishing with and/or without capture hazards of the protected species ecological component.

Table 0.2: Outcomes of assessments for ecological components conducted in 2024. *: triggered but not assessed. ^: includes Commercial Bait species.

Ecological Component	2024
Key/secondary commercial species^	Level 1
Byproduct and bycatch species	Level 2
Protected species	Level 2
Habitats	Level 1
Communities	Level 2*

Table 0.3: Stock assessments including status detail (where available) of key commercial, byproduct, bycatch and protected species that overlap the Eastern Tuna and Billfish Fishery: Pelagic longline. Food and Agriculture Organization (FAO). NOF: not overfished. OF: overfished. NSTOF: not subject to overfishing. STOF: subject to overfishing. [1]: based on ABARES classification from Blake et al. (2023) for Yellowfin Tuna (YFT), Albacore Tuna (ALB), Bigeye Tuna (BET), Broadbilled Swordfish (SWO) and Striped Marlin (STM); from Patterson and Dylewski (2023) for Southern Bluefin Tuna (SBT). MSY: Maximum Sustainable Yield. [2]: based on MSY reference points. MSE: Management Strategy Evaluation. SB: spawning biomass. SB_0: Initial spawning biomass. Stock assessments are conducted over a broader range (e.g., Western and Central Pacific Ocean) and the reported status reflects the species status in that region.

Common Name (FAO code)	Scientific Name	ERA Classification	Biomass[1]/Fishing Mortality[1]	References	Year Last Assessed
Yellowfin Tuna (YFT)	*Thunnus albacares*	Key Commercial	NSTOF / NOF	Magnusson et al. (2023)	2023
Albacore Tuna (ALB)	*Thunnus alalunga*	Key Commercial	NSTOF / NOF	Castillo-Jordán et al. (2021)	2021
Bigeye Tuna (BET)	*Thunnus obesus*	Key Commercial	NSTOF / NOF	Day et al. (2023)	2023
Broadbill Swordfish (SWO)	*Xiphias gladius*	Key Commercial	NSTOF / NOF	Ducharme-Barth et al. (2021)	2021
Striped Marlin (STM)	*Kajikia audax*	Key Commercial	OF / close to OF	Ducharme-Barth et al. (2019), MSE conducted: Preece (2021)	2019, 2021

Table 0.3: *(continued)*

Common Name (FAO code)	Scientific Name	ERA Classification	Biomass[1]/Fishing Mortality[1]	References	Year Last Assessed
Southern Bluefin Tuna (SBT)	*Thunnus maccoyii*	Key Commercial	NSTOF / NOF	Hillary et al. (2023), CCSBT (2023)	2023
Blue Shark (BSH)	*Prionace glauca*	Byproduct	NOF/NSOTF	Neubauer et al. (2021), Neubauer et al. (2022)	2022
Skipjack Tuna (SKJ)	*Katsuwonus pelamis*	Byproduct	NOF/NSTOF	Castillo-Jordán et al. (2022)	2022
Bigeye Thresher (BTH)	*Alopias superciliosus*	Bycatch	Sustainability assessements; Standardized abundnace indices	Fu et al. (2016)	2016
Blue Marlin (BUM)	*Makaira nigricans*	Bycatch	NOF[2]/NSTOF[2]	ISC21. (2021)	2021
Black Marlin (BLM)	*Istiompax indica*	Bycatch	Uncertain-Indian Ocean stock	Parker et al. (2018), IOTC. (2020)	2018, 2020
Oceanic Whitetip Shark (OCS)	*Carcharhinus longimanus*	Protected	OF[2]/STOF[2]; $SB/SB_0 < 0.1$	Tremblay-Boyer et al. (2019); Rice et al. (2021)	2021
Shortfin Mako (SMA)	*Prionace glauca*	Protected	Unstable: high estimation uncertainty and sensitivity to a range of inputs	Large et al. (2022)	2022
Silky Shark (FAL)	*Carcharhinus falciformis*	Protected	Not sufficiently robust to provide estimates of current stock status	Clarke et al. (2018)	2021

Level 2 Results and Summary

A total of 295 unique species were evaluated at Level 2 (80 with PSA and 218 with bSAFE, which includes any unassessable species in a bSAFE, subsequently assessed in a PSA). Under the revised ERAEF framework (AFMA, 2017), key commercial species that undergo tiered assessments are not assessed at Level 2. However, an ERA should be considered for species that are subject to lower tiered assessments (e.g., Tier 4/5, based on catch/effort or catch data only) when the model-based assumptions may not be satisfied.

PSA and Residual Risk

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

Bycatch species
A total of six out of 186 bycatch species were assessed in the PSA. Of these, five were unassessable in bSAFE. Of all assessed bycatch species, one was at high risk (Sicklefin Weasel Shark *Hemigaleus australiensis*), four were at medium risk, and one was at low risk. Of these, none were non-robust (i.e., data deficient) species. Of the one high risk species, none have all 11 attributes, one is missing one to three attributes, and none are non-robust (i.e., missing more than three attributes). A residual risk analysis was performed on one species. Following the residual risk analysis, none of the one species remained at high risk, i.e., all species was reduced to medium (0) or low (1) risk. Therefore, overall, there were no high risk species, four medium risk species and two low risk species.

Protected species
A total of 74 out of 84 protected species were assessed in the PSA. Of all assessed protected species, 20 were at high risk, 47 were at medium risk, and seven were at low risk. Of these, one was a non-robust (i.e., data deficient) species (White Tern *Gygis alba*). Of the 20 high risk species, 18 have all 11 attributes, one is missing one to three attributes, and one is non-robust (i.e., missing more than three attributes). A residual risk analysis was performed on 20 species. Following the residual risk analysis, seven of the 20 species remained at high risk, i.e., 13 species were reduced to medium (0) or low (13) risk. Therefore, overall, there were a total of seven high risk species, 47 medium risk species and 20 low risk species.

bSAFE and Residual Risk

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

Commercial bait species
The commercial bait species component was not evaluated in this assessment since it was eliminated at Level 1.

Byproduct species
There were 23 out of 25 byproduct species assessed in the bSAFE. Twenty-four species were below the three reference points (low risk), one was medium risk, and none were high or extreme risk. A residual risk analysis was performed on the medium, high and extreme risk species (one species; see also Section 4.6). After the residual risk analysis, 24 species were below the three reference points (low risk), one remained at medium risk (i.e., above the bSAFE-MSM reference point, Dusky Whaler *Carcharhinus obscurus*), none remained at high or extreme risk (i.e., above the bSAFE-MSM and bSAFE-LIM reference points).

Bycatch species
There were 185 out of 186 bycatch species considered in the bSAFE. Five species were unassessable due to missing biological attributes employed in the bSAFE method. Of the remaining 180 species, 179 species were below the three reference points (low risk), none were medium risk, and none were high risk) and one species was extreme risk. A residual risk analysis was performed on the medium, high and extreme risk species (one species; see also Section 4.6). After the residual risk analysis, 180 species were below the three reference points (low risk), none remained at medium risk (i.e., above the bSAFE-MSM reference point), none remained at high or extreme risk (i.e., above the bSAFE-MSM and bSAFE-LIM reference points).

Protected species
There were 10 out of 84 protected species assessed in the bSAFE. No species were above the limit (bSAFE-MSM and bSAFE-LIM) reference points, i.e., all were assessed at low risk.

Summary

A total of five marine reptiles and two cetaceans were evaluated at high risk following a residual risk analysis (Table 0.4). The five protected turtle species, i.e., Green *Chelonia mydas*, Loggerhead *Caretta caretta*, Hawksbill *Eretmochelys imbricata*, Flatback *Natator depressus* and Leatherback *Dermochelys coriacea* were evaulated at potential high risk, following a residual risk analysis partly due to life history and vulnerability parameters, and uncertainty or declining genetic stocks. The Olive Ridley Turtle *Lepidochelys olivacea* was evaluated at medium risk. The highest number of recorded turtle interactions over this assessment period (i.e., alive, dead, unknown) was Leatherback (189; 183 alive, 5 dead, 1 unknown), followed by Green (164;

137 alive, 27 dead), Loggerhead (66; 52 alive, 13 dead, 1 unknown), Hawksbill (18; 11 alive, 6 dead, 1 unknown) and Flatback (2 dead). There were also 119 turtle interactions recorded as Turtles - order Testudines, except family Testunididae comprising 94 alive, 24 dead and 1 unknown fate. While, mitigation measures for line-caught turtles and a National Turtle Recovery Plan exist interactions with these protected species should continue to be monitored.

The False Killer Whale *Pseudorca crassidens* was evaluated at potential high risk due to data deficiencies (e.g., Australian abundance estimates) and external factors (e.g., stock decline), following a residual risk analysis. Similarly, the Australian Humpback Dolphin *Sousa sahulensis* were also evaluated at potential high risk as they are known to live in small and localized subpopulations connected by limited gene flow and no subpopulation to date is estimated to contain >104 mature individuals. Also, their low reproductive rates make them vulnerable to low rates of anthropogenic mortality.

Specific recommendations arising from this assessment include further consideration of the following:

- The recorded discards (e.g., from Logbooks) for low risk species Oceanic Whitetip Shark and Shortfin Mako should continue to be monitored.
- Interactions with potential high risk turtles should continue to be monitored.
- Interactions with potential medium risk marine birds (i.e., albatrosses, petrels and shearwaters) should continue to be monitored.
- Catch and interactions to be recorded at a species taxonomic level to increase the robustness of assessments. The Electronic Monitoring (EM) program currently used in the ETBF could help provide such species-specific data from increased reviews of available footage (*cf*. 10-12% p.a. over 2018-22 period).

Table 0.4: Extreme or high-risk PSA or bSAFE species following a preliminary residual risk (RR) analysis in the Eastern Tuna and Billfish Fishery - Pelagic longline. MR: marine reptile; MM: marine mammal. No. Missing: Number of missing attributes in PSA. PS: protected.

Level 2 analysis	ERA Classification	Taxa	No. Missing	Scientific Name	Common Name	Final risk score
PSA	PS	MR	0	*Caretta caretta*	Loggerhead Turtle	High
PSA	PS	MR	0	*Chelonia mydas*	Green Turtle	High
PSA	PS	MR	0	*Eretmochelys imbricata*	Hawksbill Turtle	High
PSA	PS	MR	1	*Natator depressus*	Flatback Turtle	High
PSA	PS	MR	0	*Dermochelys coriacea*	Leatherback Turtle	High
PSA	PS	MM	0	*Pseudorca crassidens*	False Killer Whale	High
PSA	PS	MM	0	*Sousa sahulensis*	Australian Humpback Dolphin	High

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

1.1 The Hierarchical Approach

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

1.2 Conceptual Model

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

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

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

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

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

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

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

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

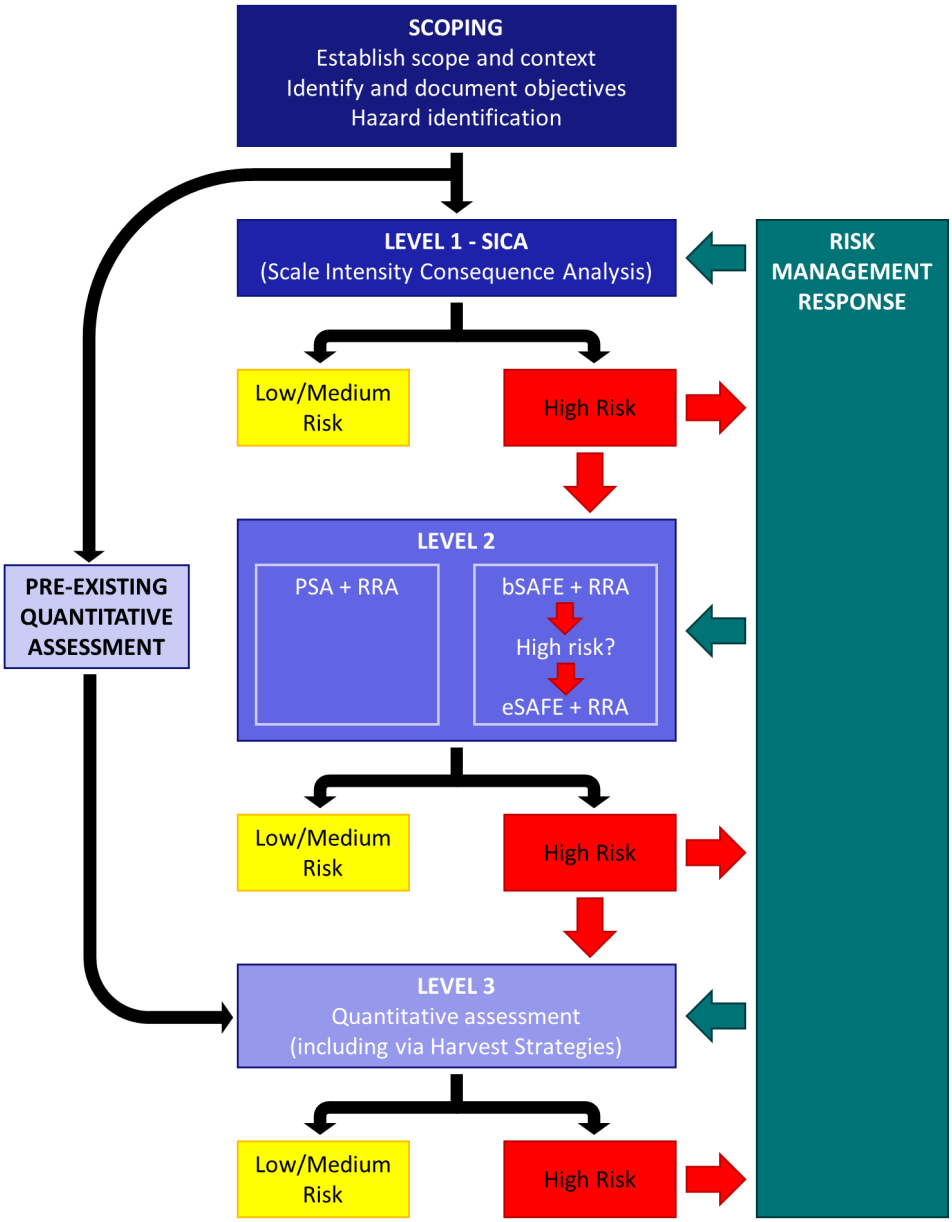

Figure 1.1: Structure of the 3 level hierarchical ERAEF methodology. SICA – Scale Intensity Consequence Analysis; PSA – Productivity Susceptibility Analysis; SAFE – Sustainability Assessment for Fishing Effects; RRA – Residual Risk Analysis. T1 – Tier 1. eSAFE may be used for species classified as high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

1.3 ERAEF Stakeholder Engagement Process

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

1.4 Scoping

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

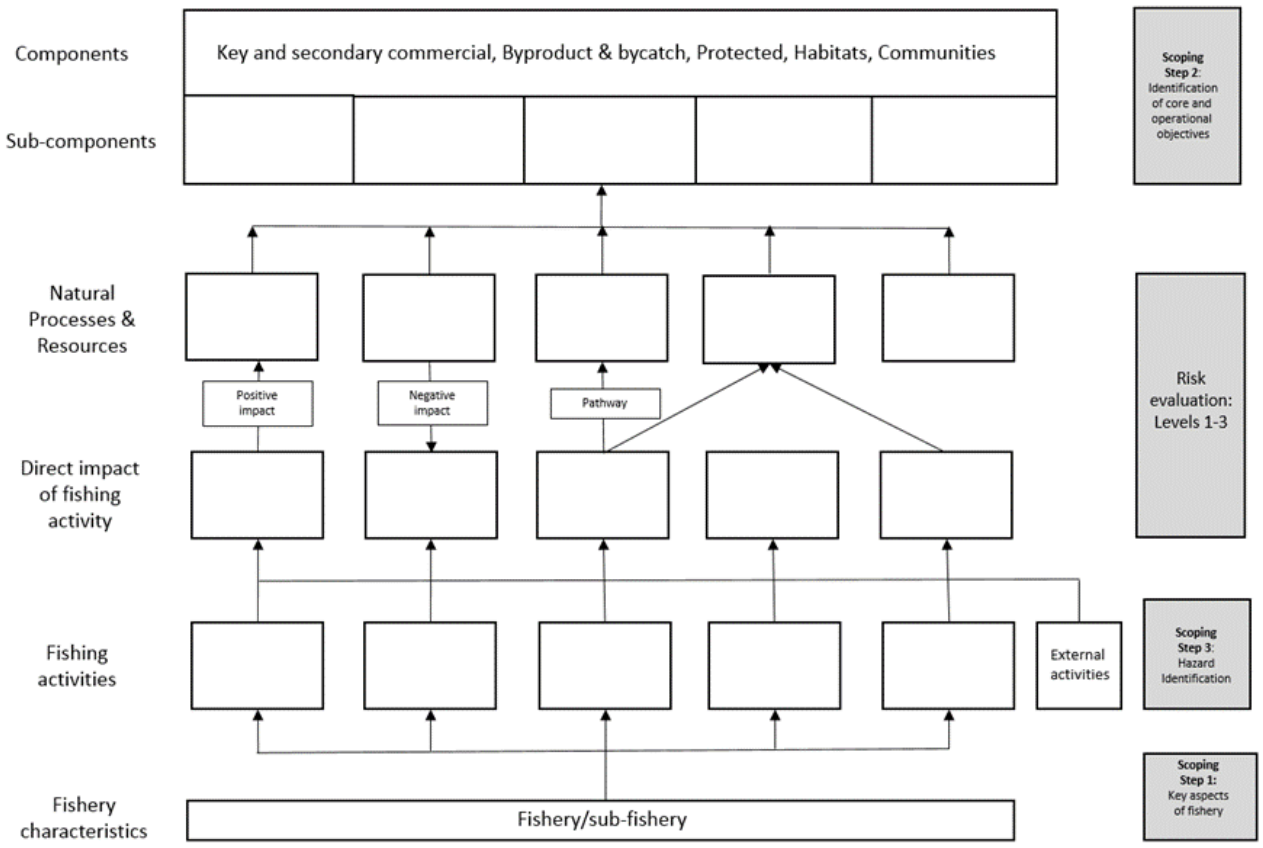

Figure 1.2: Generic conceptual model used in ERAEF.

1. **Identification of units of analysis** (species, habitats and communities) potentially impacted by fishery activities (Section 2.2.2; Scoping Documents S2A, S2B1, S2B2 and S2C1, S2C2).
2. **Selection of objectives** (Section 2.2.4; Scoping Document S3). The primary objective to be pursued for species assessed under ERAF is that of ensuring populations are maintained at biomass levels above which recruitment failure is likely, as stated in Chapter 2 (AFMA, 2017 Ecological Risk Management (ERM) Guide). This is consistent with current legislation and fisheries policies and represents a change from when the ERAEF was first developed and there was less policy or legislation-based guidance on sustainability objectives, with stakeholders able to choose from a range of "sustainability" objectives (e.g., Tables 5A-C in Hobday et al., 2007).
3. **Selection of activities** (hazards) (Section 2.2.5; Scoping Document S4) that occur in the sub-fishery is made using a checklist of potential activities provided. The checklist was developed following extensive review and allows repeatability between fisheries. Additional activities raised by the stakeholders can be included in this checklist (and would feed back into the original checklist). The background information and/or consultation with the stakeholders are used to finalize the set of activities. Many activities will be self-evident (e.g., fishing, which obviously occurs), but for others, expert or anecdotal evidence may be required.

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

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

logical progression that resulted in the consequence score.

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

1.6 Level 2. PSA and SAFE (Semi-quantitative and Quantitative Methods)

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

In the period since the first ERAEF was implemented across Commonwealth fisheries, much of the management focus has been on the assessment results associated with Level 2 and Level 2.5 or 3 risk assessment methods, which comprise semi-quantitative or rapid simple quantitative methods (e.g., PSA and SAFE). This level has been subject to the greatest level of change and improvement which are discussed in the following sections. Additional improvements are being developed for implementation in the near future (see Chapter 4.13 of AFMA ERM Guide, AFMA, 2017).

Level 2 was originally designed to rely on a single risk assessment methodology, the Productivity-Susceptibility Analysis (PSA) (see Chapter 4.9 of AFMA ERM Guide, AFMA, 2017). However, a more quantitative method called the Sustainability Assessment for Fishing Effects (SAFE) (see Chapter 4.10 of AFMA ERM Guide, AFMA, 2017) was developed early in the implementation of the ERAEF and classed as a Level 2.5 or Level 3 tool.

Under the revised ERAEF:

- bSAFE has now been reclassified as the preferred Level 2 method (over PSA) where sufficient spatial and biological data (to support bSAFE) are available. Typically this has been used for teleost and chondrichthyan species.
- Species estimated to be at high risk under bSAFE may then be assessed under eSAFE which may provide reduced estimates of uncertainty pertaining to the actual risk.
- Where either the data or species biological characteristics are insufficient to support bSAFE analyses, it is recommended that PSA be applied instead. This will be the case for many protected species, invertebrate bycatch species and some other species.
- At Level 2, either PSA or SAFE methods should be applied to any given species, not both.
- For high risk species it is a management choice whether to progress to eSAFE, pursue a Level 3 fully quantitative stock assessment, or take more immediate management action to reduce the risk. The types of considerations required in making that choice (i.e., moving up the ERAEF assessment hierarchy or taking direct management action) are outlined in Chapter 5.5 of the AFMA ERM Guide (AFMA, 2017).

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

1.6.1 PSA (Productivity Susceptibility Analysis)

Details of the PSA method are described in the accompanying ERAEF Methods Document and also summarised in Section 4.8.3 of the AFMA ERM Guide (AFMA, 2017). Stakeholders can provide input and

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

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

1.6.2 Residual Risk Analysis

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

Recently revised Residual risk guidelines have been developed (AFMA, 2018) to assist in making accurate judgements of residual risk consistently across all fisheries. At the moment, they are applied to species and not applicable to habitats or communities.

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

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

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

1.6.3 SAFE (Sustainability Assessment for Fishing Effects)

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

aspects when sufficient data are available.

bSAFE

Relative to the PSA approach, the bSAFE approach (Zhou et al., 2007, 2011; Zhou & Griffiths, 2008):

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

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

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

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

- Spatial overlap between species distribution and fishing effort distribution
- Catchability resulting from the probability of encountering the gear and size-dependent selectivity
- Post-capture mortality

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

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

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

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

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

Assumptions and issues to be aware of:

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

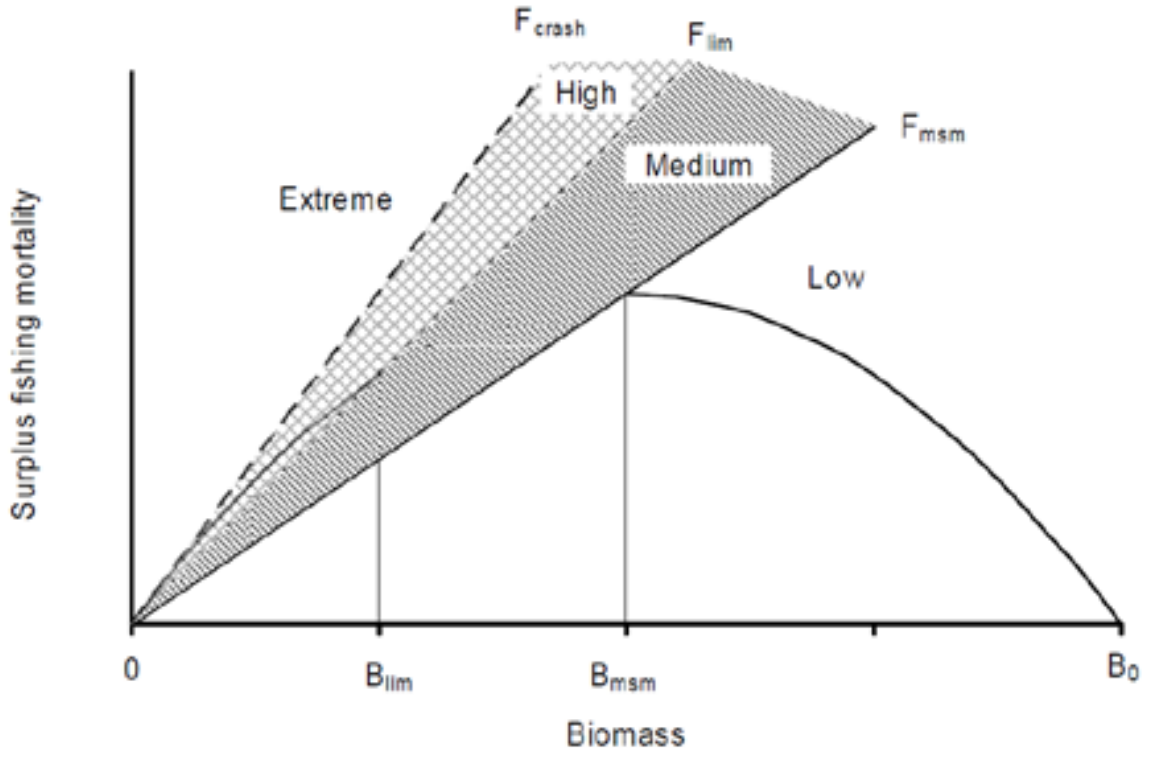

Figure 1.3: Stock productivity, biological reference points and ecological risk assessment for managing bycatch species.

- Although the bSAFE analyses provide direct estimates of uncertainty in both the exploitation rate and associated reference points, they are less explicit about uncertainties arising from key assumptions in the method, including spatial distribution and movement of stocks.
- The method assumes there would be no local depletion effects from repeat trawls at the same location (i.e., populations rapidly mix between fished and unfished areas). The fishing mortality will likely be overestimated if this assumption is not satisfied (ERA TWG 2015). The method also assumes that the mean fish density does not vary between a fished area and non-fished area within their distributional range. Hence, the level of risk would be over-estimated for species found primarily in non-fished habitats, while risk would be under-estimated for species that prefer fished habitats (ERA TWG 2015).
- The SAFE methodology makes greater assumptions than Tier 1 stock assessments in coming to its F estimates (due to a lack of the data relative to that used in a Tier 1 assessment) and it is not capable of measuring risk of a stock being already overfished (so the type of risk it measures relates only to overfishing, which may then lead to future overfished state). The limitations of SAFE with respect to measuring overfished risks are the same essentially as for PSA.

eSAFE

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

1.7 Level 3

This stage of the risk assessment is fully-quantitative and relies on in-depth scientific studies on the units identified as at medium or greater risk in the Level 2 analysis. It will be both time and data-intensive. Individual stakeholders are engaged as required in a more intensive and directed fashion. Results are presented to the stakeholder group and feedback incorporated, but live modification is considered unlikely.

1.8 Conclusion and Final Risk Assessment Report

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

1.9 Subsequent Risk Assessment Iterations for a Fishery

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

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

- The time it takes to implement risk management measures; for populations to respond to those measures to a degree detectable by monitoring processes; and to collect sufficient data to determine the effectiveness of those measures.
- Alignment with other management and accreditation processes.
- The cost of re-assessments.
- The review period for Fishery Management Strategy (FMS).

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

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

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

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

- The data upon which the indicator is based must be sufficiently representative of actual changes in catch, effort, area, gear or mitigation methods. Consideration should be given to the level of uncertainty associated with the data underpinning any prospective indicator.
- The trigger level chosen should not be overly sensitive to the normal inter-annual variance that is typical of the indicator and independent of fishing pressure, assuming such variance is unlikely to relate to a significant change in the risk posed by the fishery to any or all species.

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

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

- The trigger level should equate to the minimum level of change that the RAG (by its expert opinion) considers might potentially represent a significant change in the risk posed by the fishery.
- The trigger level could represent an absolute change (number/level) in an indicator or a percentage change in an indicator.
- The RAG should consider whether a "temporal" condition should be placed on the trigger (i.e., the trigger is breached two years in a row) to further reduce the likelihood of natural population variance or data errors triggering a re-assessment unnecessarily.

The final set of indicators and triggers will be developed for each fishery by AFMA in consultation with its fishery RAG (or for fisheries lacking a RAG, the ERA TWG), in association with the next planned re-assessment (see Chapter 6 in AFMA ERM Guide, AFMA, 2017). A RAG may choose a subset of these indicators and triggers, or include an additional indicator/trigger(s), based on consideration of the availability and reliability of data upon which to base any of the above indicators/triggers, however justification of this must be provided.

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

[6] ERA TWG recommendation, September 2015

2 Scoping and Stakeholder Engagement

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

The results presented below are for the Eastern Tuna and Billfish Fishery - Pelagic longline. A full description of the ERAEF method is provided in the methodology document (Hobday et al., 2007; Hobday et al., 2011b).

2.1 Stakeholder Engagement

Table 2.1: Summary Document SD1. Summary of stakeholder involvement for Eastern Tuna and Billfish Fishery - Pelagic longline.

Fishery ERA Report stage	Type of stakeholder interaction	Date of stakeholder interaction	Composition of stakeholder group (names or roles)	Summary of outcome
Scoping	MS Teams video meeting	28 Sep. 2023	Lachlan Farqhar (AFMA), Robert Wood (AFMA), Kate Martin (AFMA)	Project discussed, methods for Scoping analysis. Training provided on Scoping template files
Scoping - data	Email	18 Oct. 2023	Robert Wood (AFMA)	Data provided to CSIRO
Scoping - data	Emails	7 Dec. 2023; 12 Dec. 2023	Robert Wood (AFMA)	Revised data provided to CSIRO
Scoping	Email	15 Dec. 2023	Lachlan Farqhar (AFMA)	Scoping files provided to CSIRO
Scoping	Email	18 Dec. 2023	Robert Wood (AFMA)	Revised data provided to CSIRO; revised Scoping files provided to CSIRO
Scoping	Phone calls, emails	22 Dec. 2023	Robert Wood (AFMA)	Scoping files provided to CSIRO
Scoping, data	Phone calls, emails	Jan. 2024, Feb. 2024	Robert Wood (AFMA)	Review of scoping files provided
data	Emails	Dec. 2023 - Mar. 2024	Robert Wood (AFMA)	Revisions to protected species interactions provided to CSIRO
Level 1 (SICA)	Phone calls, emails	29 Feb. 2024	CSIRO	Draft Level 1 completed
Level 2	Email	11 Mar. 2024	CSIRO	Draft Level 2 completed
Draft report	Email	15 Mar. 2024	Lara Ainley (AFMA); Robert Wood (AFMA)	Draft ERA report submitted to AFMA for review and distribution to TTRAG meeting 19-21 March 2024
Level 1; Level 2	TTRAG meeting	20 Mar. 2024	TTRAG members, Scientific members, Industry participants at TTRAG	Draft Level 1 and Level 2 presented to TTRAG No. 40 meeting, 19-21 March 2023

Table 2.1: *(continued)*

Fishery ERA Report stage	Type of stakeholder interaction	Date of stakeholder interaction	Composition of stakeholder group (names or roles)	Summary of outcome
Level 2	TTRAG meeting	16-17 July 2024	TTRAG members, Scientific members, Industry participants at TTRAG	Consideration of additional information provided by ABARES (trophic level and post capture mortality) for the high risk turtle species
Level 2	Emails, MS Teams video meeting	Nov. 2024, Dec. 2024	Miriana Sporcic (CSIRO), Ryan Murphy (AFMA), Lara Ainley (AFMA), Elissa Mastroianni (AFMA), Don Bromhead (ABARES), Steph Blake (ABARES), Heather Patterson (ABARES), Brent Wise (ABARES)	Discussion on trophic level and post capture mortality estimates for turtle species
Final report	Email	18 Feb. 2025	Lara Ainley (AFMA), Ryan Murphy (AFMA)	Final ERA report submitted to AFMA

2.2 Scoping

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

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

2.2.1 General Fishery Characteristics (Step 1)

The information used to complete this step came from a range of documents such as the Fishery’s Management Plan, Assessment Reports, Bycatch Action Plans, and any other relevant background documents.

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

Fishery Assessed: Eastern Tuna and Billfish Fishery

Date of revised ERAEF assessment: February 2025

Assessor: AFMA and authors of this report (CSIRO)

2.2.1.1 General Fishery Characteristics

Fishery Name

Eastern Tuna and Billfish Fishery - Pelagic longline

Sub-fisheries

The ETBF consists of three principal methods. The predominant method is pelagic longlining.

- Pelagic longlining
- Pole and line
- Minor line

Bait fishing (inshore Purse seining) is also used in the pelagic longline sub-fishery.

Sub-fisheries assessed

The sub-fishery being assessed is the pelagic longline method in the Eastern Tuna and Billfish Fishery.

Start date/history

The Australian tuna fishing industry began with the experimental canning of southern bluefin tuna in 1939, however, commercial poling operations did not begin until the early 1950s off New South Wales, South Australia and (later) off Western Australia. The Japanese began pelagic longlining off the east coast of Australia in the early 1950s and continued until November 1997. The majority of this catch was taken to Japan. Australian commercial fishers began sporadically targeting yellowfin tuna off NSW from the mid-1950s. Over the past 50 years, Australia's tuna and billfish fisheries have expanded and developed to include several species and fishing methods, an extensive fishing area, a farming sector, and both domestic and international markets. The management of Australia's tuna and billfish fisheries has also changed throughout this period, with major changes such as the introduction of the Australian Fishing Zone in 1979 and the implementation of international management agreements.

Geographic extent of fishery

The eastern part of the Australian Fishing Zone (AFZ) from the tip of Cape York to the South Australian/Victorian border. It includes Commonwealth waters off Queensland, New South Wales, Victoria and Tasmania out to the 200 nm limit of the AFZ and includes waters around Norfolk Island (Figure 2.1).

Regions or Zones within the fishery

As per ETBF Management Plan 2010:

Area of the fishery:

Part : AFZ area (other than the Coral Sea zone)

The parts of the AFZ that are:

- within the area bounded by a notional line beginning at the intersection of the eastern coastline of the mainland at low water with the meridian of longitude 141° E, in the vicinity of the border between Victoria and South Australia and running:
  - south along that meridian to its intersection with the outer limit of the AFZ; and
  - generally southerly, easterly and northerly along that outer limit to its intersection with the meridian of longitude 144° 28' E that is off the coast of Queensland; and
  - south along that meridian to its intersection with the parallel of latitude 9° 54' S; and
  - south-westerly along the geodesic to the point of latitude 10° 15' S, longitude 144° 12' E; and
  - southerly along the geodesic to the point of latitude 10° 28' S, longitude 144° 10' E; and
  - west along that parallel to its intersection with the meridian of longitude 142° 31' 49" E; and
  - south along that meridian to its intersection with the northern coastline of the mainland at low water, in the vicinity of Cape York; and
  - generally southerly along that coastline at low water to the point where the line began; and
  - adjacent to Norfolk Island, except the area bounded by a notional line beginning at the point of latitude 28° 35' S, longitude 167° 25' E, and running:
  - east along that parallel to its intersection with the meridian of longitude 168° 25' E; and
  - south along that meridian to its intersection with the parallel of latitude 29° 50' S; and

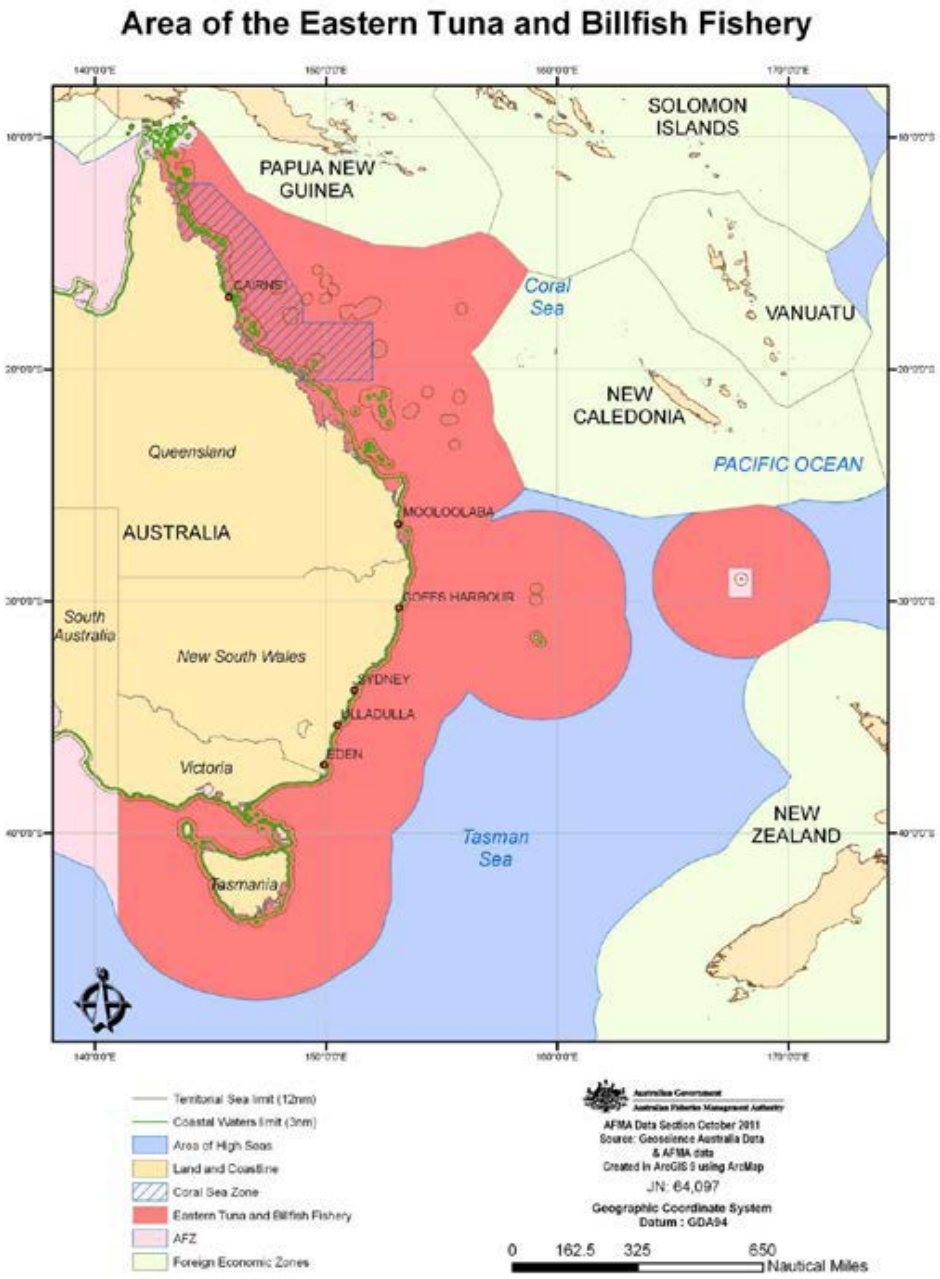

Figure 2.1: Existing Eastern Tuna and Billfish Fishery (ETBF) boundaries within the Australian Fishing Zone. Source: AFMA, Eastern Tuna and Billfish Fishery Management Arrangements Booklet 2023 Fishing Season.

– west along that parallel to its intersection with the meridian of longitude 167° 25’ E; and
– north along that meridian to the point where the line began.

Note: If an arrangement about a particular fishery is made under Division 3 of Part 5 of the Act, State coastal waters may be taken to be part of the AFZ for the purposes of the management of the fishery: see section 76 of the Act.

Part 2: Coral Sea zone

The part of the AFZ that is within the area bounded by a notional line beginning at the intersection of the eastern coastline of the mainland at low water with the parallel of latitude 12° S, in the vicinity of Shelburne Bay, and running:

- east along that parallel to its intersection with the meridian of longitude 145° E; and

- southerly along the geodesic to the point of latitude 14° S, longitude 147° E; and
- southerly along the geodesic to the point of latitude 17° S, longitude 149° E; and
- south along that meridian to its intersection with the parallel of latitude 18° S; and
- east along that parallel to its intersection with the meridian of longitude 152° E; and
- south along that meridian to its intersection with the parallel of latitude 20° 28'49" S; and
- west along that parallel to its intersection with the eastern coastline of the mainland at low water, in the vicinity of Proserpine; and
- generally northerly along that coastline at low water to the point where the line began.

Part 3: High seas zone

The part of the Pacific Ocean, other than an area that is within the AFZ or the EEZ of a foreign country, that is within the area bounded by a notional line beginning at the intersection of the south coast of Australia and the meridian of longitude 141°E, and running:

- south to its intersection with the parallel of latitude 55° S; and
- east along that parallel to its intersection with the meridian of longitude 150° E; and
- south along that meridian to its intersection with the parallel of latitude 60° S; and
- east along that parallel to its intersection with the meridian of longitude 130° W; and
- north along that meridian to its intersection with the parallel of latitude 4° S; and
- west along that parallel to its intersection with the meridian of longitude 150° W; and
- north along that meridian.

Note: Under international law, the Exclusive Economic Zone (EEZ) of a country generally extends 200 nautical miles from the baseline of a country. However, the presence of islands and reefs may extend this limit. Holders of fishing permits should contact the coastal state (within the meaning it has in the Seas and Submerged Lands Act 1973) to determine the exact coordinates of its EEZ boundaries.

Part 4: Southern Bluefin Tuna Management zone

During the assessment period of this ERA, a Southern Bluefin Tuna Management Zone was active for the area that has a high likelihood of SBT occurrence and catch. During the SBT season (around May-November generally), the details of management arrangements and the location of the SBT zone was posted on the AFMA website at: http://www.afma.gov.au/fisheries-services/sbt-zones/.

Fishing season

Fishing occurs year-round in the ETBF pelagic longline fishery. The current fishing season runs for 12 months commencing 01 January to 31 December each year. Prior to 2019, the season ran from 01 March to 28 February each year, except 2018 which ran from 01 March 2018 – 31 December 2018.

Key/secondary commercial species and stock status

Key commercial species:

- Albacore Tuna (*Thunnus alalunga*; ALB)
- Bigeye Tuna (*Thunnus obesus*, BET)
- Broadbill Swordfish (*Xiphias gladius*, SWO)
- Yellowfin Tuna (*Thunnus albacares*, YFT)
- Striped Marlin (*Kajikia audax*, STM)

Stock assessments are conducted over a broader region (Western and Central Pacific Ocean) and the reported status reflects the species status in this region.

Stock status:

- **Albacore Tuna** (*Thunnus alalunga*): not overfished (Biomass) and not subject to overfishing (Fishing mortality). Last assessed: 2021. South Pacific.
- **Bigeye Tuna** (*Thunnus obesus*): not overfished (Biomass) and not subject to overfishing (Fishing mortality). Last assessed: 2023. Western and Central Pacific.

- **Broadbill Swordfish** (*Xiphias gladius*): not overfished (Biomass) and not subject to overfishing (Fishing mortality). Last assessed: 2021. South-west Pacific.
- **Yellowfin Tuna** (*Thunnus albacares*): not overfished (Biomass) and not subject to overfishing (Fishing mortality). Last assessed: 2023. Western and Central Pacific.
- **Striped Marlin** (*Tetrapturus audax*): likely overfished (Biomass) and close to undergoing overfishing (Fishing mortality). Last assessed: 2019. South-west Pacific.

See also individual stock assessment reports for each of the species (Albacore Tuna: Castillo-Jordán et al., 2021; Bigeye Tuna: Day et al., 2023; Broadbill Swordfish: Ducharme Barth et al., 2021; Yellowfin Tuna: Magnusson et al., 2023; Striped Marlin: Ducharme Barth et al., 2019; Southern Bluefin Tuna: CCSBT, 2023). Source: Butler et al. (2023)

The primary species not covered by quota include:

- Longtail Tuna (*Thunnus tonggol*);
- Northern Bluefin Tuna (*Thunnus orientalis*);
- Rays Bream (or Pomfret) – Family *Bramidae*; and
- Skipjack Tuna (*Katsuwonus pelamis*).

Quota is not required to catch these species; however an annual 35 t catch limit of Longtail Tuna applies in the ETBF. AFMA imposes a 10 fish trip limit if the 35 t trigger limit is reached.

Secondary commercial species:

There are no secondary commercial species in the ETBF.

Bait collection and usage

Bait used in the ETBF comes from various sources:

- fresh self-caught Yellowtail Scad and Blue (slimy) Mackerel;
- frozen local Pilchards and imported Squid and Pilchards.

Most boats will use a combination of bait setting, alternating fresh live with thawed baits along the length of the line. Operators tend to identify Squid bait with Swordfish capture, and live bait with Tuna and Striped Marlin.

Overall, the difference in catch-per-unit-effort (CPUE) between bought and self-caught baits appears to be very small. The type of species targeted influences the effectiveness of the bait used. Tuna and Striped Marlin have been shown to prefer self-caught (live bait) while Swordfish tend to prefer bought bait (squid).

All boats using fresh bait, purse seine inshore for their own requirements, on state licences. Squid is not self-caught. Additionally, AFMA requires contact (i.e., a phone call) prior to these operations. Catch must be recorded to enable some assessment of inshore stocks to be maintained.

Current entitlements

Current entitlements are listed in Table 2.2.

Table 2.2: ETBF Entitlements over the last seven quota years. ^ short season 01/03/2018 - 31/12/2018. Source: AFMA.

Quota year	No. Boat SFRs	No. active operators	No. inactive operators
2016-2017	90	36	54
2017-2018	85	39	46
2018^	85	39	46
2019	82	39	43
2020	81	37	44
2021	81	35	46

Table 2.2: *(continued)*

Quota year	No. Boat SFRs	No. active operators	No. inactive operators
2022	81	34	47

Current and recent TACs, quota trends by method

Total Allowable Commercial Catch for the last seven seasons for quota species are shown in Table 2.3.

Table 2.3: Agreed Total Allowable Commercial Catch (TACC; t) and corresponding percent of the TACC caught for five key commercial species by quota year 2016 to 2022 inclusive. Source: AFMA Catchwatch reports. https://www.afma.gov.au/commercial-fishers/resources/catchwatch-reports

Common name	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23
Albacore Tuna	2500 (39)	2500 (36)	2351 (32)	2500 (34)	2500 (43)	2500 (40)	2500 (41)
Bigeye Tuna	1056 (72)	1056 (39)	957 (31)	1056 (25)	1056 (27)	1056 (34)	1056 (30)
Broadbill Swordfish	1373 (71)	1285 (85)	960 (78)	1250 (59)	1250 (45)	1163 (48)	1047 (63)
Striped Marlin	351 (68)	351 (75)	311 (63)	351 (67)	351 (54)	351 (54)	351 (74)
Yellowfin Tuna	2200 (69)	2400 (70)	2054 (53)	2400 (80)	2400 (71)	2400 (61)	2400 (52)

Current and recent fishery effort trends by method

The level of effort, determined by the total number of hooks set, has declined since 2019. By contrast, the number of hooks per set has increased since 2018 of between 1-5%, despite the small decrease (1%) in 2022 relative to the previous year. This can be attributed, in part, to the circumstances related to the outbreak of the COVID-19 pandemic and an increase in SBT quota availability and increased SBT targeting by ETBF vessels (Table 2.4). In addition, the greatest intensity of fishing (hooks/km^2) in 2022 was distributed off the NSW and southern to middle Queensland coasts (Figure 2.2).

Table 2.4: Total longline sets and hooks deployed by calendar year. Source: Based on Commonwealth logbook information from AFMA

Year	Total sets	Total Hooks (1000s)	Total hooks per set
2016	4973	7824	1573
2017	5286	8747	1655
2018	4538	7903	1742
2019	4804	8583	1787
2020	4550	8214	1805
2021	3978	7553	1899
2022	3599	6749	1875

Current and recent fishery catch trends

Annual longline catches by (A) key commercial species (Yellowfin Tuna, YFT; Bigeye Tuna, BET; Albacore Tuna, ALB; Broadbill Swordfish, SWO, Striped Marlin, STM and Southern Bluefin Tuna, SBT; and (B) selected byproduct species (Rudderfish, RUD; Dolphin Fish, DOL; Escolar, BOF) by year (Table 2.5). Source: AFMA Commonwealth logbook data.

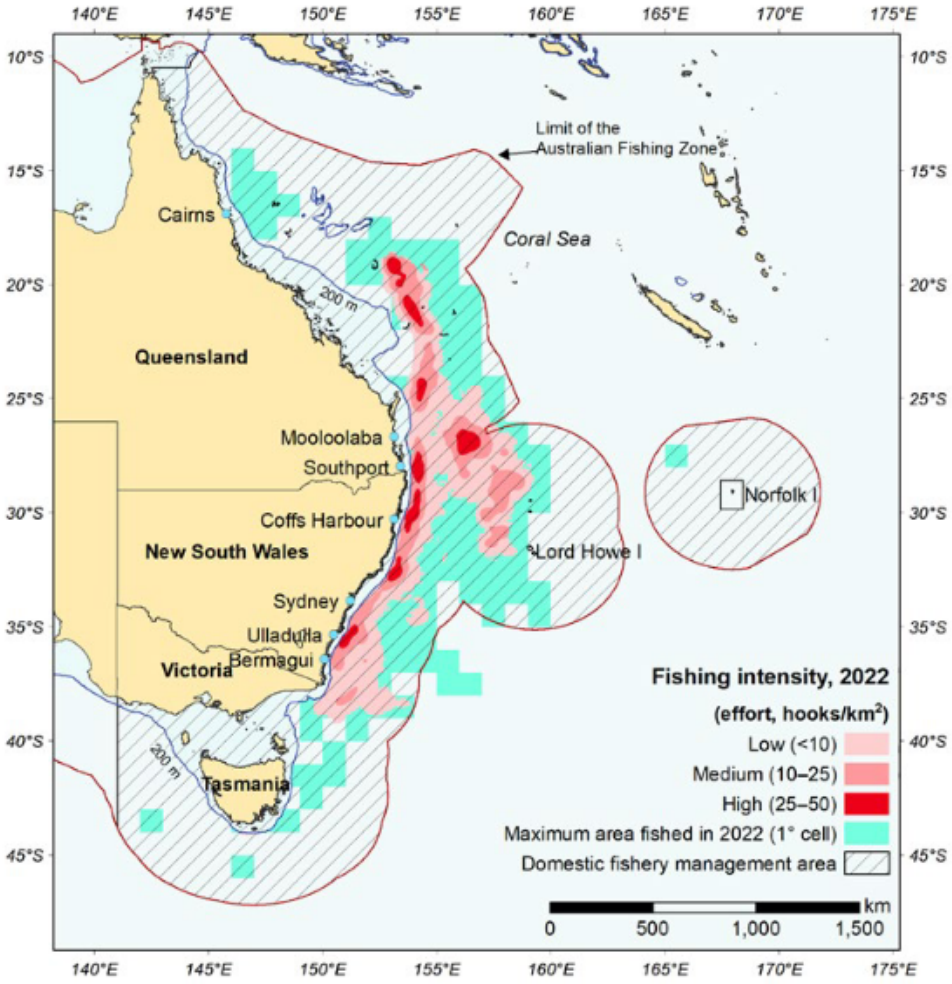

Figure 2.2: Effort Intensity (hooks per squared kilometres) in 2022. Source: Blake et al. (2023).

Table 2.5: Annual total catch (retained weight; t) of the key commercial species caught by pelagic longline in data the ETBF 2016-2022 inclusive. Annual longline catches by key commercial species (Yellowfin Tuna, YFT; Bigeye Tuna, BET; Albacore Tuna, ALB; Broadbill Swordfish, SWO; Striped Marlin, STM and Southern Bluefin Tuna, SBT) and selected byproduct species (Rudderfish, RUD; Dolphin Fish, DOL and Escolar, BOF) by calendar year. Source: AFMA Catch Disposal Records data.

Year	YFT	BET	ALB	SWO	STM	SBT	RUD	DOL	BOF
2016	1757	870	1100	1152	244	736	59	189	53
2017	1710	450	991	1179	287	643	44	168	59
2018	1510	366	887	1020	242	1027	51	153	91
2019	2074	281	903	782	249	780	23	140	57
2020	1841	307	1165	607	203	827	10	94	14
2021	1588	390	1088	617	206	1038	8	67	7
2022	1345	341	1125	710	280	1006	20	45	<1

Current and recent value of fishery ($)

The value of this sub-fishery was $34.4 million in 2021 and $33.8 million in 2022.

Further details can be found within the Fishery Status Report –
http://www.agriculture.gov.au/abares/research-topics/fisheries/fishery-status

Relationship with other fisheries

Commercially targeted and bycatch species in Australia's tuna and billfish fisheries are also targeted or caught as bycatch in other fisheries which may share the same areas. Due to the highly migratory nature of tuna, the domestic fisheries share stocks with other nations, either operating within their national waters or on the high seas. International conventions and agreements are in place to manage these species through their entire range. Australia's tuna and billfish fisheries share waters with other fisheries, however, there are few bycatch species caught while targeting tuna that are targeted by other managed fisheries. These may include the Gillnet Hook and Trap sector within the Southern and Eastern Scalefish and Shark Fishery (SESSF) and other state-managed fisheries in coastal waters of southern and south-western Australia.

Recreational fishery

The recreational fishery, however, targets many species caught in the Commonwealth-managed Tuna and Billfish fisheries, including Billfish species, Marlin, Yellowfin Tuna, Bigeye Tuna and southern bluefin tuna. These recreational operators also target species that are bycatch or by-product species in Australia's Tuna and Billfish fisheries, such as Ray's Bream and Dolphin Fish.

International Commercial Fisheries

Many of the species targeted in the ETBF are also captured by fisheries in the western and central Pacific Ocean. The level of exploitation for the Pacific Ocean stocks varies from overfished, not overfished to uncertain. The connectivity between fish caught in the ETBF and the large stocks of the central and western Pacific is the subject of ongoing research in Australia and the South Pacific.

Japanese fishing activity in the Australian Fishing Zone

In the early 1950s the Japanese began pelagic longlining off the east coast of Australia. This activity was managed under the Australia/Japan bilateral agreements. The distribution of fishing activity spread and continued until November 1997. Japanese longliners operating in the north-eastern AFZ mainly targeted Yellowfin Tuna, averaging 35% of the reported catch. Other commercially important species included Bigeye Tuna (10%), Striped Marlin (5%) and Broadbill Swordfish (10%).

Commonwealth and State Fisheries

Commonwealth fisheries that operate in the same region as the ETBF include the Southern Bluefin Tuna Fishery (SBTF), Small Pelagic Fishery (SPF), Southern and Eastern Scalefish and Shark Fishery (SESSF) and the Coral Sea Fishery (CSF). The Western Tuna and Billfish Fishery (WTBF) operates in waters adjacent to the ETBF. Many State finfish fisheries operate adjacent to the waters of the ETBF, however direct interactions are relatively limited given that most pelagic species caught in the ETBF generally do not occur in near shore waters and only a few species of inshore fish are susceptible to capture on pelagic longlines. Table 2.6 identifies the relationship between the ETBF and other fisheries.

Recreational and charter fisheries

Recreational anglers operate in the same areas as WTBF longliners but generally much closer to shore. Recreational anglers use trolling lures or baits. Baits include small Skipjack Tuna, Pilchards, and Blue Mackerel. All Australian states now have some controls on recreational and charter fishing for tuna and billfish species. More information on the management of state recreational fisheries can be found at the individual state's websites.

Queensland - www.daf.qld.gov.au/fisheries

NSW - www.dpi.nsw.gov.au/fishing

Victoria - www.agriculture.vic.gov.au/fisheries

Tasmania - www.dpipwe.gov.au

Western Australia - www.fish.wa.gov.au

South Australia - www.pir.sa.gov.au/recreational_fishing

Table 2.6: Characteristics of Commonwealth fisheries related to the ETBF.

Fishery	Key Commercial species	Interactions with ETBF	Gear
Southern Bluefin Tuna Fishery (SBT)	Southern Bluefin Tuna	Southern Bluefin Tuna is targeted by the ETBF fleet later in the season in southern waters of the ETBF	Purse seine, Pelagic longline
Western Tuna and Billfish Fishery (WTBF)	Broadbill Swordfish, Yellowfin Tuna, Bigeye Tuna, Albacore Tuna	ETBF species are caught in southern Australia	Pelagic longline, Minor line
Small Pelagic Fishery (SPF)	Peruvian Jack Mackerel, Greenback Common Jack Mackerel, Blue Mackerel, Yellowtail Scad, Redbait	Small pelagic species caught for own use and/or as bait in the ETBF	Purse seine
Skipjack Tuna Fishery (SKF)	Skipjack Tuna	Purse seine sub-fishery for Skipjack Tuna can interact with species taken in the ETBF (Yellowfin Tuna and Bigeye Tuna), but has been inactive since 2009	

2.2.1.2 Gear

Fishing methods and gear

Longlining is the primary fishing method in the ETBF. Longline vessels in the ETBF vary in size, ranging from smaller inshore boats to larger, purpose-built boats capable of high seas fishing. Historically, the majority of domestic operators carried out other types of commercial fishing operations in conjunction with their tuna and billfish fishing activity. While this still continues, a large number of longline operators are now committed to tuna fishing on a full-time basis. This is most evident in northern NSW and southern Queensland where fleets have been established to fish for Broadbill Swordfish, Yellowfin and Bigeye Tuna on a year-round basis.

Pelagic longlines are set near the surface of the water and comprise of:

- A mainline, which is suspended near the surface by a float lines attached to a series of floats (buoys or bubbles).
- Branch lines (or snoods), which hang off the mainline in between each float, and to which are attached baited hooks (Figure 2.3).

Longlines can be many kilometres long and carry thousands of hooks using fresh, frozen or live baits. Pelagic longlines are not anchored and are set to drift near the surface of the ocean with a radio beacon attached to floats so that the vessel can track them to haul in the catch.

Trips average between 5.2 and 5.6 days between 2018-2022, however trips can be up to 45 days based on vessels that fish in offshore grounds for Swordfish. The annual mean trip lengths (days) between 2016 and 2022 are listed in Table 2.7.

Table 2.7: Average Trip Length (days) by ETBF longline vessels for 2016-2022 inclusive. Source: AFMA.

Year	2016	2017	2018	2019	2020	2021	2022
Mean trip length (days)	5.49	5.52	5.46	5.55	5.2	5.22	5.55

Fishing gear restrictions

Gear is limited to pelagic longline, minor line or Purse seine equipment. Purse seine may not be used to target Skipjack Tuna, which is caught as part of the Skipjack Tuna fishery.

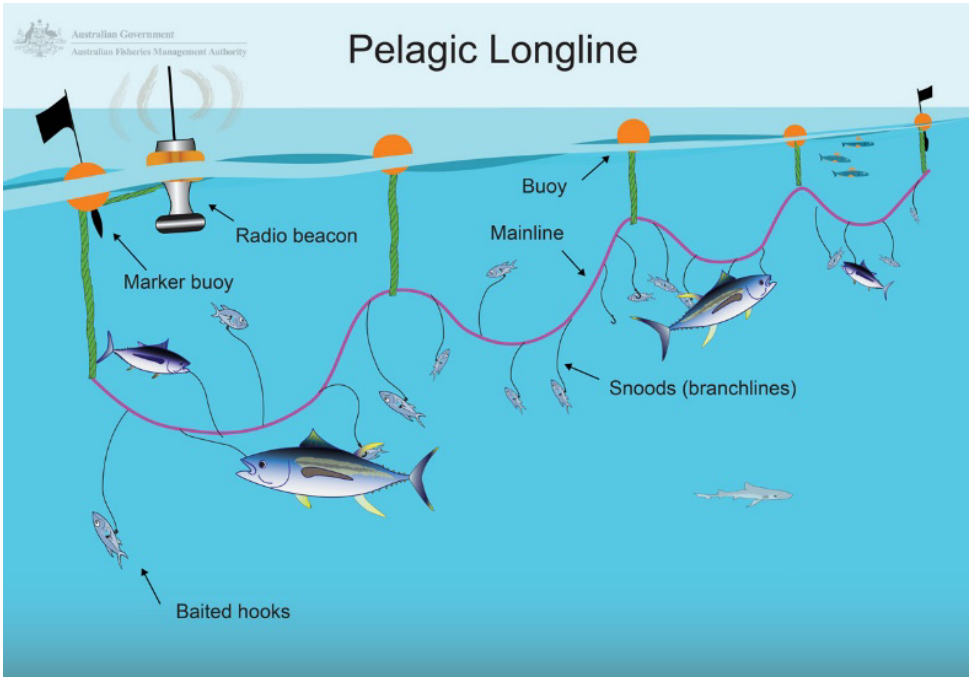

Figure 2.3: Pelagic longlining. Source: http://www.afma.gov.au/portfolio-item/longlining/

The 2018 Threat Abatement Plan to reduce incidental bycatch of marine birds, which requires longline operators to implement mitigation measures such as deploying approved bird deterring tori lines, and to not discharge offal during line setting and hauling.

Hook restrictions apply in the Coral Sea Zone (CSZ) as defined in the Eastern Tuna and Billfish Fishery Management Plan.

Since 2021 within the CSZ east of longitude 148° E, the daily limit for setting hooks is 1250, regardless of the number of longline sets and when fishing west of longitude 148° E, between March 1, and August 31, the daily limit for setting hooks is 1250 and outside this period, the daily limit on any longline set is 500.

Selectivity of fishing methods

In comparison to many other fishing methods, pelagic longlining is relatively selective. A lower diversity of species that are susceptible to longline gear are found in the upper water column in comparison to the range of species that may be impacted on by other methods such as demersal trawling. The species and size selectivity of the longline gear is dependent on various factors such as:

- the horizontal and vertical distribution of the gear given that certain species are found in selected areas and over selected substrates, and that species are found at various depths according to various environmental influences;
- the variety of bait used since the gear is based on the foraging behaviour of fish and as feeding stimulants may be species-specific and
- the hook and other gear design since the selectivity is related to the ability of the hook to penetrate the mouth of the fish.

However, in comparison to other tuna and tuna-like species fishing methods, longline fishing has the potential to interact with a wider range of species, some of which will be of high conservation value. These include environmentally protected seabirds and turtles, and commercially protected Blue and Black Marlins and various shark species of concern.

Spatial gear zone set

Depending on the target species, the gear is set either continental shelf, shelf break or slope, seamounts and rises/ridges.

Depth range gear set

The gear is set from approximately between 30-500 m below the surface depending on target species.

How gear set

A pelagic longline consists of a mainline with attached branch lines. Each branch line is fitted with one or more baited hooks or artificial lures. The longline is set so that the mainline, branch lines and hooks are suspended below the surface in the water column by floats at the sea surface. Longlines are deployed from vessel and radio beacons are used to locate the gear after a period of time.

Area of gear impact per set or shot

Pelagic longlining has no direct impact with the benthos, as the gear is set in the water column.

Capacity of gear

Most Australian pelagic longline vessels are between 15 and 30 m long and set around 1700 hooks per fishing operation. Some longliners now routinely set more than 1200 hooks per day. Australian longliners store their catch on ice, in ice slurry, brine or use brine spray systems.

Effort per annum all vessels

Effort per annum of all vessels in fishery by sets and hooks are listed in Table 2.8.

Table 2.8: Effort per annum of all vessels in the ETBF by sets and hooks. Source: AFMA

Year	No. Vessels	Total sets	Total hooks (1000s)	Total Hooks/set
2016	37	4973	7824	1573
2017	39	5286	8747	1655
2018	40	4538	7903	1742
2019	37	4804	8583	1787
2020	36	4550	8214	1805
2021	35	3978	7553	1899
2022	36	3599	6749	1875

Lost gear and ghost fishing

Radio beacons are used to locate the gear for hauling. However, some gear or parts of line may break free. If gear is lost, it may drift for a while before balling up, baits usually fall off.

2.2.1.3 Issues

Key/secondary commercial species issues and interactions

Key commercial quota species include Albacore Tuna, Bigeye Tuna, Broadbill Swordfish, Yellowfin Tuna and Striped Marlin.

The species of tuna and billfish targeted throughout Australia's tuna and billfish fisheries varies spatially and temporally. The status of the key target species in the longline fisheries is described above in Target species and stock status.

While Offshore Constitutional Settlement arrangements are broadly in place for tuna and billfish, these species are taken in a number of other fisheries. Tuna and billfish are also important recreational fishing species. The collection and sharing of information across jurisdictions and sectors is a key issue.

The link between fish caught in the ETBF and the large stocks of the central and western Pacific is the subject of ongoing research in Australia and the South Pacific.

Byproduct and bycatch issues and interactions

Based on records from AFMA Logbook database over the 2018-2022 period, the main byproduct species are Mahi Mahi, Escolar, and Rudderfish. The main bycatch species over the 2018-2022 period include Ocean Sunfish and Short Sunfish.

Blue marlin and black marlin are not permitted to be landed in the ETBF. Any catches must be reported to AFMA and recorded. There are reasonable levels of discarding occurring (see Discarding section in this scoping section). There is a spawning aggregation off the Great Barrier Reef (Domeier & Speare, 2012).

Around 70 species of fish have been recorded as retained in Australia's tuna and billfish fisheries. Only a small number of species comprise the main target species of the fisheries. Many of the species taken are utilised as by-products, however some of the species taken in Australia's tuna and billfish fisheries are either unsuitable as commercial species or are taken in numbers too small to warrant the development of markets. The survivability these animals when caught varies between species and according to other factors such as length of time the fish remains hooked, predation by other fish or sharks, oceanographic and weather conditions at the time of capture, and method of release.

All permit holders in the Commonwealth tuna and billfish fisheries are subject to the bycatch arrangements set out in the Fisheries Management Regulations 2019 administered by AFMA under the Fisheries Management Act 1991. These regulations are consistent with the bycatch provisions set out in the Offshore Constitutional Settlement arrangements and the Memoranda of Understanding that have been established between the Commonwealth Government and each respective State and Territory for tuna and tuna-like species fisheries (South Australia, Western Australia, Queensland, New South Wales and the Northern Territory). Permit holders are also subject to the Threatened Abatement Plan, Bycatch Action Plans, ETBF ERM Strategy and the Commonwealth Bycatch Policy.

Protected species issues and interactions

Longline sector operators are required to complete an electronic log of daily fishing activities on a shot-by-shot basis. Reporting of any interactions with any protected species is a mandatory requirement of the Environmental Protection and Biodiversity Conservation Act 1999 (EPBC Act 1999). The EPBC Act 1999 protects a number of marine species. The status of these species range from being at risk of extinction, threatened or at the least, requiring protection to ensure their long-term conservation. Operators in Australia's tuna and billfish fisheries therefore are legally required take all reasonable steps to ensure that EPBC listed species (other than conservation dependent species) are not killed or injured as a result of fishing. Where an interaction does occur, operators are required to report to it to AFMA. Protected species interactions are listed in Table 2.9.

Teleosts

There were no recorded interactions with protected teleosts over the 2018-2022 period based on the AFMA logbook data.

Marine birds

There were 361 marine bird interactions recorded in the AFMA Commonwealth logbook database over the 2018-2022 period (71 alive; 287 dead; 3 injured or unknown). Of these 361 marine bird interactions, most consisted of albatrosses (191: 50 alive, 139 dead, 2 unknown) and shearwaters (116: 14 alive, 101 dead, 1 unknown). Albatrosses consisted of (i) Albatrosses Diomedeidae – undifferentiated, (ii) Black-browed Albatross, (iii) Shy Albatross, (iv) Sooty Albatross and Wandering Albatrosses. Shearwaters consisted of (i) Shearwaters Puffinus spp. – undifferentiated, (ii) Short-tailed Shearwater, (iii) Sooty Shearwater and (iv) Flesh-footed Shearwater. There were an additional seven interactions recorded as Petrels and Shearwaters – Procellariidae undifferentiated (7 dead). The remaining 47 marine bird interactions comprised of Cape Petrel (1 dead), Australasian Gannet (7: 1 alive, 6 dead), Terns (1 dead) and Birds (38: 6 alive, 32 dead).

Chondrichthyans

There were 14,432 chondrichthyan interactions recorded in the AFMA Commonwealth logbook database

over the 2018-2022 period (5012 alive; 1018 dead; 8402 unknown). These comprised of seven species: Shortfin Mako (7168: 2212 alive; 499 dead; 4457 unknown), Longfin Mako (24: 3 alive; 11 dead; 10 unknown), Oceanic Whitetip Shark (5359: 2076 alive; 465 dead; 2818 unknown), Silky Shark (508 unknown), Whale Shark (1 alive), White Shark (1 unknown), Porbeagle (15: 1 alive; 8 dead; 6 unknown), Giant Manta Ray (1353: 716 alive; 35 dead; 602 unknown) and Manta Ray (3 alive). The EPBC Act listing prohibits all targeted commercial fishing of these species in Commonwealth waters. Following this listing, new management arrangements were introduced that permit commercial fishers to retain Shortfin Mako individuals that are captured dead, but require any live sharks be returned to the water unharmed. All catches of these sharks, whether retained or released, must be reported in daily fishing logbooks (Butler et al. (2010); Department of Sustainability, Environment, Water, Population and Communities (2011)).

Marine mammals

Cetaceans

There were 42 whales recorded alive in the AFMA Commonwealth logbook database over the 2018-2022 period (35 alive, 6 dead, 1 unknown). These comprised of Melon-headed Whale (2 alive), Short-finned Pilot whale (18: 14 alive; 3 dead; 1 unknown), Humpback whale (1 alive), Toothed Whales - undifferentiated (5: 2 alive; 3 dead), Long-finned Pilot Whale (4 alive), False Killer Whale (8 alive) and Whales - undifferentiated (4 alive).

There were 32 dolphins recorded in AFMA Commonwealth logbook database over the 2018-2022 period (27 alive, 5 dead). These comprised Common Dolphin (8: 6 alive; 2 dead), Bottlenose Dolphin (3 alive) and Dolphins - undifferentiated (21: 18 alive; 3 dead).

Seals and sea-lions

There were 34 pinnipeds recorded in AFMA Commonwealth logbook database over the 2018-2022 period (34: 32 alive, 2 dead). These comprised New Zealand Fur Seal (2: 1 alive; 1 dead), Australian Fur Seal (2 alive) and Seals - undifferentiated (30: 29 alive, 1 dead).

Marine reptiles

There were 592 marine reptile interactions recorded in the AFMA Commonwealth logbook database over the 2018-2022 period (505 alive, 83 dead, 4 unknown). These consisted of 189 Leatherback Turtle (183 alive; 5 dead; 1 unknown), 164 Green Turtle (137 alive; 27 dead;), 66 Loggerhead Turtle (52 alive; 13 dead; 1 unknown), 119 Turtles - undifferentiated (94 alive; 24 dead; 1 unknown), 34 Olive Ridley Turtle (28 alive; 6 dead), 18 Hawksbill Turtle (11 alive; 6 dead; 1 unknown) and 2 Flatback Turtle (2 dead).

Table 2.9: Recorded wildlife interactions from the AFMA Logbook database for the period 2018-2022 inclusive. A: alive; D: dead; U: unknown. Tot A: Total alive; Tot D: Total dead; Tot U: Total unknown. Total: Total alive, dead and unknown. Source: Commonwealth Logbook data from AFMA.

Common name	Scientific name	2018			2019			2020			2021			2022			Tot	Tot	Tot	Total
		A	D	U	A	D	U	A	D	U	A	D	U	A	D	U	A	D	U	
Albatrosses	Diomedeidae - undifferentiated	15	41	0	15	35	0	1	7	1	9	10	1	4	29	0	44	122	2	168
Australian Fur Seal	*Arctocephalus pusillus doriferus*	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	2	0	0	2
Australasian Gannet	*Morus serrator*	0	4	0	0	0	0	1	2	0	0	0	0	0	0	0	1	6	0	7
Birds	Avians	0	3	0	5	0	0	0	14	0	1	15	0	0	0	0	6	32	0	38
Black Browed Albatross	*Thalassarche melanophrys*	1	3	0	0	2	0	2	1	0	0	0	0	0	0	0	3	6	0	9
Bottlenose Dolphin	*Tursiops truncatus*	0	0	0	1	0	0	1	0	0	1	0	0	0	0	0	3	0	0	3
Cape Petrel	*Daption capense*	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	1
Common Dolphin	*Delphinus delphis*	0	0	0	2	1	0	2	1	0	0	0	0	2	0	0	6	2	0	8
Dolphins	Delphinidae - undifferentiated	3	1	0	5	2	0	4	0	0	1	0	0	5	0	0	18	3	0	21
False Killer Whale	*Pseudorca crassidens*	0	0	0	4	0	0	3	0	0	0	0	0	1	0	0	8	0	0	8
Flatback Turtle	*Natator depressus*	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	2	0	2
Flesh-footed Shearwater	*Puffinus carneipes*	0	0	0	0	0	0	0	0	0	1	15	0	8	2	0	9	17	0	26
Giant Manta Ray	*Manta birostris*	0	0	226	11	0	244	55	1	124	489	18	3	161	16	5	716	35	602	1353
Green Turtle	*Chelonia mydas*	27	9	0	42	10	0	25	6	0	14	2	0	29	0	0	137	27	0	164
Hawksbill Turtle	*Eretmochelys imbricata*	4	1	0	4	4	0	1	1	1	2	0	0	0	0	0	11	6	1	18

Table 2.9: *(continued)*

Common name	Scientific name	2018			2019			2020			2021			2022			Tot	Tot	Tot	Total
		A	D	U	A	D	U	A	D	U	A	D	U	A	D	U	A	D	U	
Humpback Whale	*Megaptera novaeangliae*	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1
Leatherback Turtle	*Dermochelys coriacea*	64	3	1	52	1	0	21	0	0	22	0	0	24	1	0	183	5	1	189
Loggerhead Turtle	*Caretta caretta*	14	3	1	5	7	0	11	2	0	9	1	0	13	0	0	52	13	1	66
Longfin Mako	*Isurus paucus*	0	3	6	0	4	1	0	1	3	0	0	0	3	3	0	3	11	10	24
Long-finned Pilot Whale	*Globicephala melas*	1	0	0	0	0	0	0	0	0	2	0	0	1	0	0	4	0	0	4
Manta Ray	*Manta alfredi*	0	0	0	0	0	0	2	0	0	0	0	0	1	0	0	3	0	0	3
Melon-headed Whale	*Peponocephala electra*	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	2	0	0	2
New Zealand Fur Seal	*Arctocephalus forsteri*	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	1	1	0	2
Oceanic Whitetip Shark	*Carcharhinus longimanus*	0	0	806	0	0	1072	360	3	723	1170	334	146	546	128	71	2076	465	2818	5359
Pacific (Olive) Ridley Turtle	*Lepidochelys olivacea*	7	0	0	8	1	0	5	2	0	4	1	0	4	2	0	28	6	0	34
Petrels and Shearwaters - unspecified	Procellariidae - undifferentiated	0	0	0	0	0	0	0	3	0	0	0	0	0	4	0	0	7	0	7
Porbeagle	*Lamna nasus*	0	2	4	0	0	1	0	2	1	0	3	0	1	1	0	1	8	6	15
Seals	Otariidae and Phocidae	5	0	0	0	0	0	1	0	0	11	0	0	12	1	0	29	1	0	30
Shearwaters	*Puffinus* spp. - undifferentiated	2	13	0	1	36	0	0	6	0	0	5	0	1	18	1	4	78	1	83

Table 2.9: ***(continued)***

Common name	Scientific name	2018 A	2018 D	2018 U	2019 A	2019 D	2019 U	2020 A	2020 D	2020 U	2021 A	2021 D	2021 U	2022 A	2022 D	2022 U	Tot A	Tot D	Tot U	Total
Short Tailed Shearwater	*Puffinus tenuirostris*	0	1	0	1	1	0	0	0	0	0	1	0	0	2	0	1	5	0	6
Shortfin Mako	*Isurus oxyrinchus*	11	0	1971	19	0	1808	1187	0	0	671	358	340	324	141	338	2212	499	4457	7168
Short-finned Pilot Whale	*Globicephala macrorhynchus*	5	2	0	3	0	1	1	0	0	3	1	0	2	0	0	14	3	1	18
Shy Albatross	*Thalassarche cauta*	0	0	0	0	1	0	0	1	0	0	0	0	0	1	0	0	3	0	3
Silky Shark	*Carcharhinus falciformis*	0	0	130	0	0	54	0	0	264	0	0	60	0	0	0	0	0	508	508
Sooty Albatross	*Phoebetria fusca*	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	1
Sooty Shearwater	*Puffinus griseus*	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
Terns	*Terns - AFMA Observer Code*	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	1
Toothed whales	*Toothed whales* - undifferentiated (suborder Odontoceti*, in part)*	0	0	0	0	0	0	0	0	0	0	0	0	2	3	0	2	3	0	5
Turtles	order Testudines (except *fam.* Testunididae) - undifferentiated	16	6	0	13	4	1	16	4	0	28	6	0	21	4	0	94	24	1	119
Wandering Albatross	*Diomedea exulans*	2	4	0	0	3	0	0	0	0	0	0	0	0	1	0	2	8	0	10

Table 2.9: ***(continued)***

Common name	Scientific name	2018 A	2018 D	2018 U	2019 A	2019 D	2019 U	2020 A	2020 D	2020 U	2021 A	2021 D	2021 U	2022 A	2022 D	2022 U	Tot A	Tot D	Tot U	Total
Whales (mixed)	*Whales* - undifferentiated (order Cetacea, *in part)*	0	0	0	1	0	0	3	0	0	0	0	0	0	0	0	4	0	0	4
Whale Shark	*Rhincodon typus*	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1
White Shark	*Carcharodon carcharias*	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	1
	Total:	179	100	3145	193	115	3183	1705	58	1117	2438	771	550	1167	357	415	5682	1401	8410	15493

Habitat issues and interactions

No benthic habitat interactions have been identified. However, over 50 seamounts are identified within the management area and are targeted due to the tendency of pelagic fishes to aggregate around them.

Community issues and interactions

There is no information on the effects of fishing on (i) lower trophic levels, or (ii) competitors (e.g., sharks) of some of the main target species, in either the (i) offshore oceanic communities or in (ii) seamount communities. Fishing has the potential to influence the survival rate of some species by altering the rates of predation on juveniles of predators which might be impacted by the fishery.

Discarding

Fish are generally discarded because the species is of no value, the return for the catch would not be adequate to cover the costs of further handling, or retention is not allowed by management arrangements. Discards may include juvenile or damaged target and non-target species, which are often discarded into the sea during fishing operations.

Blue and Black Marlin are not permitted to be taken in the ETBF. These species have been discarded in the ETBF over the 2018-2022 period (see Table 2.10) based on the AFMA Commonwealth logbook database. A total of 11,909 marlins (Black Marlin: 6320; Blue Marlin: 5589) were discarded over the 2018-2022 period.

Table 2.10: Annual discarded (numbers) of Blue Marlin and Black Marlin for the period 2016-2022 inclusive. Source: AFMA Commonwealth logbook database.

Year	Common name	Scientific name	Alive	Dead	Unknown	Total no. animals
2016	Black Marlin	*Istiompax indica*	365	302	488	1155
2016	Blue Marlin	*Makaira nigricans*	685	393	351	1429
2017	Black Marlin	*Istiompax indica*	400	297	491	1188
2017	Blue Marlin	*Makaira nigricans*	564	354	309	1227
2018	Black Marlin	*Istiompax indica*	575	367	421	1363
2018	Blue Marlin	*Makaira nigricans*	493	352	271	1116
2019	Black Marlin	*Istiompax indica*	907	434	172	1513
2019	Blue Marlin	*Makaira nigricans*	459	261	268	988
2020	Black Marlin	*Istiompax indica*	773	407	129	1309
2020	Blue Marlin	*Makaira nigricans*	286	256	139	681
2021	Black Marlin	*Istiompax indica*	1009	478	22	1509
2021	Blue Marlin	*Makaira nigricans*	650	613	21	1284
2022	Black Marlin	*Istiompax indica*	180	446	0	626
2022	Blue Marlin	*Makaira nigricans*	979	536	5	1520

2.2.1.4 Management: planned and those implemented

Management objectives

The Tropical Tuna Management Advisory Committee (Tropical Tuna MAC) provides the principal forum in which matters relating to the management of the Fishery are considered. Tropical Tuna MAC has advisory responsibility for tuna and broadbill species within the ETBF. The Tropical Tuna MAC is the principal forum where issues relating to the ETBF, the Western Tuna and Billfish Fishery and the Skipjack Tuna Fisheries are discussed. At these meetings, any problems are identified, and possible solutions are developed.

The committee also provides an avenue for consultation between industry, managers, researchers, environment and conservation groups, and state government officers. The committee continues to be AFMA's main source of advice on the management of these fisheries.

The management objectives for Tropical Tuna MAC is to advise AFMA, in line with AFMA's legislative objectives and help focus research activities within the ETBF on two main issues. These are to ensure the ecological sustainability of the resources and the pursuit of maximizing the economic efficiency of the fishery.

In particular, the ETBF Management Plan 2010 was accepted on the 10 January 2011 by the Minister. The plan commenced the day after it was registered.

The objectives of this Management Plan, and the objectives for AFMA to pursue when it is administering the Plan, are as follows:

- to manage the fishery efficiently and cost-effectively for the Commonwealth;
- 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 by-catch species and the long-term sustainability of the marine environment;
- to maximise the net economic returns to the Australian community from the management of the fishery;
- to ensure AFMA's accountability to the fishing industry and to the Australian community in managing the resources of the fishery;
- to reach Government targets for the recovery of the costs of AFMA in relation to the fishery;
- to ensure that conservation and management measures taken in relation to the fishery implement Australia's obligations under relevant international agreements.

The Australian Government has management jurisdiction for all tuna and tuna-like species within the waters of the Australian Fishing Zone (up to the low water mark). AFMA manages the Australian tuna and billfish fisheries under the provisions of the Fisheries Management Act 1991, in partnership with key stakeholders. The management is consistent with the Offshore Constitutional Settlement arrangements in place between the Commonwealth and State Governments and, where necessary, under international agreements such as the Western and Central Pacific Fisheries Commission (WCPFC).

The management of highly migratory species (such as tuna and billfish) that range far beyond the AFZ, requires that management arrangements apply to all operators targeting a specific stock under the WCPFC (https://www.wcpfc.int/doc/convention-conservation-and-management-highly-migratory-fish-stocks-western-and-central-pacific). For this reason it is important to identify the distribution of the stocks being exploited, allowing the rate of access to a particular stock to be monitored and controlled as required.

Fishery management plan

The fisheries Management Plan 2010 is a key document in managing the ETBF. It stipulates obligations, procedures and conditions when fishing in the ETBF. Particularly, it covers information on:

- Total allowable commercial catch (TACC)
- Specific ecosystem requirements (e.g., information recorded on bycatch species; minimize interactions with marine mammals, marine reptiles, fish and seabirds
- Availability and limits of Statutory Fishing Rights (SFRs) and fishing permits
- Undercatch and overcatch obligations
- Area of the fishery
- Primary species of fish

Southern Bluefin Tuna (*Thunnus maccoyii*) is also taken in the ETBF but covered by quota under the Southern Bluefin Tuna Management Plan.

The Commonwealth fisheries Harvest Strategy Policy (DAFF, 2018) is not prescribed for fisheries under International Agreements, however it does articulate the government's preferred approach. A Fishery Management Strategy has been developed for the ETBF (AFMA, 2019) and since then has been implemented for commercial catches of broadbill swordfish and striped marlin to calculate the Recommended Biological Commercial Catch (RBCC). These estimates are then used to inform the Tropical Tuna MAC who provides advice to the AFMA Commission when determining the TACC. Tropical tuna species (Yellowfin, Bigeye and Albacore Tunas) TACC are determined based on assessment of fishery indicators, stock status information and

the position of the Australian Government. The harvest strategy is not applied to these species.

Input controls

The ETBF is managed by a range of input controls:

Commercial

- Limited entries
- Gear restrictions
- Area restrictions
- Individual transferrable quotas (ITQs)

Commercial fishing is managed through a system of input controls based on annually granted fishing permits which limit entry to the fishery, the area of operations, and impose limits on the take of bycatch species and the fishing gear employed in the fishery.

Area restrictions

Fishing is permitted inside some State and Commonwealth managed Marine Parks, however it is the concession holder's responsibility to check if fishing is permitted.

Great Barrier Reef

No tuna fishing is permitted within the Great Barrier Reef Marine Park (GBRMP) without a permit issued by the GBRMP Authority.

Coral Sea Zone (Previously known as Area E; see map in Geographic extent of the fishery section).

No longline fishing is permitted in this area unless one holds a Coral Sea boat SFR. Since 2021 permit holders fishing within the CSZ east of longitude 148° east, the daily limit for setting hooks is 1250, regardless of the number of longline sets and the following gear limitations apply when fishing west of longitude 148° east, between 1 March and 31 August, the daily limit for setting hooks is 1250, and outside this period, the daily limit on any longline set is 500. This area was created to protect juvenile marlin species and their spawning grounds.

Lord Howe Island

No fishing is permitted within 12 nm of Lord Howe Island unless authorisation is gained.

Norfolk Island ETBF SFR holders must not fish inside the Norfolk Island box with the co-ordinates:

- Beginning at the point of latitude 28° 35' S, longitude 167° 25' E; and running
- East along that parallel to its intersection with the meridian of longitude 168° 25' E; and
- South along that meridian to its intersection with the parallel of latitude 29° 50' S; and
- West along that parallel to its intersection with the meridian of longitude 167° 25' E; and
- North along that meridian to the point where the line began.

Fishing in the High Seas

When conducting fishing operations on the High Seas, the concession holder must ensure that:

- The boat is clearly marked with its international radio call sign according to internationally recognised standards;
- They report to AFMA (vmsreporting@afma.gov.au) prior to entering the High Seas;
- All fishing gear is properly stowed when transiting through another country's Exclusive Economic Zone (EEZ); and
- They do not fish in another country's EEZ.

Output controls

The ETBF is managed by a range of output controls (see below).

The AFMA Commission agreed to move the ETBF from an input-controlled system, controlling the number of hooks set to an output-controlled system based on Individual Transferable Quotas (ITQs) in December 2008, which was subsequently implemented in 2011.

The ETBF target species are managed through total allowable commercial catches as ITQs, i.e., Albacore Tuna, Bigeye Tuna, Yellowfin Tuna, Broadbill Swordfish and Striped Marlin. There are no size limits for the quota species in the ETBF. There are limits in catch and numbers of species and on the species taken commercially in the ETBF (Table 2.11, Table 2.12, Table 2.13, Table 2.14, Table 2.15 and Table 2.16).

For sharks, operators must not take more sharks than the number of fish of the quota species retained, up to a maximum of 20 sharks per trip. This excludes species that are subject to other catch limits (e.g., White Shark (*Carcharodon carcharias*) and other shark species that are no-take in the ETBF; see above table). AFMA has implemented a ban on retaining Oceanic Whitetip Sharks (*Carcharhinus longimanus*) that was agreed by the WCPFC in 2012. The use of wire trace leaders is prohibited in the ETBF.

SBT catch in the ETBF:

The ETBF Plan does not allow fishing for Southern Bluefin Tuna (SBT). Any take of SBT must be done in accordance with the quota arrangements under the Southern Bluefin Tuna Fishery Management Plan 1995. Therefore, only operators who hold SBT quota SFRs are permitted to take SBT when fishing within the ETBF.

A single SBT Management Zone is implemented, usually during the winter months, when SBT are present in waters off the south-east coast of Australia, to ensure that no SBT is taken in the ETBF without being covered with quota.

The 2024 management arrangements for fishing for SBT include requirements for operators to:

- Have a fully operational e-monitoring system installed on your boat.
- On first entry (which includes being present or fishing in) to the SBT zone, hold 1 uncaught Southern Bluefin Tuna Statutory Fishing Right nominated to the boat;
- On every subsequent entry to the zone, continue to hold at least 1 uncaught Southern Bluefin Tuna Statutory Fishing Right nominated to the boat;
- Land and report all SBT taken except those released (in an alive and vigorous state*); and
- When in the Zone operators must carry 50 CDS tags on-board the vessel; and
- Carry an AFMA observer when notified by AFMA.

For current SBT fishing zones, see
https://www.afma.gov.au/commercial-fishers/management-arrangements/southern-bluefin-tuna-sbt-zone

Recreational

The Australian Government does not manage recreational fishing in Commonwealth waters. Recreational fishing in Commonwealth waters is managed by the state or territory immediately adjacent to those waters, under its management regulations. Recreational and Indigenous fishing sectors include Victoria, Tasmania, New South Wales and Queensland. Trip limits apply to recreational fishing species (see tables below).

Table 2.11: Species permitted to be taken in the ETBF. See Table 2.12 for species not permitted to be taken.

Common name	Scientific Name	Restrictions
Yellowfin Tuna	*Thunnus albacares*	Quota species
Bigeye Tuna	*Thunnus obesus*	Quota species
Albacore Tuna	*Thunnus alalunga*	Quota species
Striped Marlin	*Tetrapturus audax*	Quota species
Broadbill Swordfish	*Xiphias gladius*	Quota species

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

Common name	Scientific Name	Restrictions
Longtail Tuna	*Thunnus tonggol*	A maximum 35 t limit by the fleet per fishing year is in place for the ETBF and WTBF. A 10 fish trip limit per operator will be imposed should the 35 t trigger limit be reached in either fishery in any fishing year.
Skipjack Tuna	*Katsuwonus pelamis*	Unlimited
Northern Pacific Bluefin Tuna	*Thunnus thynnus*	One must report to AFMA prior to landing NBT (via e-mail northernbluefin@afma.gov.au or fax 02 6225 5440) at least 1 hour before landing in port. Further information is provided in the Northern Bluefin Tuna section below.
Southern Bluefin Tuna	*Thunnus maccoyii*	Any take of SBT must be done in accordance with the quota arrangements under the Southern Bluefin Tuna Fishery Management Plan 1995. Vessels must be registered on the CCSBT vessel register. A zone of likely SBT catch is put in place in the ETBF during the winter months when SBT are present in waters off the east coast of Australia.
Pomfrets and Rays Bream	Family Bramidae	Unlimited
Indo-Pacific Sailfish	*Istiophorus platypterus*	Unlimited
Shortbill Spearfish	*Tetrapusus angusirostris*	Unlimited
Moonfish	Genus *Lampris*	Unlimited
Rudderfish	Genus *Centrolophus*	Unlimited
Escolar/Oilfish	*Ruvettus pretiosus* and *Lepidocybium flavobrunneum*	Unlimited
Mahi Mahi (Dolphinfish)	*Coryphaena hippurus*	Unlimited
Sharks	Class Chondrichthyes	Not more than the number of tuna and billfish quota species taken per trip, not exceeding a maximum of 20 sharks per trip.
(those that are not subject to limits elsewhere)		
Shortfin Mako Shark	*Isurus oxyrinchus*	May only be retained and landed if brought to the boat dead. If alive on the line, they must be released.
Longfin Mako Shark	*Isurus paucus*	
Porbeagle	*Lamna nasus*	

Table 2.12: Species not permitted to be taken in the ETBF.

Common name	Scientific Name
Blue Eye Trevalla	*Hyperoglyphe antarctica* and *Schedophilus labyrinthica*
Blue Grenadier	*Macruronus novaezelandiae*
Black Marlin	*Istiompax indica*
Blue Marlin	*Makaira mazara*

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

Common name	Scientific Name
Blue Warehou	*Seriolella brama*
Flathead	*Platycephalus* and *Neoplatycephalus* sp.
Gemfish	*Rexea solandri*
Jackass Morwong	*Nemadactylus macropterus*
John Dory	*Zeus faber*
Ling	*Genypterus blacodes*
Mirror Dory	*Zenopsis nebulosus*
Ocean Perch	*Helicolenus* sp.
Orange Roughy	*Hoplostethus atlanticus*
Redfish	*Centroberyx affinis*
Royal Red Prawn	*Haliporoides sibogae*
School Whiting	*Sillago findersi*
Silver Trevally	*Pseudocaranx dentex*
Spotted Warehou	*Seriolella punctata*
Black Cod	*Epinephelus daemelii*
Great White Shark	*Carcharodon carcharias*
Grey Nurse Shark	*Carcharias taurus*
School Shark	*Galeorhinus galeus*
Gummy Shark	*Mustelus antarcticus*
Elephant Fish	Families Callorhinchidae, Chimaeridae and Rhinochimaeridae
Sawshark	*Pristiophorus cirratus* and *Pristiophorus nudipinnis*
Deepwater Sharks	*Centroscymnus coelolepis*
	Centroscymnus crepidater
	Centroscymnus owstoni
	Centroscymnus plunketi
	Centroscyllium kamoharai
	Dalatias licha
	Dalatias calcea
	Dalatias quadrispinosa
	Etmopterus bigelowi
	Etmopterus dianthus
	Etmopterus dislineatus
	Etmopterus evansi
	Etmopterus fusus
	Etmopterus granulosus
	Etmopterus lucifer
	Etmopterus molleri
	Etmopterus pusillus
Oceanic Whitetip Shark	*Carcharhinus longimanus*
Silky Shark	*Carcharhinus falciformis*
All mobulid rays	Family Mobulidae

Table 2.13: Restricted species in Victorian waters with a maximum take of 200 kg per trip of all species combined.

Common Name	Scientific Name	Limits	Total limit
Barracouta	*Thyrsites atun*	200 kg	200 kg total per trip for all species combined
Leatherjackets – all species	Family Monocanthidae	200 kg	200 kg total per trip for all species combined
Snapper	*Pagrus auratus*	50 kg per trip	50 kg per trip
Striped Trumpeter	*Latris lineata*	20 kg per trip	20 kg per trip
Yellowtail Kingfish	*Seriola lalandi*	10 fish per trip	10 fish per trip

Table 2.14: Bycatch limits off Tasmania. SN: Snapper, YTK: Tellowtail Kingfish, ST: Striped Trumpeter.

Common Name	Scientific Name	Limits
Australian Anchovy	*Engraulis australis*	No take
Australian Salmon/Tommy Ruff	Genus *Arripis*	No take
Banded Morwong	*Cheilodactylus spectabilis*	No take
Black Bream	*Acanthopagrus butcheri*	No take
Blue Sprat	*Spratelloides robustus*	No take
Dusky Morwong	*Dactylophora nigricans*	No take
Garfish	*Hyporhamphus melanochir*	No take
Grassy (rock) Flathead	*Platycephalus laevigatus*	No take
King Gar	*Scomberesox forsteri*	No take
King George Whiting	*Sillaginodes punctata*	No take
Luderick	*Girrella tricuspidata*	No take
Magpie Morwong	*Cheilodactylus nigripes*	No take
Mulloway	*Argyrosomus hololepidotus*	No take
Pilchard	*Sardinops neopilchardus*	No take
Red Mullet	*Upeneichthys vlamingii*	No take
Sea Sweep	*Scorpis aequipinnis*	No take
Snook	*Sphyraena novaehollandiae*	No take
Sprat	*Clupea bassensis*	No take
Wrasse	Family Labridae	No take
Yellow Eye Mullet	*Aldrichetta forsteri*	No take
Yellow-finned Whiting	*Sillago schomburgkii*	No take
Bastard Trumpeter	*Latidopsis forsteri*	20 kg per trip
Blue Groper	*Achoerodus gouldii*	50 kg per trip
Snapper (SN)	*Pagrus auratus*	Combined total of 250 kg per trip of SN, YTK and ST. Maximum 150 kg per trip of ST
Yellowtail Kingfish (YTK)	*Seriola lalandi*	Combined total of 250 kg per trip of SN, YTK and ST. Maximum 150 kg per trip of ST

Table 2.14: ***(continued)***

Common Name	Scientific Name	Limits
Striped Trumpeter (ST)	*Latris lineata*	Combined total of 250 kg per trip of SN, YTK and ST. Maximum 150 kg per trip of ST

Table 2.15: Bycatch limits off Queensland. YTK: Yellowtail Kingfish, BK: Black Kingfish, AJ: Amberjack, AB: Australian Bonito, WR: Wrasse, BM: Buttrefly Mackerel, SLT: Slender Tuna, WH: Wahoo.

Common Name	Scientific Name	State Limits
Yellowtail Kingfish	*Seriola lalandi*	Combined total of 2 fish (of YTK,BK, AJ) per trip
Black Kingfish	*Rachycentron canadus*	Combined total of 2 fish (of YTK,BK, AJ) per trip
Amberjack	*Seriola dumerili*	Combined total of 2 fish (of YTK,BK, AJ) per trip
Australian Bonito	*Sardi australis*	Combined total of 10 fish (from AB through to WR in column 1) per trip
Australian Spotted Mackerel	*Scomberomus munroi*	Combined total of 10 fish (from AB through to WR in column 1) per trip
Bar Cod	*Polyprion moeone*	Combined total of 10 fish (from AB through to WR in column 1) per trip
Cod	Family Serranidae, except *Epinephelus daemelii*	Combined total of 10 fish (from AB through to WR in column 1) per trip
Dog Toothed Tuna	*Gymnosarda unicolor*	Combined total of 10 fish (from AB through to WR in column 1) per trip
Emperor	Families Lethrinidae and Lutjanidae	Combined total of 10 fish (from AB through to WR in column 1) per trip
Frigate Mackerel	*Auxis thazard*	Combined total of 10 fish (from AB through to WR in column 1) per trip
Grouper	Family Serranidae, except *Epinephelus daemelii*	Combined total of 10 fish (from AB through to WR in column 1) per trip
Hapuku	*Polyprion oxygeneios*	Combined total of 10 fish (from AB through to WR in column 1) per trip
Leaping Bonito	*Cybiosarda elegans*	Combined total of 10 fish (from AB through to WR in column 1) per trip
Mackerel Tuna	*Euthynnus affinis*	Combined total of 10 fish (from AB through to WR in column 1) per trip
Oriental Bonito	*Sarda orientalis*	Combined total of 10 fish (from AB through to WR in column 1) per trip
Rainbow Runner	*Elagatis bipinnulata*	Combined total of 10 fish (from AB through to WR in column 1) per trip
Rake-Gilled Mackerel	*Rastrelliger kanagurta*	Combined total of 10 fish (from AB through to WR in column 1) per trip
Shark Mackerel	*Grammatorcynus bicarinatus* and *G. Bilineatus*	Combined total of 10 fish (from AB through to WR in column 1) per trip
Snapper	*Pagrus auratus*	Combined total of 10 fish (from AB through to WR in column 1) per trip
Spanish Mackerel	*Scomberomorus commerson*	Combined total of 10 fish (from AB through to WR in column 1) per trip

Table 2.15: *(continued)*

Common Name	Scientific Name	State Limits
Trevally	Family Carangidae, except Genus *Seriola*	Combined total of 10 fish (from AB through to WR in column 1) per trip
Tropical Snapper	Families Lethrinidae and Lutjanidae	Combined total of 10 fish (from AB through to WR in column 1) per trip
Tuskfish	Family Labridae	Combined total of 10 fish (from AB through to WR in column 1) per trip
Wrasse	Family Labridae	Combined total of 10 fish (from AB through to WR in column 1) per trip
Shark	Subclass Elasmobranchii and family Serranidae	Combined total of 20 fish (Shark, BM, SLT and WH) per trip
Butterfly Mackerel	*Gasterochisma melampus*	Combined total of 20 fish (Shark, BM, SLT and WH) per trip
Slender Tuna	*Allothunnus fallai*	Combined total of 20 fish (Shark, BM, SLT and WH) per trip
Wahoo	*Acanthocybium solandri*	Combined total of 20 fish (Shark, BM, SLT and WH) per trip

Table 2.16: Bycatch limits off Bycatch limits off New South Wales

Common Name	Scientific Name	State Limits
Finfish	Class Osteichthyes (not including Tuna and Tuna like species)	Total of 200 kg

Technical measures

Processing fish:

Tuna (except SBT and NBT) cannot be processed at sea except for the removal of fins (except the caudal fin), gilling and gutting. SBT and NBT can be landed gilled and gutted (also known as Australian cut). There are specific landing requirements for tuna in the ETBF:

- Tuna (except NBT) cannot be processed at sea except for the removal of fins (except the caudal fin), gilling and gutting (Figure 2.4). Please see the ETBF Longline Boat SFR conditions for more details.
- Billfish (except Broadbill Swordfish) must be landed with the caudal keel, pectoral and anal fins still attached to the carcass. No other processing can be conducted.
- Broadbill Swordfish can be processed at sea, either by filleting or the removal of all fins (Figure 2.5).
- Bony fishes must not be landed in a form other than as a whole, gilled, gutted or headed fish or a combination of these forms.
- Sharks must be landed with their fins still attached to the carcass and it is forbidden to carry, retain or land shark liver unless the carcass from which the liver was obtained is also landed.

Regulations

The Management Plan 2010, made under the Fisheries Management Act 1991, manages only commercial fishing for tuna and billfish species in the fishery area.

The bycatch provisions set out in the Fisheries Management Regulations 2019 apply to all fishing permits in the Eastern Tuna and Billfish Fishery.

Also, other regulations and management plans exist:

- Eastern Tuna and Billfish Fishery Harvest Strategy Policy and Guidelines;

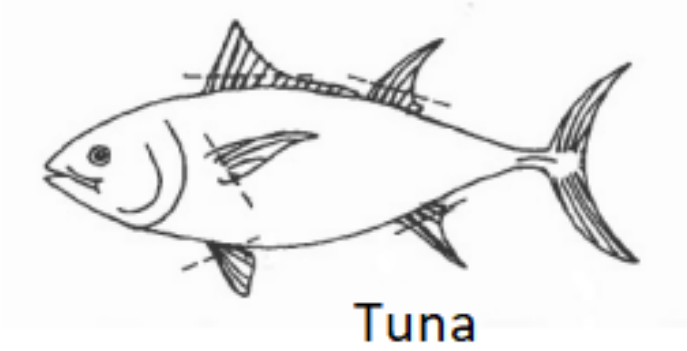

Figure 2.4: Processing cuts for Tuna. Source: AFMA, Eastern Tuna and Billfish Fishery (ETBF) Management Arrangements Booklet 2023 Fishing Season.

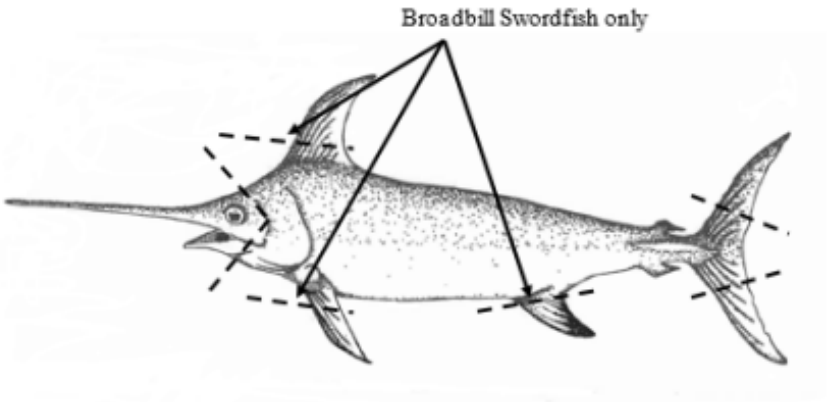

Figure 2.5: Processing cuts for Broadbill Swordfish. Source: AFMA, Eastern Tuna and Billfish Fishery (ETBF) Management Arrangements Booklet 2023 Fishing Season.

- Australian Tuna and Billfish Fisheries Bycatch and Discarding Workplan 1 July 2014-30 June 2016 (AFMA, 2014).
- Australia's National Plan of Action for the management of Sharks and Shark Policy
- Memorandum of Understanding with the department which administers the EPBC Act 1999 for reporting interactions with protected species;
- Management plans and Bycatch and Discard Workplans for overlapping fisheries;
- Threat Abatement Plans (TAP) 2014, 2018 reduce incidental bycatch of marine birds;
- Various international plans of action and recovery plans for Threatened, Endangered and Protected (TEP) species;
- Five year strategic research plan for the Australia and Tuna and Billfish Fisheries;
- A revised Threat Abatement Plan for seabirds interacting with pelagic longline fisheries (http://www.antarctica.gov.au/environment/plants-and-animals/threat-abatement-plan-seabirds);
- Revised Commonwealth Marine Parks arrangements: (https://parksaustralia.gov.au/marine/parks/);

Australia is also obliged to abide by the Management Measures and Resolutions implemented by the Western and Central Pacific Fisheries Commission (WCPFC) to conserve the populations of sharks, turtles and seabirds in the Western and Central Pacific Ocean. Australia must also abide by Measures adopted by the Commission for the Conservation of Southern Bluefin Tuna (CCSBT) which state that Members should implement national plans of action to reduce the interactions between the fishery and non-target species, namely seabirds, sharks and turtles. Management plans and other policy measures for Commonwealth fisheries incorporate the conservation measures adopted by both CCSBT and WCPFC.

Initiatives, strategies and incentives

Chondrichthyans

Logbook and e-monitoring data (mid 2015 onwards): monitor bycatch species.

Ban on Wire Trace: A ban has been imposed on the use of wire trace to minimize shark captures.

Ban on Shark Finning: The practice of shark finning is prohibited.

Equipment Requirements: Boats are required to have line cutters and dehookers to facilitate the safe release of sharks before hauling them onto the deck.

Catch Limits: There are restrictions on the number of sharks that can be retained per trip, with a total trip limit of 20 sharks. This prevents targeted shark fishing, and any excess sharks are classified as bycatch and must be discarded.

A National Plan of Action (NPOA): for the Conservation and Management of Sharks 2012 Shark-plan 2 developed by the Commonwealth Government. Shark-plan 2 provides an updated assessment of the conservation and management issues concerning sharks in Australian waters and identifies the research and management actions across Australia's state, territory and Commonwealth jurisdictions that will be pursued over the life of the ETBF Management Plan

The Chondrichthyan guide for fisheries managers: A practical guide to mitigating chondrichthyan bycatch. This guide was developed in 2009, by ABARES and AFMA. The guide aims to provide fisheries managers with practical options to mitigate chondrichthyan TEP and high-risk species bycatch.

Recovery Plans: exist for the Grey Nurse Shark (*Carcharias taurus*), and the Great White (*Carcharodon carcharias*) in Australia. See http://www.environment.gov.au/cgi-bin/sprat/public/publicshowallrps.pl

Marine mammals

All cetaceans are protected under the EPBC Act 1999, and within the boundaries of the Australian Whale Sanctuary https://www.environment.gov.au/marine/marine-species/cetaceans/australian-whale-sanctuary

Fishery Management Strategy: Eastern Tuna and Billfish fishery, fishery management strategy (FMS) 2019-2023 outlines AFMA's intended monitoring strategies, and management responses to address at risk species. The FMS Includes a Code of Practice when dealing with seals: if a seal is caught on a tuna longline hook, ETBF fishers should use the dehooker to ensure the safe release of the seal.

Seabirds

The Threat Abatement Plan (2018) outlines the compulsory and voluntary mitigation measures that currently exist for vessels operating in the AFZ. Mandatory measures include:

AFMA will require all pelagic longline tuna fishers operating within either the ETBF or the Western Tuna and Billfish Fishery (WTBF), or both fisheries, southwards of the parallel of 25^{o} South to:

- employ a line-weighting strategy approved by AFMA that enables the bait to be rapidly taken below the reach of most seabirds;
- employ either of the following:
- at least one bird-scaring line constructed to a specified standard approved by AFMA, or use another proven mitigation measure approved by AFMA for use without such a line; or
- only set longlines at night;
- not discharge offal during line setting; and
- employ, as part of an adaptive management approach to seabird bycatch mitigation, such other mitigation measures as AFMA may stipulate following consultation with the Department of the Environment and Energy (including, but not limited to, use of bird scaring lines, bird exclusion devices and/or managing offal discharge during line hauling, night setting, and area closures).

AFMA requires domestic and foreign vessels in all longline fisheries operating within Australian jurisdiction to adopt proven mitigation measures that ensure the performance criteria for each fishery are achieved in all

areas and seasons.

- The seabird bycatch rate for the ETBF, based on the Threat Abatement Plan is less than 0.05 birds per 1000 hooks in each fishing area.

The ETBF SFR conditions stipulate the Mandatory Seabird Mitigation Measures for Longline Fishing at all times which requires concession holders to:

- Carry on board more than one assembled tori line. Each tori line must be constructed and used in accordance with the following specifications:
- must be 100 meters in length
- must be deployed from a position on board the boat and utilise an additional towed line, material or object to create drag and ensure that it remains above the water surface for a minimum of 75 m from the stern of the boat;
- must have streamers attached to it with a maximum interval between the streamers of 3.5 m;
- all streamers must be maintained to ensure their lengths are as close to the water surface as possible.

When fishing south of the parallel of latitude 25^{o} South:

- non-frozen baits are attached to the hooks; and
- prior to longlines entering the water he/she deploys a separate tori line at each point at which hooks enter the water. All tori lines must comply with the above;
- a tori line is not required to be deployed when performing fishing operations between the hours of nautical dusk and nautical dawn; and
- longlines are set with each branch line having:
- 40 g or greater attached within 0.5 m of each hook; or
- 60 g or greater attached within 3.5 m of each hook; or
- 98 g or greater attached within 4.0 m of each hook; or
- a hook-shielding device attached and deployed directly to each hook according to ACAP specifications.

Electronic monitoring program: currently a very small percentage (~10%) of line sets are observed for protected interactions, and bycatch rate. To combat the issue of species identification, fishers are to collect feather samples from dead birds and follow the protocols outlined below from the ETBF SFR conditions 2024.

Feather samples and photos

In the event of a seabird interaction that results in a mortality where the bird is bought to the boat, the holder must:

- collect feathers using the feather sample kits developed by the Australian Antarctic Division.
- at a minimum, hold the seabird in view of and in close proximity to the closest or most convenient electronic monitoring camera. Show first the head and bill (for three seconds), then underside (with one wing outstretched, for three seconds), then the back of the bird (with one wing outstretched, for three seconds).

Feather samples must be accompanied with information from the fisher that outlines:

- Date of interaction;
- Time of interaction;
- Latitude and Longitude of interaction;
- Fishing method; and
- ID number

Recovery Plans: exist for a number of species and can be viewed here:
http://www.environment.gov.au/cgi-bin/sprat/public/publicshowallrps.pl

Marine reptiles

Mandatory Turtle Mitigation Measures for Longline Fishing:

- Large circle hooks must be used if less than eight hooks per bubble are set.

• De-hooking device

At all times concession holders must carry on board a minimum of one de-hooking device, with the following specifications:

• The device must enable the hook to be secured and the barb shielded so that the barb does not re-engage with the fish while the hook is being removed;

• The device must be blunt with all edges rounded;

• Where more than one size of hook is to be carried, a de-hooking device (or devices) must be carried that can be used with all hooks on the boat; and

• The shaft of the device must be a minimum of 1.5 m in length.

Line cutting device:

At all times concession holder must carry on board a minimum of one line cutting device.

The line cutting device must be constructed and used in accordance with the following specifications:

• The device must be constructed to allow the line to be cut as close to the hook as possible;

• The blade of the device must be enclosed in a blunt rounded (arc-shaped) cover with the hook exposed on the inside of the arc; and

• The shaft of the device must be a minimum of 1.5 m in length

Recovery Plan: for marine turtles in Australia. See http://www.environment.gov.au/cgi-bin/sprat/public/publicshowallrps.pl

See also AFMA's 2023 management arrangements booklet: https://www.afma.gov.au/commercial-fishers/management-arrangements/management-booklets#referenced-section-3

Enabling processes

Monitoring, logbooks, observer data, scientific surveys); assessment stock assessments); performance indicators (decision rules, processes, compliance; education; consultation process.

Refer Initiatives, Strategies and Incentives above.

Other initiatives or agreements

There are three marine park networks within the ETBF (over the 2018-2022 ERA assessment period):

- Coral Sea Marine Park
- South-East Marine Parks network
- Temperate East Marine Parks network.

Source: https://parksaustralia.gov.au/marine/parks/

International obligations:

Australia has signed the Convention for the Conservation and Management of Highly Migratory Fish Stocks in the Western and Central Pacific Ocean. The Convention establishes a Commission, comprising coastal states and distant water fishing nations, which will manage the tuna and billfish stocks on a regional basis.

There is also a bilateral agreement between Japan and Australia under the Bilateral agreement, regarding the protection of wild flora and fauna, including endangered species, and bycatch mitigation measures for sharks.

2.2.1.5 Data

Logbook data

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

Electronic logbooks (e-logs) are an electronic alternative to submitting traditional paper logbooks. E-logs allow data to be received by AFMA in near real time, closer to actual fishing events.

Observer and Electronic Monitoring data

The purpose of the Observer and Electronic Monitoring (EM) Programs 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 observers are highly experienced in fishery observer work in Australia. They:

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

There is no Observer coverage in this fishery. Instead, an EM Program has been implemented.

Electronic Monitoring Program

The AFMA e-monitoring program uses video and sensor data to independently validate fishing operations and fisheries' logbook information. This program provides verifiable and near real time fisheries data, which can be incorporated into fisheries management decisions and be used as a tool to monitor compliance. Since 2016, all ETBF longline vessels are required to have a functioning e-monitoring system installed. Electronic Monitoring and Observer data annual coverage rates are listed in Table 2.17.

Table 2.17: Percentage of electronic monitoring review in the ETBF by calendar year. Source: AFMA.

Fishing season	Percentage of hooks reviewed (%)
2016	9.39
2017	10.26
2018	11.32
2019	12.24
2020	10.42
2021	9.97
2022	10.19

Other data

The ETBF has a five-year Australian Strategic Research Plan 2023-2028 inclusive.

Legislative instruments and directions

- ETBF Management Plan 2010. https://www.legislation.gov.au/Details/F2016C00636
- Fisheries Management Act 1991. https://www.legislation.gov.au/Details/C2017C00363
- Fisheries Management Regulations 2019. https://www.legislation.gov.au/Details/F2019L00383
- Environment Protection and Biodiversity Conservation Act 1999. https://www.legislation.gov.au/Series/C2004A00485.
- Declaration of an Approved Wildlife Trade Operation – Commonwealth Eastern Tuna and Billfish Fishery, August 2022. https://www.legislation.gov.au/Details/F2022N00187
- Fisheries Management (E-Monitoring Eastern Tuna and Billfish Fishery) Direction 2021. https://www.legislation.gov.au/Details/F2021L00458
- National Plan of Action for the Conservation and Management of Sharks 2012** Shark-plan 2. Licensed from the Commonwealth of Australia under a Creative Commons Attribution 3.0 Australia Licence.

https://www.agriculture.gov.au/sites/default/files/sitecollectiondocuments/fisheries/environment/sharks/sharkplan2-action.pdf

2.2.2 Unit of Analysis Lists (Step 2)

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

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

Ecological Units Assessed

Key commercial and secondary species 6 (C1), 0 (C2), 3 (CB)
Byproduct and bycatch species 25 (BP), 186 (BC)
Protected species 84
Habitats 107 (96 benthic, 11 pelagic)
Communities 86 (73 demersal, 13 pelagic)

Scoping Document S2A. Species

Each species identified during the scoping is added to the ERAEF database used to run the Level 1 and/or Level 2 analyses. A CAAB code (Code for Australian Aquatic Biota) is required to input the information. The CAAB codes for each species may be found at http://www.cmar.csiro.au/caab/

Key/Secondary Commercial Species

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

Table 2.18: Key commercial species (C1) and/or secondary commercial species (C2) and/or commercial bait species (CB) list for the Eastern Tuna and Billfish Fishery - Pelagic longline. CDR: refers to Catch Disposal Records. EM: Electronic Monitoring. ERA: Ecological Risk Assessment LOG: refers to AFMA Logbook data.

ERA Species ID	Role in Fishery	Taxa	Family Name	CAAB Code	Scientific Name	Common Name	Source(s)
212	C1	Teleost	Scombridae	37441002	*Thunnus albacares*	Yellowfin Tuna	LOG, EM, CDR, also in 37441912, LOG, EM, CDR
255	C1	Teleost	Scombridae	37441004	*Thunnus maccoyii*	Southern Bluefin Tuna	LOG, EM, CDR, also in 37441912, LOG, EM, CDR
895	C1	Teleost	Scombridae	37441005	*Thunnus alalunga*	Albacore	LOG, EM, CDR, also in 37441912, LOG, EM, CDR
62	C1	Teleost	Scombridae	37441011	*Thunnus obesus*	Bigeye Tuna	LOG, EM, CDR, also in 37441912, LOG, EM, CDR
213	C1	Teleost	Xiphiidae	37442001	*Xiphias gladius*	Broadbill Swordfish;Swordfish	LOG, EM, CDR
884	C1	Teleost	Istiophoridae	37444002	*Kajikia audax*	Striped Marlin	LOG, EM, CDR, also in 37444000, LOG, EM
1088	CB	Teleost	Carangidae	37337002	*Trachurus declivis*	Common Jack Mackerel	expanded from 37337000, LOG, CDR, expanded from previous ERA
540	CB	Teleost	Carangidae	37337003	*Trachurus novaezelandiae*	Yellowtail Scad	LOG, also in 37337000, LOG, CDR
210	CB	Teleost	Scombridae	37441001	*Scomber australasicus*	Blue Mackerel	expanded from 37441911, LOG, CDR, expanded from previous ERA

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 2.19: Byproduct species list for the Eastern Tuna and Billfish Fishery - Pelagic longline. CDR: refers to Catch Disposal Records. EM: Electronic Monitoring. ERA: Ecological Risk Assessment LOG: refers to AFMA Logbook data.

ERA Species ID	Role in Fishery	Taxa	Family Name	CAAB Code	Scientific Name	Common Name	Source(s)
936	BP	Chondrichthyan	Triakidae	37017008	*Galeorhinus galeus*	School Shark	CDR
535	BP	Chondrichthyan	Carcharhinidae	37018001	*Carcharhinus brachyurus*	Bronze Whaler	LOG, EM, CDR, also in 37018000, 37018901, LOG, EM
808	BP	Chondrichthyan	Carcharhinidae	37018003	*Carcharhinus obscurus*	Dusky Shark; Dusky Whaler	LOG, EM, CDR, also in 37018000, 37018901, LOG, EM
1039	BP	Chondrichthyan	Carcharhinidae	37018004	*Prionace glauca*	Blue Shark	LOG, EM, also in 37018000, LOG, EM
551	BP	Chondrichthyan	Carcharhinidae	37018022	*Galeocerdo cuvier*	Tiger Shark	LOG, EM, CDR, also in 37018000, LOG, EM
476	BP	Chondrichthyan	Carcharhinidae	37018030	*Carcharhinus amblyrhynchos*	Grey Reef Shark	LOG, also in 37018000, 37018901, LOG, EM
8282	BP	Teleost	Lampridae	37268001	*Lampris australensis*	Opah	expanded from 37268900, LOG, EM, CDR, expanded from previous ERA
148	BP	Teleost	Carangidae	37337006	*Seriola lalandi*	Yellowtail Kingfish	LOG, EM, CDR, also in 37337000, LOG, CDR
814	BP	Teleost	Coryphaenidae	37338001	*Coryphaena hippurus*	Dolphin Fish;Mahi Mahi	LOG, EM, CDR
152	BP	Teleost	Bramidae	37342001	*Brama brama*	Ray's Bream	LOG, EM, CDR, also in 37342000, LOG, EM, CDR
683	BP	Teleost	Lutjanidae	37346005	*Lutjanus erythropterus*	Crimson Snapper	LOG
727	BP	Teleost	Lutjanidae	37346029	*Lutjanus bohar*	Red Bass	CDR
732	BP	Teleost	Lutjanidae	37346043	*Lutjanus fulvus*	Blacktail Snapper	LOG, EM, CDR
610	BP	Teleost	Latridae	37377005	*Dactylophora nigricans*	Dusky Morwong	LOG, EM
976	BP	Teleost	Latridae	37378001	*Latris lineata*	Striped Trumpeter	LOG
204	BP	Teleost	Gempylidae	37439003	*Ruvettus pretiosus*	Oilfish	LOG, EM, CDR, also in 37439918, LOG

Table 2.19: *(continued)*

ERA Species ID	Role in Fishery	Taxa	Family Name	CAAB Code	Scientific Name	Common Name	Source(s)
845	BP	Teleost	Gempylidae	37439008	*Lepidocybium flavobrunneum*	Escolar	LOG, EM, CDR, also in 37439918, LOG
64	BP	Teleost	Scombridae	37441003	*Katsuwonus pelamis*	Skipjack Tuna	LOG, EM, CDR, also in 37441912, LOG, EM, CDR
1229	BP	Teleost	Scombridae	37441014	*Scomberomorus queenslandicus*	School Mackerel	CDR, also in 37441911, LOG, CDR
211	BP	Teleost	Scombridae	37441020	*Sarda australis*	Australian Bonito	LOG, EM, CDR, also in 37441912, LOG, EM, CDR
259	BP	Teleost	Scombridae	37441024	*Acanthocybium solandri*	Wahoo	LOG, EM, CDR
897	BP	Teleost	Scombridae	37441026	*Thunnus orientalis*	Pacific Northern Bluefin Tuna; Pacific Bluefin Tuna;Northern Bluefin Tuna	LOG, EM, CDR, also in 37441912, LOG, EM, CDR
836	BP	Teleost	Istiophoridae	37444005	*Istiophorus platypterus*	Sailfish	LOG, EM, CDR, also in 37444000, LOG, EM
883	BP	Teleost	Istiophoridae	37444007	*Tetrapturus angustirostris*	Shortbill Spearfish	LOG, EM, CDR, also in 37444000, LOG, EM
215	BP	Teleost	Centrolophidae	37445004	*Centrolophus niger*	Rudderfish	LOG, EM, CDR

Bycatch (Discard) Species

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

Table 2.20: Bycatch species list for the Eastern Tuna and Billfish Fishery - Pelagic longline. CDR: refers to Catch Disposal Records. EM: Electronic Monitoring. ERA: Ecological Risk Assessment LOG: refers to AFMA Logbook data.

ERA Species ID	Role in Fishery	Taxa	Family Name	CAAB Code	Scientific Name	Common Name	Source(s)
60	BC	Chondrichthyan	Hexanchidae	37005002	*Notorynchus cepedianus*	Broadnose Shark	LOG, EM, also in 37005000, LOG
365	BC	Chondrichthyan	Hexanchidae	37005005	*Hexanchus griseus*	Bluntnose Sixgill Shark	expanded from 37005000, LOG, expanded from previous ERA
317	BC	Chondrichthyan	Odontaspididae	37008003	*Odontaspis ferox*	Smalltooth Sandtiger Shark;Sandtiger Shark	LOG
862	BC	Chondrichthyan	Pseudocarchariidae	37009003	*Pseudocarcharias kamoharai*	Crocodile Shark	LOG, EM
179	BC	Chondrichthyan	Alopiidae	37012001	*Alopias vulpinus*	Thresher Shark	LOG, EM, CDR, also in 37012901, LOG, EM
462	BC	Chondrichthyan	Alopiidae	37012002	*Alopias superciliosus*	Bigeye Thresher	LOG, also in 37012901, LOG, EM
375	BC	Chondrichthyan	Alopiidae	37012003	*Alopias pelagicus*	Pelagic Thresher	LOG, EM, also in 37012901, LOG, EM
866	BC	Chondrichthyan	Carcharhinidae	37018006	*Rhizoprionodon acutus*	Milk Shark	expanded from 37018000, 37018901, LOG, EM
619	BC	Chondrichthyan	Carcharhinidae	37018009	*Carcharhinus coatesi*	Whitecheek Shark	expanded from 37018000, 37018901, LOG, EM
466	BC	Chondrichthyan	Hemigaleidae	37018011	*Hemipristis elongata*	Fossil Shark	expanded from 37018000, LOG, EM
467	BC	Chondrichthyan	Carcharhinidae	37018012	*Carcharhinus altimus*	Bignose Shark	expanded from 37018000, 37018901, LOG, EM, expanded from previous ERA
630	BC	Chondrichthyan	Carcharhinidae	37018013	*Carcharhinus sorrah*	Spot-Tail Shark	expanded from 37018000, 37018901, LOG, EM
647	BC	Chondrichthyan	Carcharhinidae	37018014	*Carcharhinus tilstoni*	Australian Blacktip Shark	expanded from 37018000, 37018901, LOG, EM, expanded from previous ERA
468	BC	Chondrichthyan	Hemigaleidae	37018020	*Hemigaleus australiensis*	Sicklefin Weasel Shark	expanded from 37018000, LOG, EM
469	BC	Chondrichthyan	Carcharhinidae	37018021	*Carcharhinus leucas*	Bull Shark	LOG, EM, also in 37018000, 37018901, LOG, EM
470	BC	Chondrichthyan	Carcharhinidae	37018023	*Carcharhinus brevipinna*	Spinner Shark	expanded from 37018000, 37018901, LOG, EM, expanded from previous ERA
473	BC	Chondrichthyan	Carcharhinidae	37018026	*Carcharhinus amboinensis*	Pigeye Shark	expanded from 37018000, 37018901, LOG, EM, expanded from previous ERA

Table 2.20: *(continued)*

ERA Species ID	Role in Fishery	Taxa	Family Name	CAAB Code	Scientific Name	Common Name	Source(s)
474	BC	Chondrichthyan	Carcharhinidae	37018027	*Carcharhinus albimarginatus*	Silvertip Shark	expanded from 37018000, 37018901, LOG, EM, expanded from previous ERA
475	BC	Chondrichthyan	Carcharhinidae	37018029	*Negaprion acutidens*	Lemon Shark	LOG, also in 37018000, LOG, EM
478	BC	Chondrichthyan	Carcharhinidae	37018034	*Carcharhinus cautus*	Nervous Shark	expanded from 37018000, 37018901, LOG, EM
480	BC	Chondrichthyan	Carcharhinidae	37018036	*Carcharhinus melanopterus*	Blacktip Reef Shark	expanded from 37018000, 37018901, LOG, EM, expanded from previous ERA
482	BC	Chondrichthyan	Carcharhinidae	37018038	*Triaenodon obesus*	Whitetip Reef Shark	LOG, EM, also in 37018000, LOG, EM
483	BC	Chondrichthyan	Carcharhinidae	37018039	*Carcharhinus limbatus*	Blacktip Shark	expanded from 37018000, 37018901, LOG, EM, expanded from previous ERA
880	BC	Chondrichthyan	Sphyrnidae	37019001	*Sphyrna lewini*	Scalloped Hammerhead	expanded from 37019000, LOG, EM, CDR, expanded from previous ERA
485	BC	Chondrichthyan	Sphyrnidae	37019002	*Sphyrna mokarran*	Great Hammerhead	expanded from 37019000, LOG, EM, CDR, expanded from previous ERA
552	BC	Chondrichthyan	Sphyrnidae	37019004	*Sphyrna zygaena*	Smooth Hammerhead	LOG, EM, CDR, also in 37019000, LOG, EM, CDR
371	BC	Chondrichthyan	Centrophoridae	37020001	*Centrophorus moluccensis*	Endeavour Dogfish	expanded from 37020000, LOG, expanded from previous ERA
590	BC	Chondrichthyan	Dalatiidae	37020002	*Dalatias licha*	Black Shark	expanded from 37020000, LOG
604	BC	Chondrichthyan	Centrophoridae	37020003	*Deania calceus*	Brier Shark, Birdbeak Dogfish	expanded from 37020000, LOG, expanded from previous ERA
1078	BC	Chondrichthyan	Squalidae	37020006	*Squalus megalops*	Piked Spurdog;Spikey Dogfish	expanded from 37020000, LOG, expanded from previous ERA
963	BC	Chondrichthyan	Dalatiidae	37020014	*Isistius brasiliensis*	Smalltooth Cookiecutter Shark	LOG, EM, also in 37020000, LOG
496	BC	Chondrichthyan	Dalatiidae	37020017	*Squaliolus aliae*	Smalleye Pygmy Shark	expanded from 37020000, LOG
491	BC	Chondrichthyan	Somniosidae	37020019	*Centroscymnus owstonii*	Owston's Dogfish	expanded from 37020000, LOG, expanded from previous ERA
642	BC	Chondrichthyan	Etmopteridae	37020027	*Etmopterus bigelowi*	Smooth Lanternshark	expanded from 37020000, LOG

Table 2.20: *(continued)*

ERA Species ID	Role in Fishery	Taxa	Family Name	CAAB Code	Scientific Name	Common Name	Source(s)
6015	BC	Chondrichthyan	Dalatiidae	37020043	*Isistius plutodus*	Largetooth Cookiecutter Shark	expanded from 37020000, LOG, expanded from previous ERA
2153	BC	Chondrichthyan	Echinorhinidae	37022001	*Echinorhinus brucus*	Bramble Shark	expanded from 37990071, LOG, EM, expanded from previous ERA
816	BC	Chondrichthyan	Dasyatidae	37035010	*Pteroplatytrygon violacea*	Pelagic Stingray	expanded from 37035000, LOG, EM, 37990001, LOG, EM, 37990030, LOG, EM, expanded from previous ERA
522	BC	Chondrichthyan	Dasyatidae	37035027	*Urogymnus asperrimus*	Porcupine Ray	LOG, EM, also in 37035000, LOG, EM, and 37990001, LOG, EM
777	BC	Chondrichthyan	Urolophidae	37038007	*Urolophus viridis*	Greenback Stingaree	expanded from 37990001, LOG, EM, 37990030, LOG, EM, expanded from previous ERA
784	BC	Chondrichthyan	Myliobatidae	37039001	*Myliobatis tenuicaudatus*	New Zealand Eagle Ray; Southern Eagle Ray	expanded from 37990001, LOG, EM, 37990030, LOG, EM, expanded from previous ERA
529	BC	Chondrichthyan	Aetobatidae	37039003	*Aetobatus ocellatus*	Spotted Eagle Ray	expanded from 37990030, LOG, EM
6434	BC	Chondrichthyan	Chimaeridae	37042001	*Chimaera ogilbyi*	Ogilby's Ghostshark	expanded from 37042000, LOG
8222	BC	Chondrichthyan	Chimaeridae	37042006	*Chimaera obscura*	Shortspine Chimaera	expanded from 37042000, LOG
11	BC	Invertebrate	Ommastrephidae	23636004	*Nototodarus gouldi*	Gould's Squid	expanded from 23615000, LOG, EM
9259	BC	Teleost	Congridae	37067035	*Ariosoma anagoides*	Sea Conger	expanded from 37067000, LOG
9266	BC	Teleost	Congridae	37067038	*Ariosoma howensis*	Lord Howe Conger	expanded from 37067000, LOG
788	BC	Teleost	Paralepididae	37126004	*Magnisudis prionosa*	Southern Barracudina	LOG
373	BC	Teleost	Alepisauridae	37128001	*Alepisaurus ferox*	Long Snouted Lancetfish;Longnose Lancetfish	LOG, EM, also in 37128000, LOG, EM, CDR
372	BC	Teleost	Alepisauridae	37128002	*Alepisaurus brevirostris*	Short Snouted Lancetfish;Shortnose Lancetfish	LOG, EM, also in 37128000, LOG, EM, CDR
924	BC	Teleost	Macrouridae	37232003	*Coelorinchus mirus*	Gargoyle Fish	expanded from 37232000, LOG
977	BC	Teleost	Macrouridae	37232004	*Lepidorhynchus denticulatus*	Toothed Whiptail	expanded from 37232000, LOG

Table 2.20: *(continued)*

ERA Species ID	Role in Fishery	Taxa	Family Name	CAAB Code	Scientific Name	Common Name	Source(s)
6580	BC	Teleost	Macrouridae	37232005	*Lucigadus nigromaculatus*	Blackspot Whiptail	expanded from 37232000, LOG
925	BC	Teleost	Macrouridae	37232007	*Malacocephalus laevis*	Softhead Grenadier;Smooth Whiptail	expanded from 37232000, LOG, expanded from previous ERA
284	BC	Teleost	Macrouridae	37232016	*Coryphaenoides subserrulatus*	Long-Rayed Whiptail	expanded from 37232000, LOG, expanded from previous ERA
6582	BC	Teleost	Macrouridae	37232039	*Coryphaenoides dossenus*	Humpback Whiptail	expanded from 37232000, LOG
343	BC	Teleost	Macrouridae	37232040	*Coelorinchus kermadecus*	Kermadec Whiptail	expanded from 37232000, LOG
6583	BC	Teleost	Macrouridae	37232041	*Odontomacrurus murrayi*	Largefang Whiptail	expanded from 37232000, LOG
6347	BC	Teleost	Macrouridae	37232045	*Coelorinchus maurofasciatus*	Falseband Whiptail	expanded from 37232000, LOG
6348	BC	Teleost	Macrouridae	37232047	*Coelorinchus gormani*	Little Whiptail	expanded from 37232000, LOG
6590	BC	Teleost	Macrouridae	37232062	*Kuronezumia leonis*	Snubnose Whiptail	expanded from 37232000, LOG
6594	BC	Teleost	Macrouridae	37232072	*Lucigadus microlepis*	Smallfin Whiptail	expanded from 37232000, LOG
6608	BC	Teleost	Bathygadidae	37232119	*Gadomus aoteanus*	Filamentous Rat Tail	expanded from 37232000, LOG
1097	BC	Teleost	Zeidae	37264003	*Zenopsis nebulosa*	Mirror Dory	CDR
8284	BC	Teleost	Trachipteridae	37271001	*Trachipterus jacksonensis*	Southern Ribbonfish	LOG, EM, also in 37271000, LOG, EM
4913	BC	Teleost	Trachipteridae	37271002	*Desmodema polystictum*	Spotted Ribbonfish	expanded from 37271000, LOG, EM
4969	BC	Teleost	Trachipteridae	37271003	*Zu cristatus*	Scalloped Ribbonfish	expanded from 37271000, LOG, EM
562	BC	Teleost	Regalecidae	37272002	*Regalecus glesne*	Oarfish (”King Of Herrings”)	LOG, EM, CDR

Table 2.20: *(continued)*

ERA Species ID	Role in Fishery	Taxa	Family Name	CAAB Code	Scientific Name	Common Name	Source(s)
1037	BC	Teleost	Platycephalidae	37296001	*Platycephalus richardsoni*	Tiger Flathead	LOG
133	BC	Teleost	Serranidae	37311095	*Caprodon longimanus*	Longfin Perch	CDR
139	BC	Teleost	Dinolestidae	37327002	*Dinolestes lewini*	Longfin Pike	expanded from 37327000, LOG, CDR
147	BC	Teleost	Rachycentridae	37335001	*Rachycentron canadum*	Cobia	LOG, EM, CDR
2416	BC	Teleost	Carangidae	37337005	*Carangoides malabaricus*	Malabar Trevally	expanded from 37337000, LOG, CDR
149	BC	Teleost	Carangidae	37337007	*Seriola hippos*	Samsonfish	LOG, CDR, also in 37337000, LOG, CDR
1128	BC	Teleost	Carangidae	37337008	*Selar boops*	Oxeye Scad	expanded from 37337000, LOG, CDR
1120	BC	Teleost	Carangidae	37337010	*Alepes apercna*	Smallmouth Scad	expanded from 37337000, LOG, CDR
657	BC	Teleost	Carangidae	37337011	*Carangoides chrysophrys*	Longnose Trevally	expanded from 37337000, LOG, CDR
663	BC	Teleost	Carangidae	37337012	*Gnathanodon speciosus*	Golden Trevally	expanded from 37337000, LOG, CDR
6988	BC	Teleost	Carangidae	37337013	*Carangoides equula*	Whitefin Trevally	expanded from 37337000, LOG, CDR
1122	BC	Teleost	Carangidae	37337014	*Seriolina nigrofasciata*	Blackbanded Trevally, Blackbanded Amberjack	expanded from 37337000, LOG, CDR
1132	BC	Teleost	Carangidae	37337015	*Selaroides leptolepis*	Yellowstripe Scad	expanded from 37337000, LOG, CDR
1123	BC	Teleost	Carangidae	37337016	*Caranx bucculentus*	Bluespotted Trevally	expanded from 37337000, LOG, CDR
2451	BC	Teleost	Carangidae	37337017	*Decapterus macrosoma*	Shortfin Scad, Slender Scad	expanded from 37337000, LOG, CDR
2299	BC	Teleost	Carangidae	37337018	*Alectis ciliaris*	African Pompano, Pennantfish	expanded from 37337000, LOG, CDR
2420	BC	Teleost	Carangidae	37337020	*Uraspis uraspis*	Whitemouth Jack	expanded from 37337000, LOG, CDR
654	BC	Teleost	Carangidae	37337021	*Carangoides caeruleopinnatus*	Coastal Trevally	expanded from 37337000, LOG, CDR

Table 2.20: *(continued)*

ERA Species ID	Role in Fishery	Taxa	Family Name	CAAB Code	Scientific Name	Common Name	Source(s)
2405	BC	Teleost	Carangidae	37337022	*Turrum gymnostethus*	Bludger, Bludger Trevally	expanded from 37337000, LOG, CDR
1130	BC	Teleost	Carangidae	37337023	*Decapterus russelli*	Indian Scad	expanded from 37337000, LOG, CDR
2415	BC	Teleost	Carangidae	37337024	*Atule mate*	Barred Yellowtail Scad	expanded from 37337000, LOG, CDR
591	BC	Teleost	Carangidae	37337025	*Seriola dumerilli*	Amberjack	expanded from 37337000, LOG, CDR
4418	BC	Teleost	Carangidae	37337027	*Caranx ignobilis*	Giant Trevally	expanded from 37337000, LOG, CDR
1131	BC	Teleost	Carangidae	37337028	*Megalaspis cordyla*	Torpedo Scad, Finny Scad	expanded from 37337000, LOG, CDR
593	BC	Teleost	Carangidae	37337029	*Elagatis bipinnulata*	Rainbow Runner	LOG, EM, CDR, also in 37337000, LOG, CDR
2297	BC	Teleost	Carangidae	37337032	*Scomberoides commersonnianus*	Talang Queenfish	expanded from 37337000, LOG, CDR
2308	BC	Teleost	Carangidae	37337037	*Carangoides fulvoguttatus*	Yellowspotted Trevally, Turrum	expanded from 37337000, LOG, CDR
664	BC	Teleost	Carangidae	37337039	*Caranx sexfasciatus*	Bigeye Trevally	expanded from 37337000, LOG, CDR
4938	BC	Teleost	Carangidae	37337040	*Naucrates ductor*	Pilotfish	LOG, also in 37337000, LOG, CDR
2347	BC	Teleost	Carangidae	37337044	*Scomberoides tol*	Needlescaled Queenfish, Needleskin Queenfish	expanded from 37337000, LOG, CDR
2312	BC	Teleost	Carangidae	37337050	*Caranx melampygus*	Bluefin Trevally	expanded from 37337000, LOG, CDR
661	BC	Teleost	Carangidae	37337052	*Seriola rivoliana*	Highfin Amberjack	expanded from 37337000, LOG, CDR
662	BC	Teleost	Carangidae	37337053	*Caranx lugubris*	Black Trevally	expanded from 37337000, LOG, CDR
4912	BC	Teleost	Carangidae	37337055	*Decapterus macarellus*	Mackerel Scad	expanded from 37337000, LOG, CDR
7929	BC	Teleost	Carangidae	37337056	*Decapterus kurroides*	Redtail Scad	expanded from 37337000, LOG, CDR
6507	BC	Teleost	Carangidae	37337057	*Carangoides orthogrammus*	Thicklip Trevally; Island Trevally	expanded from 37337000, LOG, CDR
4968	BC	Teleost	Carangidae	37337059	*Uraspis secunda*	Cottonmouth Trevally	expanded from 37337000, LOG, CDR
6989	BC	Teleost	Carangidae	37337060	*Decapterus tabl*	Rough-Ear Scad	expanded from 37337000, LOG, CDR

Table 2.20: *(continued)*

ERA Species ID	Role in Fishery	Taxa	Family Name	CAAB Code	Scientific Name	Common Name	Source(s)
150	BC	Teleost	Carangidae	37337062	*Pseudocaranx georgianus*	Silver Trevally	expanded from 37337000, LOG, CDR
6508	BC	Teleost	Carangidae	37337064	*Caranx papuensis*	Brassy Trevally	expanded from 37337000, LOG, CDR
9236	BC	Teleost	Carangidae	37337068	*Ferdauia ferdau*	Blue Trevally	expanded from 37337000, LOG, CDR
1121	BC	Teleost	Carangidae	37337072	*Parastromateus niger*	Black Pomfret	LOG, CDR, also in 37337000, LOG, CDR
7921	BC	Teleost	Carangidae	37337073	*Trachinotus anak*	Giant Oystercracker	expanded from 37337000, LOG, CDR
1767	BC	Teleost	Bramidae	37342002	*Xenobrama microlepis*	Golden Pomfret	CDR, also in 37342000, LOG, EM, CDR
882	BC	Teleost	Bramidae	37342003	*Taractichthys longipinnis*	Bigscale Pomfret	LOG, EM, CDR, also in 37342000, LOG, EM, CDR
6004	BC	Teleost	Bramidae	37342004	*Brama orcini*	Bigbelly Pomfret	expanded from 37342000, LOG, EM, CDR
4949	BC	Teleost	Bramidae	37342006	*Pteraclis velifera*	Southern Fanfish	expanded from 37342000, LOG, EM, CDR
4950	BC	Teleost	Bramidae	37342007	*Pterycombus petersii*	Prickly Fanfish	expanded from 37342000, LOG, EM, CDR
4960	BC	Teleost	Bramidae	37342008	*Taractes asper*	Flathead Pomfret	expanded from 37342000, LOG, EM, CDR, expanded from previous ERA
6003	BC	Teleost	Bramidae	37342009	*Brama pauciradiata*	Shortfin Pomfret	expanded from 37342000, LOG, EM, CDR
594	BC	Teleost	Bramidae	37342010	*Brama australis*	Southern Ray's Bream	LOG, EM, also in 37342000, LOG, EM, CDR
6002	BC	Teleost	Bramidae	37342011	*Brama dussumieri*	Lesser Bream	expanded from 37342000, LOG, EM, CDR
6994	BC	Teleost	Bramidae	37342013	*Pteraclis aesticola*	Pacific Fanfish	expanded from 37342000, LOG, EM, CDR
4961	BC	Teleost	Bramidae	37342014	*Taractes rubescens*	Knifetail Pomfret	expanded from 37342000, LOG, EM, CDR
4962	BC	Teleost	Bramidae	37342015	*Taractichthys steindachneri*	Sickle Pomfret	expanded from 37342000, LOG, EM, CDR, expanded from previous ERA
600	BC	Teleost	Lutjanidae	37346014	*Etelis carbunculus*	Ruby Snapper	expanded from 37346914, CDR, expanded from previous ERA
723	BC	Teleost	Lutjanidae	37346038	*Etelis coruscans*	Flame Snapper	expanded from 37346914, CDR
158	BC	Teleost	Sparidae	37353001	*Chrysophrys auratus*	Snapper	expanded from 37353000, LOG, EM, expanded from previous ERA
2507	BC	Teleost	Ephippidae	37362002	*Platax batavianus*	Humphead Batfish	expanded from 37362000, LOG

Table 2.20: *(continued)*

ERA Species ID	Role in Fishery	Taxa	Family Name	CAAB Code	Scientific Name	Common Name	Source(s)
1154	BC	Teleost	Ephippidae	37362003	*Zabidius novemaculeatus*	Shortfin Batfish	expanded from 37362000, LOG
1155	BC	Teleost	Ephippidae	37362004	*Platax teira*	Longfin Batfish	expanded from 37362000, LOG
1151	BC	Teleost	Drepaneidae	37362005	*Drepane punctata*	Spotted Sicklefish	expanded from 37362000, LOG
7821	BC	Teleost	Sphyraenidae	37382001	*Sphyraena pinguis*	Striped Barracuda	LOG, EM, also in 37382901, LOG
7077	BC	Teleost	Sphyraenidae	37382003	*Sphyraena acutipinnis*	Sharpfin Barracuda	expanded from 37382901, LOG
2349	BC	Teleost	Sphyraenidae	37382005	*Sphyraena forsteri*	Blackspot Barracuda	expanded from 37382901, LOG
1237	BC	Teleost	Sphyraenidae	37382006	*Sphyraena putnamae*	Military Barracuda	expanded from 37382901, LOG
1238	BC	Teleost	Sphyraenidae	37382007	*Sphyraena obtusata*	Yellowtail Barracuda	expanded from 37382901, LOG
614	BC	Teleost	Sphyraenidae	37382008	*Sphyraena barracuda*	Great Barracuda	LOG, EM, also in 37382901, LOG
8075	BC	Teleost	Sphyraenidae	37382011	*Sphyraena helleri*	Heller's Barracuda	expanded from 37382901, LOG
1087	BC	Teleost	Gempylidae	37439001	*Thyrsites atun*	Barracouta	LOG, EM, CDR, also in 37439918, LOG, also in 37439914, LOG, EM
1066	BC	Teleost	Gempylidae	37439002	*Rexea solandri*	Gemfish	LOG, EM, also in 37439918, LOG
7242	BC	Teleost	Gempylidae	37439006	*Rexea prometheoides*	Royal Gemfish	expanded from 37439918, LOG
7243	BC	Teleost	Gempylidae	37439007	*Rexea bengalensis*	Small Gemfish	expanded from 37439918, LOG
206	BC	Teleost	Gempylidae	37439009	*Rexea antefurcata*	Longfin Gemfish	expanded from 37439918, LOG
618	BC	Teleost	Gempylidae	37439010	*Gempylus serpens*	Snake Mackerel	LOG, EM, also in 37439918, LOG
7244	BC	Teleost	Gempylidae	37439011	*Nealotus tripes*	Black Snake Mackerel	expanded from 37439918, LOG
4940	BC	Teleost	Gempylidae	37439012	*Nesiarchus nasutus*	Black Gemfish	expanded from 37439918, LOG, expanded from previous ERA
4946	BC	Teleost	Gempylidae	37439013	*Promethichthys prometheus*	Singleline Gemfish	expanded from 37439918, LOG, expanded from previous ERA
7245	BC	Teleost	Gempylidae	37439014	*Rexichthys johnpaxtoni*	Paxton's Gemfish	expanded from 37439918, LOG
7246	BC	Teleost	Gempylidae	37439016	*Thyrsitoides marleyi*	Black Snoek	expanded from 37439918, LOG
207	BC	Teleost	Trichiuridae	37440001	*Benthodesmus elongatus*	Slender Frostfish	expanded from 37440000, LOG, EM, expanded from previous ERA

Table 2.20: *(continued)*

ERA Species ID	Role in Fishery	Taxa	Family Name	CAAB Code	Scientific Name	Common Name	Source(s)
208	BC	Teleost	Trichiuridae	37440002	*Lepidopus caudatus*	Southern Frostfish;Frostfish	LOG, also in 37440000, LOG, EM
209	BC	Teleost	Trichiuridae	37440004	*Trichiurus lepturus*	Largehead Hairtail	expanded from 37440000, LOG, EM, expanded from previous ERA
8407	BC	Teleost	Trichiuridae	37440006	*Tentoriceps cristatus*	Crested Hairtail	expanded from 37440000, LOG, EM
7248	BC	Teleost	Trichiuridae	37440011	*Benthodesmus tuckeri*	Tucker's Frostfish	expanded from 37440000, LOG, EM
620	BC	Teleost	Scombridae	37441007	*Scomberomorus commerson*	Spanish Mackerel	LOG, CDR, also in 37441911, LOG, CDR
6221	BC	Teleost	Scombridae	37441008	*Cybiosarda elegans*	Leaping Bonito	expanded from 37441912, LOG, EM, CDR, expanded from previous ERA
908	BC	Teleost	Scombridae	37441009	*Auxis thazard*	Frigate Mackerel	LOG, also in 37441912, LOG, EM, CDR
63	BC	Teleost	Scombridae	37441010	*Euthynnus affinis*	Mackerel Tuna	expanded from 37441912, LOG, EM, CDR, expanded from previous ERA
1228	BC	Teleost	Scombridae	37441012	*Rastrelliger kanagurta*	Mouth Mackerel	expanded from 37441911, LOG, CDR
899	BC	Teleost	Scombridae	37441013	*Thunnus tonggol*	Long-Tail Tuna	LOG, CDR, also in 37441912, LOG, EM, CDR
622	BC	Teleost	Scombridae	37441015	*Scomberomorus munroi*	Spotted Mackerel	expanded from 37441911, LOG, CDR
623	BC	Teleost	Scombridae	37441018	*Scomberomorus semifasciatus*	Grey Mackerel	expanded from 37441911, LOG, CDR
830	BC	Teleost	Scombridae	37441019	*Gasterochisma melampus*	Butterfly Mackerel	LOG, EM, CDR
377	BC	Teleost	Scombridae	37441021	*Allothunnus fallai*	Slender Tuna	expanded from 37441912, LOG, EM, CDR, expanded from previous ERA
4903	BC	Teleost	Scombridae	37441027	*Auxis rochei*	Bullet Tuna	expanded from 37441912, LOG, EM, CDR
835	BC	Teleost	Scombridae	37441029	*Gymnosarda unicolor*	Dogtooth Tuna	LOG, also in 37441912, LOG, EM, CDR
852	BC	Teleost	Istiophoridae	37444003	*Makaira nigricans*	Blue Marlin	LOG, EM, also in 37444000, LOG, EM
851	BC	Teleost	Istiophoridae	37444006	*Istiompax indica*	Black Marlin	LOG, EM, also in 37444000, LOG, EM

Table 2.20: *(continued)*

ERA Species ID	Role in Fishery	Taxa	Family Name	CAAB Code	Scientific Name	Common Name	Source(s)
1069	BC	Teleost	Centrolophidae	37445006	*Seriolella punctata*	Silver Warehou	LOG
245	BC	Teleost	Tetraodontidae	37467004	*Sphoeroides pachygaster*	Balloonfish	expanded from 37467000, LOG, EM
246	BC	Teleost	Tetraodontidae	37467005	*Arothron firmamentum*	Starry Toadfish	expanded from 37467000, LOG, EM
1256	BC	Teleost	Tetraodontidae	37467007	*Lagocephalus sceleratus*	Silver Toadfish	expanded from 37467000, LOG, EM
2458	BC	Teleost	Tetraodontidae	37467008	*Lagocephalus inermis*	Smooth Golden Toadfish	expanded from 37467000, LOG, EM
1258	BC	Teleost	Tetraodontidae	37467012	*Lagocephalus lunaris*	Rough Golden Toadfish	expanded from 37467000, LOG, EM
1257	BC	Teleost	Tetraodontidae	37467017	*Lagocephalus spadiceus*	Brownback Toadfish	expanded from 37467000, LOG, EM
8976	BC	Teleost	Tetraodontidae	37467018	*Canthigaster rivulata*	Ocellate Toby	expanded from 37467000, LOG, EM
4928	BC	Teleost	Tetraodontidae	37467023	*Lagocephalus lagocephalus*	Oceanic Puffer;Ocean Puffer	expanded from 37467000, LOG, EM
2386	BC	Teleost	Tetraodontidae	37467026	*Torquigener hicksi*	Hicks' Toadfish	expanded from 37467000, LOG, EM
6838	BC	Teleost	Tetraodontidae	37467033	*Arothron hispidus*	Stars-And-Stripes Puffer	expanded from 37467000, LOG, EM, expanded from previous ERA
249	BC	Teleost	Diodontidae	37469001	*Diodon nicthemerus*	Globefish	expanded from 37469000, LOG, EM
250	BC	Teleost	Diodontidae	37469002	*Allomycterus pilatus*	Australian Burrfish	expanded from 37469000, LOG, EM, expanded from previous ERA
2505	BC	Teleost	Diodontidae	37469007	*Cyclichthys orbicularis*	Shortspine Porcupinefish	expanded from 37469000, LOG, EM
6304	BC	Teleost	Diodontidae	37469013	*Dicotylichthys punctulatus*	Three-Barred Porcupinefish	expanded from 37469000, LOG, EM
6844	BC	Teleost	Diodontidae	37469014	*Chilomycterus reticulatus*	Spotfin Porcupinefish	expanded from 37469000, LOG, EM
4514	BC	Teleost	Diodontidae	37469015	*Diodon hystrix*	Spotted Porcupinefish	expanded from 37469000, LOG, EM

Table 2.20: *(continued)*

ERA Species ID	Role in Fishery	Taxa	Family Name	CAAB Code	Scientific Name	Common Name	Source(s)
4515	BC	Teleost	Diodontidae	37469016	*Diodon liturosus*	Blackblotched Porcupinefish	expanded from 37469000, LOG, EM
8430	BC	Teleost	Molidae	37470001	*Mola alexandrini*	Bumphead Sunfish	LOG, EM
252	BC	Teleost	Molidae	37470002	*Mola mola*	Ocean Sunfish	LOG, EM

Protected Species

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

Protected species 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 workbook 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); birds: Menkhorst et al. (2017), Reid et al. (2002), Marchant and Higgins (1990); marine mammals: Woinarski et al.(2014), Jefferson et al. (2015); teleosts: Atlas of Living Australia Fishmap http://fish.ala.org.au/ , CAAB http://www.cmar.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.

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

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

Table 2.21: Protected species list for the Eastern Tuna and Billfish Fishery - Pelagic longline. AFMA: Australian Fisheries Management Authority. CDR: refers to Catch Disposal Records. EM: Electronic Monitoring. ERA: Ecological Risk Assessment LOG: refers to AFMA Logbook data.

ERA Species ID	Role in Fishery	Taxa	Family Name	CAAB Code	Scientific Name	Common Name	Source(s)
964	PS	Chondrichthyan	Lamnidae	37010001	*Isurus oxyrinchus*	Shortfin Mako	LOG, EM, CDR
370	PS	Chondrichthyan	Lamnidae	37010002	*Isurus paucus*	Longfin Mako	LOG, EM, CDR
315	PS	Chondrichthyan	Lamnidae	37010003	*Carcharodon carcharias*	White Shark	AFMA
972	PS	Chondrichthyan	Lamnidae	37010004	*Lamna nasus*	Porbeagle Shark	LOG, EM, CDR
1067	PS	Chondrichthyan	Rhincodontidae	37014001	*Rhincodon typus*	Whale Shark	AFMA
629	PS	Chondrichthyan	Carcharhinidae	37018007	*Carcharhinus plumbeus*	Sandbar Shark	expanded from 37018000, 37018901, LOG, EM, expanded from previous ERA
621	PS	Chondrichthyan	Carcharhinidae	37018008	*Carcharhinus falciformis*	Silky Shark	AFMA, LOG, EM, also in 37018000, 37018901, LOG, EM
625	PS	Chondrichthyan	Carcharhinidae	37018032	*Carcharhinus longimanus*	Oceanic Whitetip Shark	AFMA, LOG, EM, CDR, also in 37018000, 37018901, LOG, EM
853	PS	Chondrichthyan	Myliobatidae	37041004	*Mobula birostris*	Giant Manta Ray	AFMA, LOG, EM, also in 37990001, LOG, EM
8220	PS	Chondrichthyan	Mobulidae	37041005	*Mobula alfredi*	Manta Ray	AFMA
1032	PS	Marine bird	Diomedeidae	40040001	*Thalassarche bulleri platei*	Buller's Albatross	expanded from 40040000, AFMA
1033	PS	Marine bird	Diomedeidae	40040002	*Thalassarche cauta*	Shy Albatross	AFMA, also in 40040000, AFMA
1035	PS	Marine bird	Diomedeidae	40040004	*Thalassarche chrysostoma*	Grey-Headed Albatross	expanded from 40040000, AFMA
753	PS	Marine bird	Diomedeidae	40040005	*Diomedea epomophora*	Southern Royal Albatross	expanded from 40040000, AFMA
451	PS	Marine bird	Diomedeidae	40040006	*Diomedea exulans*	Wandering Albatross	AFMA, also in 40040000, AFMA
1085	PS	Marine bird	Diomedeidae	40040007	*Thalassarche melanophris*	Black-Browed Albatross	AFMA, also in 40040000, AFMA
1008	PS	Marine bird	Diomedeidae	40040008	*Phoebetria fusca*	Sooty Albatross	AFMA, also in 40040000, AFMA

Table 2.21: *(continued)*

ERA Species ID	Role in Fishery	Taxa	Family Name	CAAB Code	Scientific Name	Common Name	Source(s)
1009	PS	Marine bird	Diomedeidae	40040009	*Phoebetria palpebrata*	Light-Mantled Albatross;Light-Mantled Sooty Albatross	expanded from 40040000, AFMA
755	PS	Marine bird	Diomedeidae	40040010	*Diomedea gibsoni*	Gibson's Albatross	expanded from 40040000, AFMA
628	PS	Marine bird	Diomedeidae	40040011	*Diomedea antipodensis*	Antipodean Albatross	expanded from 40040000, AFMA
799	PS	Marine bird	Diomedeidae	40040012	*Diomedea sanfordi*	Northern Royal Albatross	expanded from 40040000, AFMA
1084	PS	Marine bird	Diomedeidae	40040013	*Thalassarche impavida*	Campbell Albatross	expanded from 40040000, AFMA
1031	PS	Marine bird	Diomedeidae	40040014	*Thalassarche carteri*	Indian Yellow-Nosed Albatross	expanded from 40040000, AFMA
894	PS	Marine bird	Diomedeidae	40040016	*Thalassarche salvini*	Salvin's Albatross	expanded from 40040000, AFMA
889	PS	Marine bird	Diomedeidae	40040017	*Thalassarche eremita*	Chatham Albatross	expanded from 40040000, AFMA
1428	PS	Marine bird	Diomedeidae	40040018	*Diomedea amsterdamensis*	Amsterdam Albatross	expanded from 40040000, AFMA
1429	PS	Marine bird	Diomedeidae	40040019	*Diomedea dabbenena*	Tristan Albatross	expanded from 40040000, AFMA
595	PS	Marine bird	Procellariidae	40041003	*Daption capense*	Cape Petrel	AFMA
1053	PS	Marine bird	Procellariidae	40041036	*Puffinus assimilis*	Little Shearwater	expanded from 40041050, AFMA
1055	PS	Marine bird	Procellariidae	40041038	*Ardenna carneipes*	Flesh-Footed Shearwater	AFMA, also in 40041000, AFMA
1056	PS	Marine bird	Procellariidae	40041040	*Puffinus gavia*	Fluttering Shearwater	expanded from 40041050, AFMA
1057	PS	Marine bird	Procellariidae	40041042	*Ardenna griseus*	Sooty Shearwater	AFMA, also in 40041000, AFMA
1058	PS	Marine bird	Procellariidae	40041043	*Puffinus huttoni*	Hutton's Shearwater	expanded from 40041050, AFMA
1060	PS	Marine bird	Procellariidae	40041047	*Ardenna tenuirostris*	Short-Tailed Shearwater	AFMA, also in 40041000, AFMA
998	PS	Marine bird	Hydrobatidae	40047002	*Morus serrator*	Australasian Gannet	AFMA
1438	PS	Marine bird	Laridae	40128001	*Anous minutus*	Black Noddy	expanded from 40128901, AFMA

Table 2.21: *(continued)*

ERA Species ID	Role in Fishery	Taxa	Family Name	CAAB Code	Scientific Name	Common Name	Source(s)
203	PS	Marine bird	Laridae	40128002	*Anous stolidus*	Common Noddy	expanded from 40128901, AFMA
6083	PS	Marine bird	Laridae	40128006	*Chlidonias hybrida*	Whiskered Tern	expanded from 40128901, AFMA
6084	PS	Marine bird	Laridae	40128007	*Chlidonias leucopterus*	White-Winged Black Tern	expanded from 40128901, AFMA
10535	PS	Marine bird	Laridae	40128009	*Gygis alba*	White Tern	expanded from 40128901, AFMA
1582	PS	Marine bird	Laridae	40128018	*Procelsterna cerulea*	Grey Ternlet	expanded from 40128901, AFMA
1014	PS	Marine bird	Laridae	40128022	*Sterna albifrons*	Little Tern	expanded from 40128901, AFMA
1015	PS	Marine bird	Laridae	40128023	*Onychoprion anaethetus*	Bridled Tern	expanded from 40128901, AFMA
1016	PS	Marine bird	Laridae	40128024	*Thalasseus bengalensis*	Lesser Crested Tern	expanded from 40128901, AFMA
1017	PS	Marine bird	Laridae	40128025	*Thalasseus bergii*	Crested Tern	expanded from 40128901, AFMA
1018	PS	Marine bird	Laridae	40128026	*Hydroprogne caspia*	Caspian Tern	expanded from 40128901, AFMA
1019	PS	Marine bird	Laridae	40128027	*Sterna dougallii*	Roseate Tern	expanded from 40128901, AFMA
1020	PS	Marine bird	Laridae	40128028	*Onychoprion fuscatus*	Sooty Tern	expanded from 40128901, AFMA
1021	PS	Marine bird	Laridae	40128029	*Sterna hirundo*	Common Tern	expanded from 40128901, AFMA
6081	PS	Marine bird	Laridae	40128030	*Sternula nereis*	Fairy Tern	expanded from 40128901, AFMA
1023	PS	Marine bird	Laridae	40128032	*Sterna paradisaea*	Arctic Tern	expanded from 40128901, AFMA
1024	PS	Marine bird	Laridae	40128033	*Sterna striata*	White-Fronted Tern	expanded from 40128901, AFMA
1025	PS	Marine bird	Laridae	40128034	*Sterna sumatrana*	Black-Naped Tern	expanded from 40128901, AFMA
984	PS	Marine mammal	Balaenopteridae	41112006	*Megaptera novaeangliae*	Humpback Whale	AFMA
612	PS	Marine mammal	Delphinidae	41116001	*Delphinus delphis*	Common Dolphin	AFMA
902	PS	Marine mammal	Delphinidae	41116002	*Feresa attenuata*	Pygmy Killer Whale	expanded from 41116000, AFMA
934	PS	Marine mammal	Delphinidae	41116003	*Globicephala macrorhynchus*	Short-Finned Pilot Whale	AFMA
935	PS	Marine mammal	Delphinidae	41116004	*Globicephala melas*	Long-Finned Pilot Whale	AFMA

Table 2.21: *(continued)*

ERA Species ID	Role in Fishery	Taxa	Family Name	CAAB Code	Scientific Name	Common Name	Source(s)
937	PS	Marine mammal	Delphinidae	41116005	*Grampus griseus*	Risso's Dolphin	expanded from 41116000, AFMA
970	PS	Marine mammal	Delphinidae	41116006	*Lagenodelphis hosei*	Fraser's Dolphin	expanded from 41116000, AFMA
832	PS	Marine mammal	Delphinidae	41116007	*Lagenorhynchus cruciger*	Hourglass Dolphin	expanded from 41116000, AFMA
971	PS	Marine mammal	Delphinidae	41116008	*Lagenorhynchus obscurus*	Dusky Dolphin	expanded from 41116000, AFMA
61	PS	Marine mammal	Delphinidae	41116009	*Lissodelphis peronii*	Southern Right Whale Dolphin	expanded from 41116000, AFMA
860	PS	Marine mammal	Delphinidae	41116010	*Orcaella heinsohni*	Australian Snubfin Dolphin	expanded from 41116000, AFMA
1002	PS	Marine mammal	Delphinidae	41116011	*Orcinus orca*	Killer Whale	expanded from 41116000, AFMA
1007	PS	Marine mammal	Delphinidae	41116012	*Peponocephala electra*	Melon-Headed Whale	AFMA
1044	PS	Marine mammal	Delphinidae	41116013	*Pseudorca crassidens*	False Killer Whale	AFMA
1076	PS	Marine mammal	Delphinidae	41116014	*Sousa sahulensis*	Australian Humpback Dolphin	expanded from 41116000, AFMA
1080	PS	Marine mammal	Delphinidae	41116015	*Stenella attenuata*	Spotted Dolphin	expanded from 41116000, AFMA
1081	PS	Marine mammal	Delphinidae	41116016	*Stenella coeruleoalba*	Striped Dolphin	expanded from 41116000, AFMA
1082	PS	Marine mammal	Delphinidae	41116017	*Stenella longirostris*	Spinner Dolphin	expanded from 41116000, AFMA
1083	PS	Marine mammal	Delphinidae	41116018	*Steno bredanensis*	Rough-Toothed Dolphin	expanded from 41116000, AFMA
1091	PS	Marine mammal	Delphinidae	41116019	*Tursiops truncatus*	Bottlenose Dolphin	AFMA
1494	PS	Marine mammal	Delphinidae	41116020	*Tursiops aduncus*	Indian Ocean Bottlenose Dolphin	expanded from 41116000, AFMA
216	PS	Marine mammal	Otariidae	41131001	*Arctocephalus forsteri*	New Zealand Fur-Seal	AFMA, also in 41131000, AFMA
253	PS	Marine mammal	Otariidae	41131003	*Arctocephalus pusillus doriferus*	Australian Fur Seal	AFMA, also in 41131000, AFMA

Table 2.21: ***(continued)***

ERA Species ID	Role in Fishery	Taxa	Family Name	CAAB Code	Scientific Name	Common Name	Source(s)
263	PS	Marine mammal	Otariidae	41131004	*Arctocephalus tropicalis*	Subantarctic Fur-Seal	expanded from 4113100, AFMA
1000	PS	Marine mammal	Otariidae	41131005	*Neophoca cinerea*	Australian Sea-Lion	expanded from 4113100, AFMA
324	PS	Marine reptile	Cheloniidae	39020001	*Caretta caretta*	Loggerhead Turtle	AFMA
541	PS	Marine reptile	Cheloniidae	39020002	*Chelonia mydas*	Green Turtle	AFMA
822	PS	Marine reptile	Cheloniidae	39020003	*Eretmochelys imbricata*	Hawksbill Turtle	AFMA
844	PS	Marine reptile	Cheloniidae	39020004	*Lepidochelys olivacea*	Olive Ridley Turtle	AFMA
857	PS	Marine reptile	Cheloniidae	39020005	*Natator depressus*	Flatback Turtle	AFMA
613	PS	Marine reptile	Dermochelyidae	39021001	*Dermochelys coriacea*	Leatherback Turtle	AFMA

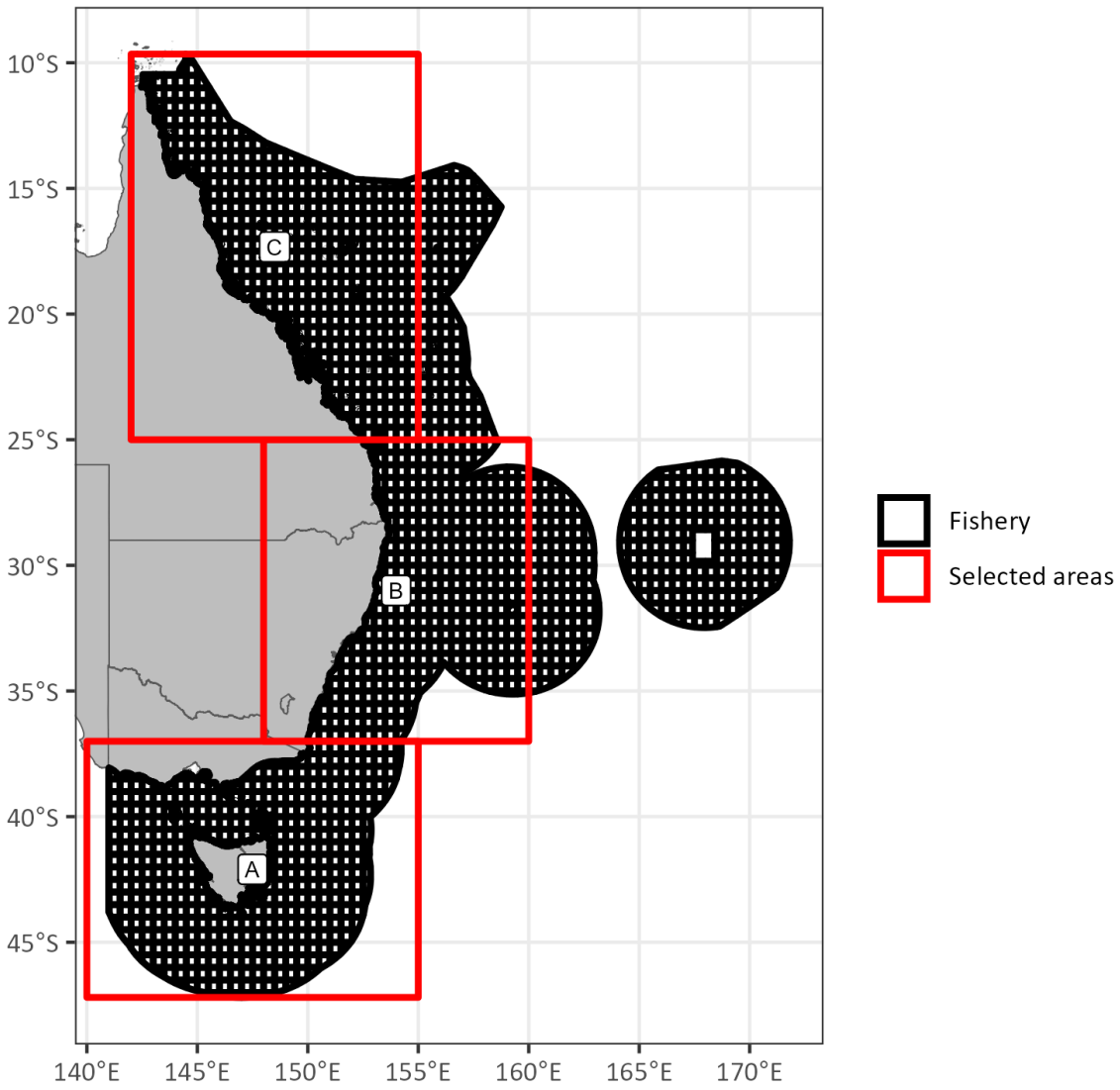

Figure 2.6: Map of the fishery region showing the locations for which detailed maps of biomes and assemblages are shown in the following figures (Figure 2.7 to Figure 2.9).

There has been considerable research and habitat identification and modelling of demersal habitats around Australia and specifically in the SESSF region (Althaus et al., 2009; Hobday et al., 2011a; Pitcher et al., 2015, 2016; Williams et al., 2009, 2010a; Williams et al., 2010b, 2010c, 2011). This has culminated in Pitcher et al. (2018) in an FRDC–funded project, redefined much of the Australian seafloor based on mesoscale surrogates collated from data from biological surveys, environmental data, protected area/fishery closure data. Assemblages (=habitat) types were predicted, mapped (Figure 2.7) and overlaid with the footprint of the fishery being assessed.

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

Annual effort (hooks-per-set) has slightly increased (between 1.0 - 5.3%) between 2018 to 2021 despite the slight decrease in 2022 (1.3 %) while fishery footprint has not changed significantly (Table 2.4).

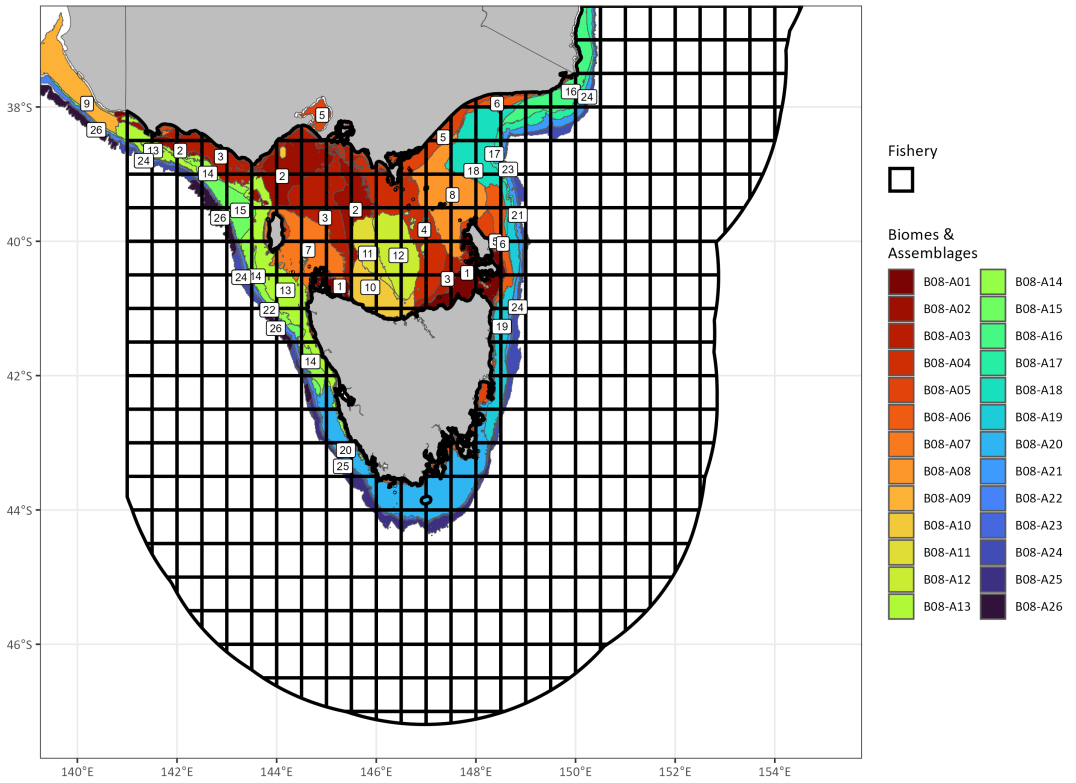

Figure 2.7: Map of the fishery region A showing the biomes and assemblages derived by Pitcher et al. (2018). Please note that the map may contain biomes and assemblage numbers that do not overlap the fishery. Biomes: 08 = South-east Australian shelf and slope region. For detailed descriptions of the biome and assemblage numbers, please refer to Table 2.22.

Pelagic longlining effort occurs over pelagic habitats. Therefore benthic habitats are not considered to be vulnerable to fishing activities.

Table 2.22: Benthic habitats that occur within the jurisdictional boundary of the Eastern Tuna and Billfish Fishery - Pelagic longline. Further details of these assemblages were not available. Bold text denotes habitats where fishing effort has occurred (67 habitats).

Biome Number	Biome	ERAEF Assemblage Number	Habitat Type
05	East Australian shelf and slope region	1	
05	East Australian shelf and slope region	2	
05	**East Australian shelf and slope region**	**3**	
05	**East Australian shelf and slope region**	**4**	
05	**East Australian shelf and slope region**	**5**	
05	**East Australian shelf and slope region**	**6**	
05	**East Australian shelf and slope region**	**7**	
05	**East Australian shelf and slope region**	**8**	

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

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

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

Biome Number	Biome	ERAEF Assemblage Number	Habitat Type
03	**Northeast Australian slope and Coral Sea plateau region**	**6**	
03	**Northeast Australian slope and Coral Sea plateau region**	**7**	
03	**Northeast Australian slope and Coral Sea plateau region**	**8**	
03	**Northeast Australian slope and Coral Sea plateau region**	**9**	
03	**Northeast Australian slope and Coral Sea plateau region**	**10**	
03	**Northeast Australian slope and Coral Sea plateau region**	**11**	
03	**Northeast Australian slope and Coral Sea plateau region**	**12**	
03	**Northeast Australian slope and Coral Sea plateau region**	**13**	
03	**Northeast Australian slope and Coral Sea plateau region**	**14**	
08	Southeast Australian shelf and slope region	1	
08	Southeast Australian shelf and slope region	2	
08	Southeast Australian shelf and slope region	3	
08	Southeast Australian shelf and slope region	4	
08	Southeast Australian shelf and slope region	5	
08	**Southeast Australian shelf and slope region**	**6**	
08	Southeast Australian shelf and slope region	7	
08	Southeast Australian shelf and slope region	8	
08	Southeast Australian shelf and slope region	9	
08	Southeast Australian shelf and slope region	10	
08	Southeast Australian shelf and slope region	11	
08	Southeast Australian shelf and slope region	12	
08	Southeast Australian shelf and slope region	13	

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

Biome Number	Biome	ERAEF Assemblage Number	Habitat Type
08	Southeast Australian shelf and slope region	14	
08	Southeast Australian shelf and slope region	15	
08	**Southeast Australian shelf and slope region**	**16**	
08	**Southeast Australian shelf and slope region**	**17**	
08	Southeast Australian shelf and slope region	18	
08	Southeast Australian shelf and slope region	19	
08	**Southeast Australian shelf and slope region**	**20**	
08	**Southeast Australian shelf and slope region**	**21**	
08	**Southeast Australian shelf and slope region**	**22**	
08	**Southeast Australian shelf and slope region**	**23**	
08	**Southeast Australian shelf and slope region**	**24**	
08	**Southeast Australian shelf and slope region**	**25**	
08	Southeast Australian shelf and slope region	26	
11	Southern GBR shelf region	1	
11	Southern GBR shelf region	2	
11	Southern GBR shelf region	3	
11	**Southern GBR shelf region**	**4**	
11	**Southern GBR shelf region**	**5**	
11	**Southern GBR shelf region**	**6**	
11	**Southern GBR shelf region**	**7**	
11	**Southern GBR shelf region**	**8**	
11	**Southern GBR shelf region**	**9**	
11	**Southern GBR shelf region**	**10**	
11	**Southern GBR shelf region**	**11**	
11	**Southern GBR shelf region**	**12**	
11	**Southern GBR shelf region**	**13**	
11	Southern GBR shelf region	14	
11	**Southern GBR shelf region**	**15**	
11	**Southern GBR shelf region**	**16**	
11	**Southern GBR shelf region**	**17**	

Table 2.22: *(continued)*

Biome Number	Biome	ERAEF Assemblage Number	Habitat Type
11	**Southern GBR shelf region**	**18**	
11	**Southern GBR shelf region**	**19**	
11	**Southern GBR shelf region**	**20**	
11	**Southern GBR shelf region**	**21**	
11	**Southern GBR shelf region**	**22**	
11	**Southern GBR shelf region**	**23**	
11	**Southern GBR shelf region**	**24**	
11	**Southern GBR shelf region**	**25**	
11	**Southern GBR shelf region**	**26**	

Scoping Document S2B2. Pelagic Habitats

Table 2.23: Pelagic habitats for the Eastern Tuna and Billfish Fishery - Pelagic longline. Shading denotes habitats occurring within the jurisdictional boundary of the fishery. Bold text refers to pelagic habitats where fishing effort has occurred.

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

Table 2.23: *(continued)*

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

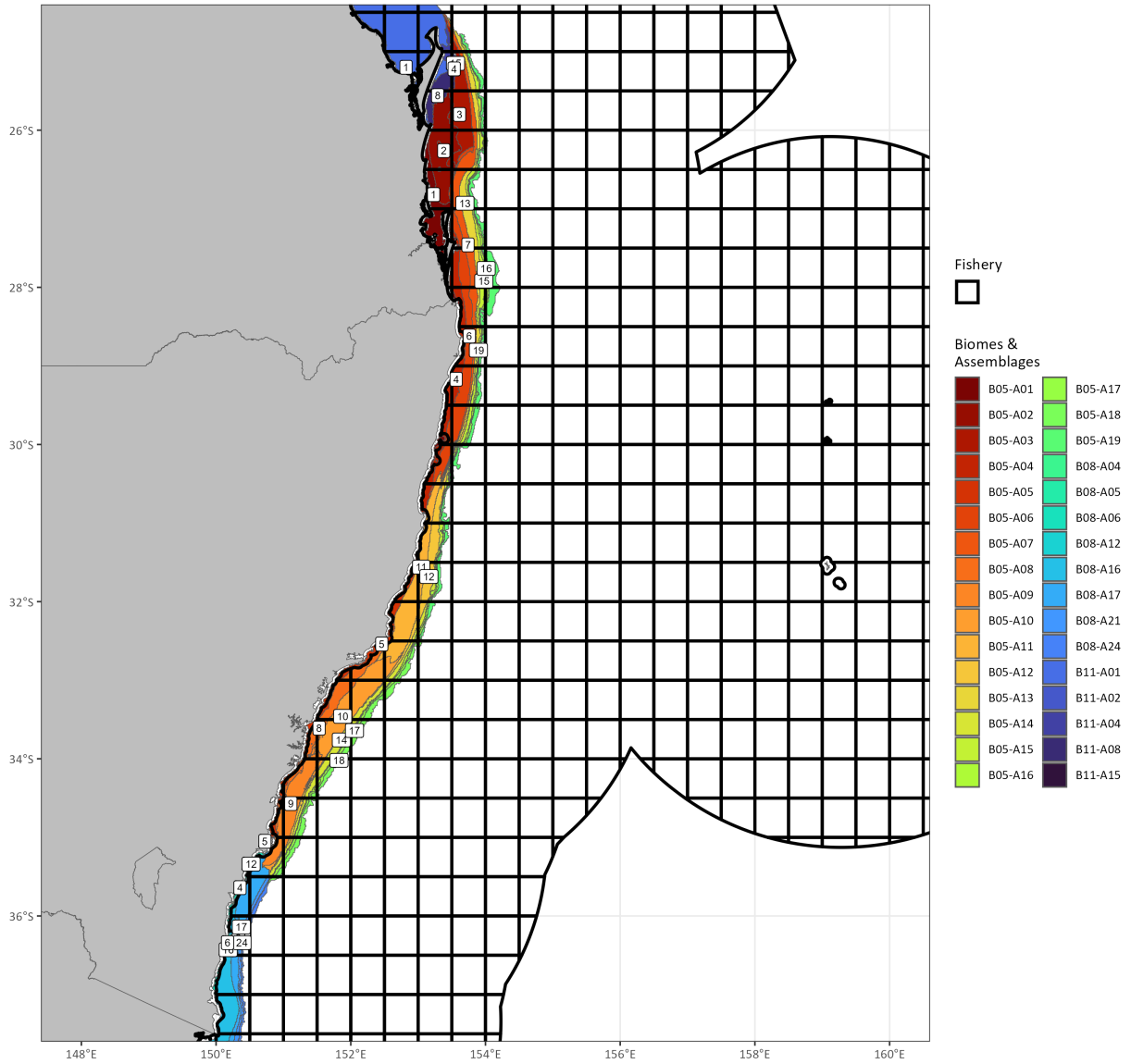

Figure 2.8: Map of the fishery region B, showing the biomes and assemblages derived by Pitcher et al. (2018). Please note that the map may contain biomes and assemblage numbers that do not overlap the fishery. Biomes: 05 = East Australian shelf and slope region; 11 = Southern GBR shelf region; 08 = Southeast Australian shelf and slope region. For detailed descriptions of the biome and assemblage numbers, please refer to Table 2.22.

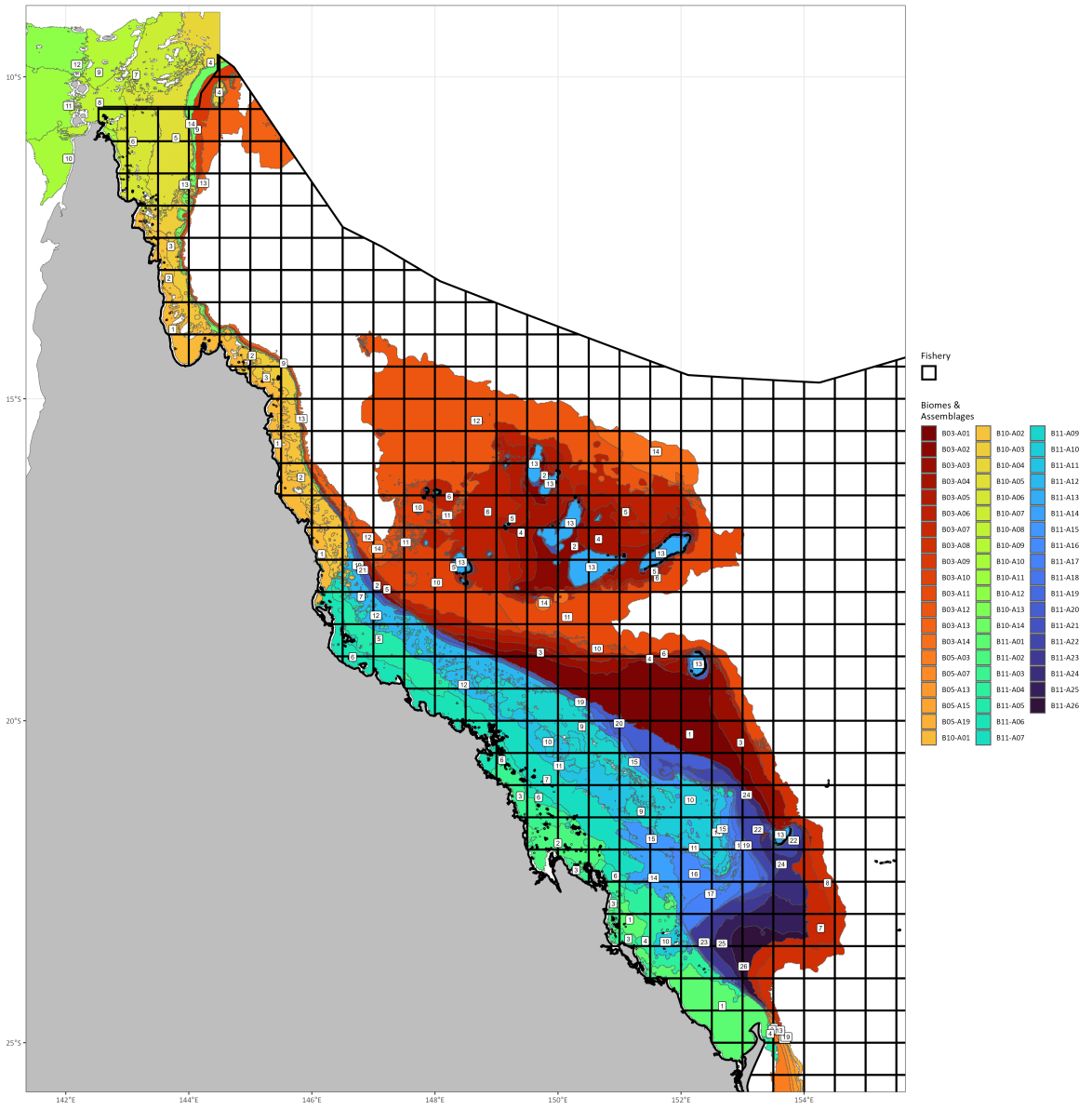

Figure 2.9: Map of the fishery region C, showing the biomes and assemblages derived by Pitcher et al. (2018). Please note that the map may contain biomes and assemblage numbers that do not overlap the fishery. Biomes: 10 = North-east Australian shelf region; 03 = Northeast Australian slope and Coral Sea plateau region; 11 = Southern GBR shelf region; 05 = East Australian shelf and slope region. For detailed descriptions of the biome and assemblage numbers, please refer to Table 2.22.

Scoping Document S2C1. Demersal Communities

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

Table 2.24: Demersal communities in which fishing activity can occur (white shading). Shaded blue cells indicate all communities present within the province. Crosses refer to communities where fishing has occurred in the Eastern Tuna and Billfish Fishery - Pelagic longline.

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

Table 2.24: *(continued)*

Demersal Community	Cape Province	North Eastern Transition	North Eastern Province	Central Eastern Transition	Central Eastern Province	South Eastern Transition	Central Bass	Tasmanian Province	Western Tasmanian Transition	Southern Province	South Western Transition	Central Western Province	Central Western Transition	North Western Province	North Western Transition	Timor Province	Timor Transition	Heard/McDonald Islands	Macquarie Island
Seamount 0 – 110 m	X																		
Seamount 110 – 250 m	X																		
Seamount 250 – 565 m	X																		
Seamount 565 – 820 m	X																		
Seamount 820 – 1100 m	X	X																	
Seamount > 1100 m			X	X	X														
Plateau 0 – 110 m			X																
Plateau 110 – 250 m			X																
Plateau 250 – 565 m			X																
Plateau 565 – 820 m			X																
Plateau 820 – 1100 m			X																
Shelf (Territorial Seas) 0 – 100 m																			
Shelf 0 – 250 m²																			
Upper-Mid Slope 250 – 1100 m³																			
Inner Heard Plateau 100 – 500 m⁴																			
Outer Heard Plateau 100 – 500 m⁴																			
Shell Bank 100 – 500 m⁴																			
Western Banks 200 – 500 m⁴																			
North Eastern Plateau 500 – 1000 m⁵																			
North Eastern Trough 500 – 1000 m⁵																			
South Eastern Trough 500 – 1000 m⁵																			

Table 2.24: ***(continued)***

Demersal Community	Cape Province	North Eastern Transition	North Eastern Province	Central Eastern Transition	Central Eastern Province	South Eastern Transition	Central Bass	Tasmanian Province	Western Tasmanian Transition	Southern Province	South Western Transition	Central Western Province	Central Western Transition	North Western Province	North Western Transition	Timor Province	Timor Transition	Heard/McDonald Islands	Macquarie Island
Western Trough 500 – 1000 m[5]	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■		■
Southern Upper Slope 500 – 1000 m[5]	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■		■
Shell Bank Deep > 1000 m[6]	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■		■
North East Lower Slope/ Abyssal > 1000 m[6]	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■		■
Southern Lower Slope/ Abyssal > 1100 m	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■		

Note:

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

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

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

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

Table 2.25: Pelagic communities in which fishing activity occurs in the Eastern Tuna and Billfish Fishery - Pelagic longline (cross; x). Shaded cells indicate all communities that exist in the province.

Pelagic Community	Northeastern	Eastern	Southern	Western	Northern	Northwestern	Heard and McDonald Is	Macquarie Is
Coastal pelagic 0-200m[1] [2]		X			X			
Oceanic (1) 0 – 600m	X	X						
Oceanic (2) >600m	X	X						
Seamount oceanic (1) 0 – 600m								
Seamount oceanic (2) 600–3000m		X						
Oceanic (1) 0 – 200m								
Oceanic (2) 200-600m								
Oceanic (3) >600m								
Seamount oceanic (1) 0 – 200m								
Seamount oceanic (2) 200 – 600m								
Seamount oceanic (3) 600–3000m								
Oceanic (1) 0-400m								
Oceanic (2) >400m								
Oceanic (1) 0-800m								
Oceanic (2) >800m								
Plateau (1) 0-600m								
Plateau (2) >600m								
Heard Plateau 0-1000m[3]								
Oceanic (1) 0-1000m								
Oceanic (2) >1000m								
Oceanic (1) 0-1600m								
Oceanic (2) >1600m								

Note:

[1] Northern Province has five coastal pelagic zones (NWS, Bonaparte, Arafura, Gulf and East Cape York) and Southern Province has two zones (Tas, GAB).

[2] At Macquarie Island: coastal pelagic zone to 250m.

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

2.2.3 Units Excluded from Analysis

Species lists for Level 2 analysis are derived from recent observer data where possible or, for fisheries with no observer programs, from logbook and scientific data. In some logbook data, there may only be family-level identifications. Where possible these are resolved to species level by cross-checking with alternative data sources and discussion with experts. In cases where this is not possible (mainly invertebrates) the analysis may be based on family average data.

A list of the species/species groups/taxa excluded in this fishery is provided in Table 2.26.

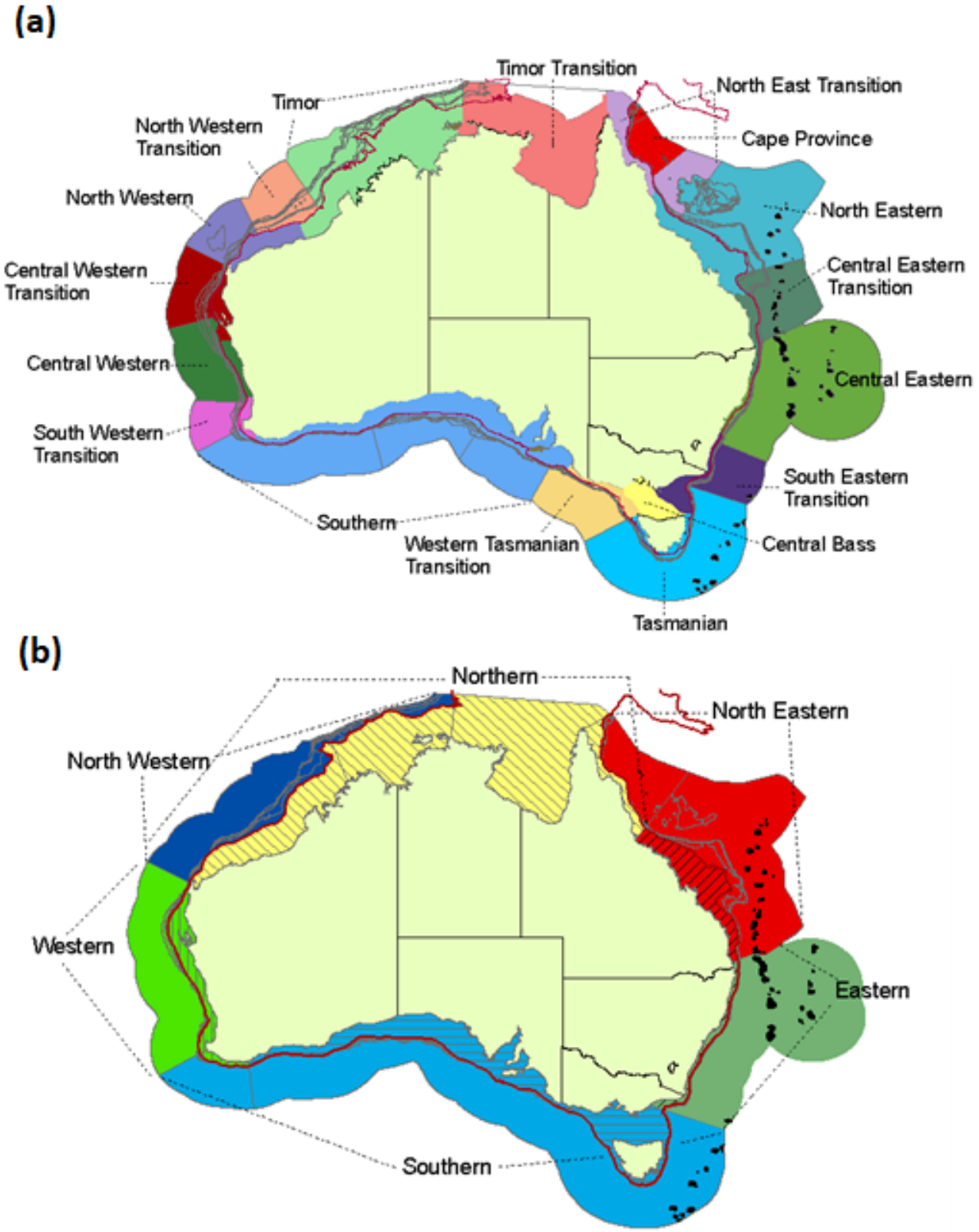

Figure 2.10: (a) Demersal communities around mainland Australia based on bioregionalisation schema. Some inshore (0-110 m) communities comprise more than one community e.g., Timor Transition comprises four distinct communities. (b) Australian pelagic provinces. Hatched areas indicate coastal epipelagic zones overlying the shelf. Offshore (oceanic) provinces comprise two or more overlaying pelagic zones as indicated in Table 2.25. Seamounts (black) and plateaux (light green) are illustrated in their demersal or pelagic provinces.

Table 2.26: Species/species groups/taxa excluded from analysis because they were either not identified at the species level, not interacted in the fishery or outside the fishery's jurisdictional boundary. No obs/ints: No observations or interactions. These entries have been excluded from the protected species list since the last ERA because they have not been observed within the fishery and/or occur outside the depth range of the fishery. LOG: refers to AFMA Logbook data. EM: Electronic Monitoring. CDR: refers to Catch Disposal Records. AFMA: Australian Fisheries Management Authority.

Role in Fishery	Taxa	Family Name	CAAB Code	Scientific Name	Common Name	Rationale
BC	Chondrichthyan	Aetobatidae, Anacanthobatidae, Arhynchobatidae, Dasyatidae, Glaucostegidae, Gymnuridae, Hexatrygonidae, Myliobatidae, Plesiobatidae, Rajidae, Rhinidae, Rhinobatidae, Trygonorrhinidae, Urolophidae	37990030	Order Rajiformes - undifferentiated	Skates and Rays (mixed)	LOG, EM, already expanded from 37035000, LOG, EM and 37990001, LOG, EM. Added 1 species to list (37039003)
BC	Chondrichthyan	Alopiidae	37012901	*Alopias* spp.	Thresher Sharks (mixed)	LOG, EM, 3 existing species in list (37012001, 37012002, 37012003)
BC	Chondrichthyan	Carcharhinidae	37018901	Carcharhinus, Loxodon & Rhizoprionodon spp.	Blacktip sharks (mixed)	LOG, EM, 6 existing species in list (37018001, 37018003, 37018008, 37018021, 37018030, 37018032), added 12 species to list (37018006, 37018007, 37018009, 37018012, 37018013, 37018014, 37018023, 37018026, 37018027, 37018034, 37018036, 37018039)

Table 2.26: *(continued)*

Role in Fishery	Taxa	Family Name	CAAB Code	Scientific Name	Common Name	Rationale
BC	Chondrichthyan	Carcharhinidae, Hemigaleidae	37018000	Carcharhinidae, Hemigaleidae - undifferentiated	Whaler and Weasel Sharks	LOG, EM, 10 existing species in list (37018001, 37018003, 37018004, 37018008, 37018021, 37018022, 37018029, 37018030, 37018032, 37018038), added 14 species to list (37018006, 37018007, 37018009, 37018011, 37018012, 37018013, 37018014, 37018020, 37018023, 37018026, 37018027, 37018034, 37018036, 37018039)
BC	Chondrichthyan	Centrophoridae, Dalatiidae, Echinorhinidae, Etmopteridae, Oxynotidae, Somniosidae, Squalidae	37990071	Order Squaliformes - undifferentiated	Dogfish Sharks (mixed)	LOG, EM, already expanded from 37020000, LOG. Added 1 species to list (37021001)
BC	Chondrichthyan	Centrophoridae, Dalatiidae, Squalidae, Somniosidae, Etmopteridae	37020000	Centrophoridae, Dalatiidae, Squalidae, Somniosidae, Etmopteridae - undifferentiated	Gulper Sharks, Sleeper Sharks, Dogfishes	LOG, 1 existing species in list (37020014), added 8 species to list (37020001, 37020002, 37020003, 37020006, 37020017, 37020019, 37020027, 37020043)
BC	Chondrichthyan	Chimaeridae	37042000	Chimaeridae - undifferentiated	Ghostsharks	LOG, added 2 species to list (37042001,37042006)
BC	Chondrichthyan	Dasyatidae	37035000	Dasyatidae - undifferentiated	Stingrays - unspecified	LOG, EM, also in 37990001, LOG, EM, 1 existing species in list (37035027), added 1 species to list (37035010)
BC	Chondrichthyan	Dasyatidae, Gymnuridae, Myliobatidae, Urolophidae	37990001	Dasyatidae, Gymnuridae, Myliobatidae, Urolophidae - undifferentiated	Rays (mixed)	LOG, EM, 1 existing species in list (37035027), added 2 species to list (37038007, 37039001)
BC	Chondrichthyan	Hexanchidae	37005000	Hexanchidae - undifferentiated	Sixgill and Sevengill Sharks unspecified	LOG, 1 existing species in list (37005002), added 1 species to list (37005005)

Table 2.26: *(continued)*

Role in Fishery	Taxa	Family Name	CAAB Code	Scientific Name	Common Name	Rationale
BC	Chondrichthyan		37990003	Sharks - other	Sharks (mixed)	LOG, EM, CDR, already expanded from 37005000, LOG; 37012901, LOG, EM; 37018000, LOG, EM; 37018901, LOG, EM; 37020000, LOG; 37042000, LOG; 37990071, LOG, EM
BC	Chondrichthyan		37990018	Skates & rays, unspecified	Skates and Rays	LOG, EM, already expanded from 37035000, LOG, EM; 37990001, LOG, EM and 37990030, LOG, EM
BC	Invertebrate		23615000	Order Teuthoidea - undifferentiated	Squids	LOG, EM, added 1 species to list (23636004)
BC	Teleost	Alepisauridae	37128000	Alepisauridae - undifferentiated	Lancetfishes - unspecified	LOG, EM, CDR, 2 existing species in list (37128001, 37128002)
BC	Teleost	Apogonidae, Dinolestidae	37327000	Apogonidae, Dinolestidae - undifferentiated	Cardinalfishes	LOG, CDR, added 1 species to list (37327002)
BC	Teleost	Bramidae	37342000	Bramidae - undifferentiated	Pomfrets - unspecified	LOG, EM, CDR, 4 existing species in list (37342001, 37342002, 37342003, 37342010, added 9 species to list: 37342004, 37342006, 37342007, 37342008, 37342009, 37342011, 37342013, 37342014, 37342015)
BC	Teleost	Carangidae	37337000	Carangidae - undifferentiated	Trevallies and Scads - unspecified	LOG, CDR, 6 existing species in list (37337003, 37337006, 37337007, 37337029, 37337040, 37337072), added 35 species to list (37337005, 37337008, 37337010, 37337011, 37337012, 37337013, 37337014, 37337015, 37337016, 37337017, 37337018, 37337020, 37337021, 37337022, 37337023, 37337024, 37337025, 37337027, 37337028, 37337032, 37337037, 37337039, 37337044, 37337050, 37337052, 37337053, 37337055, 37337056, 37337057, 37337059, 37337060, 37337062, 37337064, 37337068, 37337073)
BC	Teleost	Congridae, Colocongridae	37067000	Congridae, Colocongridae - undifferentiated	Conger eels	LOG, added 2 species to list (37067035, 37067038)

Table 2.26: *(continued)*

Role in Fishery	Taxa	Family Name	CAAB Code	Scientific Name	Common Name	Rationale
BC	Teleost	Diodontidae	37469000	Diodontidae - undifferentiated	Porcupine Fish	LOG, EM, added 7 species to list (37469001, 37469002, 37469007, 37469013, 37469014, 37469015, 37469016)
BC	Teleost	Ephippidae, Drepaneidae	37362000	Ephippidae, Drepaneidae - undifferentiated	Batfishes - unspecified	LOG, added 4 species to list (37362002, 37362003, 37362004, 37362005)
BC	Teleost	Gempylidae	37439914	*Thyrsites* spp.	Barracoutas (mixed)	LOG, EM, 1 existing species in list (37439001)
BC	Teleost	Gempylidae	37439918	Gempylidae - undifferentiated	Gemfishes & Snake Mackerels (mixed)	LOG, 5 existing species in list (37439001, 37439002, 37439003, 37439008, 37439010, added 8 species to list: 37439006, 37439007, 37439009, 37439011, 37439012, 37439013, 37439014, 37439016)
BC	Teleost	Istiophoridae	37444000	Istiophoridae - undifferentiated	Marlins - unspecified	LOG, EM, 5 existing species in list (37444002, 37444003, 37444005, 37444006, 37444007)
BC	Teleost	Lutjanidae	37346914	*Etelis* spp.	Long Tail Rubies/Snapper	CDR, added 2 species to list (37346014, 37346038)
BC	Teleost	Macrouridae, Bathygadidae	37232000	Macrouridae, Bathygadidae - undifferentiated	Whiptails and Rat-tails (mixed)	LOG, added 13 species to list (37232003, 37232004, 37232005, 37232007, 37232016, 37232039, 37232040, 37232041, 37232045, 37232047, 37232062, 37232072, 37232119)
BC	Teleost	Scombridae	37441911	Scombridae spp. (tribes Scomberomorini & Scombrini)	Mackerels (mixed)	LOG, CDR, 2 existing species in list (37441007, 37441014, added 4 species to list: 37441001, 37441012, 37441015, 37441018)
BC	Teleost	Scombridae	37441912	Scombridae spp. (tribes Sardini & Thunnini)	Tuna (mixed)	LOG, EM, CDR, 7 existing species in list (37441002, 37441004, 37441005, 374410011, 374410013, 37441020, 37441026, added 4 species to list: 37441008, 37441010, 37441021, 37441027)
BC	Teleost	Sparidae	37353000	Sparidae - undifferentiated	Breams - unspecified	LOG, EM, 1 existing species in list: 37353003, added 1 species to list (37353001)
BC	Teleost	Sphyraenidae	37382901	*Sphyraena* spp.	Barracudas	LOG, 2 existing species in list (37382001, 37382008, added 5 species to list: 37382003, 37382005, 37382006, 37382007, 37382011)

Table 2.26: *(continued)*

Role in Fishery	Taxa	Family Name	CAAB Code	Scientific Name	Common Name	Rationale
BC	Teleost	Tetraodontidae	37467000	Tetraodontidae - undifferentiated	Toadfishes unspecified	LOG, EM, added 10 species to list (37467004, 37467005, 37467007, 37467008, 37467012, 37467017, 37467018, 37467023, 37467026, 37467033)
BC	Teleost	Trachipteridae	37271000	Trachipteridae - undifferentiated	Ribbonfishes - unspecified	LOG, EM, 1 existing species in list: 37271001, added 2 species to list (37271002, 37271003)
BC	Teleost	Trichiuridae	37440000	Trichiuridae - undifferentiated	Cutlassfishes - unspecified	LOG, EM, 1 existing species in list (37440002, added 8 species to list: 37440001, 37440004, 37440006, 37440011)
BC	Teleost		37990020	Fish Oceanic (mixed)	Fish Oceanic (mixed)	LOG, insufficient taxonomic resolution
BC	Teleost		37999999	Mixed fish	Fish (mixed)	LOG, EM, CDR, insufficient taxonomic resolution
BP	Chondrichthyan	Sphyrnidae	37019000	Sphyrnidae - undifferentiated	Hammerhead Sharks - unspecified	LOG, EM, CDR, 1 existing species in list: 37019004, added 2 species to list (37019001, 37019002)
BP	Teleost	Lampridae	37268900	*Lampris guttatus* & *Lampris immaculatus*	Moonfish (mixed)	LOG, EM, CDR, added 1 species to list (37268001)
PS	Marine bird	Laridae	40128901	Terns - AFMA Observer Code	Terns	AFMA, added 18 species to list (40128001, 40128002, 40128006, 40128007, 40128009, 40128018, 40128022, 40128023, 40128024, 40128025, 40128026, 40128027, 40128028, 40128029, 40128030, 40128032, 40128033, 40128034)
PS	Marine bird	Procellariidae	40041000	Procellariidae - undifferentiated	Petrels and Shearwaters - unspecified	AFMA, added 3 species to list (40041038, 40041042, 40041047). Also in 40041050
PS	Marine bird		40040000	Diomedeidae - undifferentiated	Albatrosses	AFMA, 4 existing species in list (40040002, 40040006, 40040007, 40040008), added 14 species to list (40040001, 40040004, 40040005, 40040009, 40040010, 40040011, 40040012, 40040013, 40040014, 40040015, 40040016, 40040017, 40040018, 40040019)
PS	Marine bird		40041050	*Puffinus* spp. - undifferentiated	Shearwaters	AFMA, added 3 species to list (40041036, 40041040, 40041043). Also in 40041000

Table 2.26: *(continued)*

Role in Fishery	Taxa	Family Name	CAAB Code	Scientific Name	Common Name	Rationale
PS	Marine bird			Avians	Birds	AFMA. Insufficient taxonomic resolution
PS	Marine mammal		41000001	Whales - undifferentiated (order Cetacea, in part)	Whales (mixed)	LOG, 1 existing species in list: 41116003, LOG. Four other whales also exist from species expansion of 41116000 (Delphinidae), 41116003, 41116004, 41116012 and 41116013
PS	Marine mammal		41000002	Toothed whales - undifferentiated (suborder Odontoceti, in part)	Toothed whales	AFMA, insufficient taxonomic resolution
PS	Marine mammal		41116000	Delphinidae - undifferentiated	Dolphins	AFMA, 6 existing species in list (41116001, 41116003, 41116004, 41116012, 41116013, 41116019), added 14 species to list (41116002, 41116005, 41116006, 41116007, 41116008, 41116009, 41116010, 41116011, 41116014, 41116015, 41116016, 41116017, 41116018, 41116020)
PS	Marine mammal		41131000	Otariidae	Seals	AFMA, 2 existing species in list (41131001, 41131003). Added 2 species to list (41131004, 41131005)
PS	Marine mammal			Otariidae and Phocidae	Seals	AFMA - see 41131000
PS	Marine reptile	Cheloniidae, Dermochelyidae	3901001	Order Testudines except family Testunididae	Turtles	LOG, 6 existing species in list (39020001, 39020002, 39020003, 39020004, 39020005, 39021001)

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

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

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

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

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

Key Commercial and Secondary Commercial Species

Core objectives:

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

Table 2.27: Scoping Document S3. Identification of operational objectives and rationale for C1-C2 component. Operational objectives that are eliminated are shaded out. EMO: Existing Management Objective; AMO: Existing AFMA Objective

Sub-component	Example Operational Objectives	Example indicators	Rationale
1. Population size	1.1 No trend in biomass	Biomass, numbers, density, CPUE, yield	1.1 Increases in biomass of the key/secondary commercial species would be acceptable.
	1.2 Maintain biomass above a specified level		1.2. To ensure that population at acceptable level by the assessment.
	1.3 Maintain catch at specified level		1.3. TAC levels are specified.
	1.4 Species do not approach extinction or become extinct		1.4. This is a general objective for all AFMA fisheries as per Fisheries Management Act 1991 (objective (b): ensuring that the exploitation of fisheries resources and the carrying on of any related activities are conducted in a manner consistent with the principles of ecologically sustainable development).
2. Geographic range	2.1 Geographic range of the population, in terms of size and continuity does not change outside acceptable bounds	Presence of population across the known distribution range	2.1 Not currently monitored. No specific management objective based on the geographic range of key/secondary commercial species.

Table 2.27: *(continued)*

Sub-component	Example Operational Objectives	Example indicators	Rationale
3. Genetic structure	3.1 Genetic diversity does not change outside acceptable bounds	Frequency of genotypes in the population, effective population size (Ne), number of spawning units	3.1 Genetic studies have identified multiple stocks of Striped Marlin in Pacific Ocean. Stock assessment split by north and south Pacific Ocean.
4. Age/size/sex structure	4.1 Age/size/sex structure does not change outside acceptable bounds (e.g. more than X% from reference structure)	Biomass, numbers or relative proportion in age/size/sex classes Biomass of spawners Mean size, sex ratio	4.1 Covered in general by 1.2 EMO and AMO. The size range of species suggests that the fishery is not targeting recruitment or spawning grounds.
5. Reproductive Capacity	5.1 Fecundity of the population does not change outside acceptable bounds (e.g. more than X% of reference population fecundity)	Egg production of population Abundance of recruits	5.1 Covered by 1.2 EMO and AMO. Reproductive capacity in terms of egg production may be easier to monitor via changes in Age/size/sex structure.
	5.2 Recruitment to the population does not change outside acceptable bounds		5.2 Covered by 1.2 EMO and AMO. May be easier to monitor via changes in Age/size/sex structure in the fishery.
6. Behaviour /Movement	6.1 Behaviour and movement patterns of the population do not change outside acceptable bounds	Presence of population across space, movement patterns within the population (e.g. attraction to bait, lights)	6.1. Changes to behaviour that are deleterious to the species and populations are to be avoided.

Byproduct and Bycatch

Core objectives:

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

Table 2.28: Scoping Document S3. Identification of operational objectives and rationale for BP-BC component. Operational objectives that are eliminated are shaded out. EMO: Existing Management Objective; AMO: Existing AFMA Objective

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

Table 2.28: ***(continued)***

Sub-component	Example Operational Objectives	Example indicators	Rationale
	1.2 Maintain biomass above a specified level		1.2. To ensure that population at acceptable level by the assessment. Covered by EMO and AMO that ensures the fishery does not threaten bycatch species.
	1.3 Maintain catch at specified level		1.3. TAC levels are specified. EMO/AMO - annual reviews of all information on bycatch species with the aim of developing species specific bycatch limits.
	1.4 Species do not approach extinction or become extinct		1.4. This is a general objective for all AFMA fisheries as per Fisheries Management Act 1991 (objective (b): and mentions specifically non-target species and the long term sustainability of the marine environment.)
2. Geographic range	2.1 Geographic range of the population, in terms of size and continuity does not change outside acceptable bounds	Presence of population across space	2.1 Not currently monitored. No specific management objective based on the geographic range of byproduct/bycatch species.
3. Genetic structure	3.1 Genetic diversity does not change outside acceptable bounds	Frequency of genotypes in the population, effective population size (Ne), number of spawning units	3.1 Not currently monitored. No reference levels established. No specific management objective based on the genetic structure of bycatch species.
4. Age/size/sex structure	4.1 Age/size/sex structure does not change outside acceptable bounds (e.g. more than X% from reference structure)	Biomass, numbers or relative proportion in age/size/sex classes Biomass of spawners Mean size, sex ratio	4.1 EMO – 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.
5. Reproductive Capacity	5.1 Fecundity of the population does not change outside acceptable bounds (e.g. more than X% of reference population fecundity) 5.2 Recruitment to the population does not change outside acceptable bounds	Egg production of population Abundance of recruits	5.1 Beyond the generality of the EMO "Fishing is conducted in a manner that does not threaten stocks of byproduct / bycatch species", reproductive capacity is not currently measured for bycatch/byproduct species and is largely covered by other objectives.

Table 2.28: *(continued)*

Sub-component	Example Operational Objectives	Example indicators	Rationale
6. Behaviour /Movement	6.1 Behaviour and movement patterns of the population do not change outside acceptable bounds	Presence of population across space, movement patterns within the population (e.g. attraction to bait, lights)	6.1 Longlining does not appear to attract bycatch species or alter their behaviour and movement patterns, resulting in the attraction of species to fishing grounds.

Protected Species

Core objectives:

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

Table 2.29: Scoping Document S3. Identification of operational objectives and rationale for PS component. Operational objectives that are eliminated are shaded out. EMO: Existing Management Objective; AMO: Existing AFMA Objective

Sub-component	Example Operational Objectives	Example indicators	Rationale
1. Population size	1.1 Species do not further approach extinction or become extinct	Biomass, numbers, density	1.1 EMO – This is a general objective for all AFMA fisheries as per Fisheries Management Act 1991 objective (1b): ensuring that the exploitation of fisheries resources and the carrying on of any related activities are conducted in a manner consistent with the principles of ecologically sustainable development); and objective (2): ensuring, through proper conservation and management measures, that the living resources of the AFZ are not endangered by over-exploitation; Therefore the fishery is conducted in a manner that avoids mortality of, or injuries to, endangered, threatened or protected species.
	1.2 No trend in biomass	CPUE, yield	1.2 A positive trend in biomass is desirable for protected species.
	1.3 Maintain biomass above a specified level		1.3 Maintenance of protected species biomass above specified levels not currently a fishery operational objective.
	1.4 Maintain catch at specified level		1.4 The above EMO states 'must avoid mortality/injury' to protected species.
2. Geographic range	2.1 Geographic range of the population, in terms of size and continuity does not change outside acceptable bounds	Presence of population across space, i.e. the Southern Ocean	2.1 Change in geographic range of protected species may have serious consequences e.g. population fragmentation and/or forcing species into sub-optimal areas.

Table 2.29: *(continued)*

Sub-component	Example Operational Objectives	Example indicators	Rationale
3. Genetic structure	3.1 Genetic diversity does not change outside acceptable bounds	Frequency of genotypes in the population, effective population size (Ne), number of spawning units	3.1 Because population size of protected species is often small, protected species are sensitive to loss of genetic diversity. Genetic monitoring may be an effective approach to measure possible fishery impacts.
4. Age/size/sex structure	4.1 Age/size/sex structure does not change outside acceptable bounds (e.g. more than X% from reference structure)	Biomass, numbers or relative proportion in age/size/sex classes Biomass of spawners Mean size, sex ratio	4.1 Monitoring the age/size/sex structure of protected species populations is a useful management tool allowing the identification of possible fishery impacts and that cross-section of the population most at risk.
5. Reproductive Capacity	5.1 Fecundity of the population does not change outside acceptable bounds (e.g. more than X% of reference population fecundity) 5.2 Recruitment to the population does not change outside acceptable bounds	Egg production of population Abundance of recruits	5.1 The reproductive capacity of protected species is of concern because potential fishery induced changes in reproductive ability may have immediate impact on the population size of protected species.
6. Behaviour /Movement	6.1 Behaviour and movement patterns of the population do not change outside acceptable bounds	Presence of population across space, movement patterns within the population (e.g. attraction to bait, lights)	6.1 Trawling operations may attract protected species and alter behaviour and movement patterns, resulting in the habituation of protected species to fishing vessels. The overall effect may be to prevent juveniles from learning to fend for themselves therefore increasing the animals' reliance on fishing vessels. Subsequently this could substantially increase the risk of injury/mortality by collision, entrapment or entanglement with a vessel or fishing gear.
7. Interactions with fishery	7.1 Survival after interactions is maximised 7.2 Interactions do not affect the viability of the population or its ability to recover	Survival rate of species after interactions Number of interactions, biomass or numbers in population	7.1, 7.2, EMO – The fishery is conducted in a manner that avoids mortality of, or injuries to, endangered, threatened or protected species. Includes the prohibition on discarding offal (bycatch, fish processing waste, unwanted dead fish), gear restrictions and reduced lighting levels to minimise interactions and attraction of the vessel to protected species.

Habitats

Core objectives:

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

Table 2.30: Scoping Document S3. Identification of operational objectives and rationale for Habitats component. Operational objectives that are eliminated are shaded out. EMO: Existing Management Objective; AMO: Existing AFMA Objective

Sub-component	Example Operational Objectives	Example indicators	Rationale
1. Water quality	1.1 Water quality does not change outside acceptable bounds	Water chemistry, noise levels, debris levels, turbidity levels, pollutant concentrations, light pollution from artificial light	1.1 EMO control the discharge or discarding of waste (fish offal) and limit lighting on the vessels. MARPOL regulations prohibit discharge of oils, discarding of plastics.
2. Air quality	2.1 Air quality does not change outside acceptable bounds	Air chemistry, noise levels, visual pollution, pollutant concentrations, light pollution from artificial light	2.1 Not currently perceived as an important habitat sub-component, trawling operations not believed to strongly influence air quality.
3. Substrate quality	3.1 Sediment quality does not change outside acceptable bounds	Sediment chemistry, stability, particle size, debris, pollutant concentrations	3.1 EMO – General objective for all AFMA fisheries as per Fisheries Management Act 1991 (objective 1b): ensuring that the exploitation of fisheries resources and the carrying on of any related activities are conducted in a manner consistent with the principles of ecologically sustainable development. The fishery is conducted, in a manner that minimises the impact of fishing operations on benthic habitat.
4. Habitat types	4.1 Relative abundance of habitat types does not vary outside acceptable bounds	Extent and area of habitat types, % cover, spatial pattern, landscape scale	4.1 Longlining activities may result in changes to the local habitat types on fishing grounds.
5. Habitat structure and function	5.1 Size, shape and condition of habitat types does not vary outside acceptable bounds	Size structure, species composition and morphology of biotic habitats	5.1 Longlining activities may result in local disruption to pelagic and benthic processes.

Communities

Core objectives:

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

Table 2.31: Scoping Document S3. Identification of operational objectives and rationale for Communities component. Operational objectives that are eliminated are shaded out. EMO: Existing Management Objective; AMO: Existing AFMA Objective

Sub-component	Example Operational Objectives	Example indicators	Rationale
1. Species composition	1.1 Species composition of communities does not vary outside acceptable bounds	Species presence/absence, species numbers or biomass (relative or absolute) Richness Diversity indices Evenness indices	1.1 EMO – General objective for all AFMA fisheries as per Fisheries Management Act 1991 (objective 1b): ensuring that the exploitation of fisheries resources and the carrying on of any related activities are conducted in a manner consistent with the principles of ecologically sustainable development) in particular the need to have regard to the impact of fishing activities on non-target species and the long term sustainability of the marine environment.
2. Functional group composition	2.1 Functional group composition does not change outside acceptable bounds	Number of functional groups, species per functional group (e.g. autotrophs, filter feeders, herbivores, omnivores, carnivores)	2.1 The presence/abundance of 'functional group' members may fluctuate widely, however in terms of maintenance of ecosystem processes it is important that the aggregate effect of a functional group is maintained.
3. Distribution of the community	3.1 Community range does not vary outside acceptable bounds	Geographic range of the community, continuity of range, patchiness	3.1 Pelagic longlining operations have unknown impacts on the benthos in the fishing grounds. The current MPA and conservation areas reserve large areas of the known habitat types from fishing disturbance.
4. Trophic/size structure	4.1 Community size spectra/trophic structure does not vary outside acceptable bounds	Size spectra of the community Number of octaves, Biomass/number in each size class Mean trophic level Number of trophic levels	4.1 Longlining activities for key/secondary commercial species have the potential to remove a significant component of the predator functional group. Increased abundance of the prey groups may then allow shifts in relative abundance of higher trophic level organisms.
5. Bio- and geo- chemical cycles	5.1 Cycles do not vary outside acceptable bounds	Indicators of cycles, salinity, crabon, nitrogen, phosphorus flux	5.1 Longlining operations not preceived to have a detectable effect on bio and geochecmical cycles, but other activities may e.g., aquaculture.

2.2.5 Hazard Identification (Step 4)

Hazards are the activities undertaken in the process of fishing, and any external activities, which have the potential to lead to harm. The effects of fishery/sub-fishery specific hazards are identified under the following categories:

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

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

Scoping Document S4. Hazard Identification Scoring Sheet

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

Fishery name Eastern Tuna and Billfish Fishery - Pelagic longline

Table 2.32: Hazard identification, score (i.e., presence/absence) and rationale(s) for the Eastern Tuna and Billfish Fishery - Pelagic longline.

Direct impact of Fishing	Fishing Activity	Presence (1) Absence (0)	Documentation of Rationale
Capture	Bait collection	1	Coral Sea sector – bait is frozen squid and pilchards (imported). Southern QLD, NSW - Frozen squid and pilchards and live mackerel, and scad. An increasing live bait ratio, although >70% bait used is still frozen stock. Operators choose bait to target specific species (i.e., squid vs live). All operators using live bait self catch; small purse seining occurs inshore for fresh baits. Tasmania – frozen and fresh bait.
	Fishing	1	Occurs, resulting in capture of animals.
	Incidental behaviour	1	Crew may handline or dropline while anchored. Trolling may occur while steaming after line setting.
Direct impact without capture	Bait collection	1	See notes above in same category. Bait collection occurs and could impact species without capture through interactions with the gear and subsequent escape, cryptic mortality.
	Fishing	1	Direct impact without capture is likely, not all fish hooked are retrieved, may fall off hook, or be eaten while on the hook. Longlining is unlikely to impact benthic habitats and animals as the gear does not contact seafloor. Purse-seining for bait may contact the bottom and thus have an impact.
	Incidental behaviour	1	Fish may escape capture while hand-lining in down time. Firearms are present on boats.
	Gear loss	1	Lost gear may interact with animals, including benthic species and habitats.

Table 2.32: ***(continued)***

Direct impact of Fishing	Fishing Activity	Presence (1) Absence (0)	Documentation of Rationale
	Anchoring/ mooring	1	Occurs and when anchoring on seafloor may impact benthic species, suggestion that in oceanic fishing there is little benthic habitat to hook up on, and so boats are not anchored in most of the fishing grounds.
	Navigation/ steaming	1	Occurs throughout the fishery grounds.
Addition/ movement of biological material	Translocation of species	1	Reballasting or use of brine tanks for stability may result in discharge of water at sea. Movement of species due to movement of boats between areas of the fishery is a possibility. Quarantine of a boat with green crab infestation is a past example. Quarantine regulations involving use of imported baits.
	On board processing	1	Heading and gutting – some of the catch is cleaned at sea and discarded.
	Discarding catch	1	Target and byproduct species are occasionally discarded. Commercial fish are damaged by shark and discarded, while small fish <12 - 15 kg Bigeye and Yellowfin Tuna are discarded; these are often alive. Bycatch species are discarded.
	Stock enhancement	0	Does not occur in this fishery
	Provisioning	1	Bait is used in the fishery, sometimes berley, this may be lost from the hooks, or captured fish may be taken from the line by toothed whales, dolphins and sharks.
	Organic waste disposal	1	Food scraps etc., from fishing fleet are discarded at sea.
Addition of non-biological material	Debris	1	Debris from the fishing process: cardboard gets thrown over from bait boxes, light sticks lost from lines (although some lights can be reused), straps and netting bags are kept on board. Debris from non-fishing activities e.g., Crew rubbish – discarding regulations, plastics must be retained under MARPOL Convention.
	Chemical pollution	1	MARPOL regulations via Protection of the Sea (Prevention of Pollution from Ships) Act 1983 prohibits domestic and operational waste discharge from vessels. Leakage of substances such as fuel, oil, bilge discharges, natural decay of antifouling agents may occur in normal course of operations. Also, possible oil spills, detergents, other cleaning agents or chemicals.

Table 2.32: *(continued)*

Direct impact of Fishing	Fishing Activity	Presence (1) Absence (0)	Documentation of Rationale
	Exhaust	1	Occurs through steaming and engine operations.
	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. Loss of hooks is regular, light sticks are also lost, but New light stick clip improvements means less light sticks lost overboard. Line may be lost infrequently, if so fishers try and retrieve it. Every discard including some line and hook may remain after organic component breaks down. Quantity uncertain, depending on the amount of discarding.
	Navigation/ steaming	1	Navigation to and from fishing grounds introduces noise and visual stimuli into the environment. A vessel is in the water as a part of regular fishing activity.
	Activity/ presence on water	1	Vessel introduces noise and visual stimuli into the environment. Noise and movement, visual stimuli may be a cue to some species attracting them to the vessel or a part of the fishing operation.
Disturb physical processes	Bait collection	1	Possible that if gear contacts the seafloor it may disturb sediment, only in shallow water, as nets for bait collection via purse seining are shallow.
	Fishing	1	Fishing gear may mix the water column, as does boat movement during regular operations.
	Boat launching	0	Not applicable. Vessels in fishery come from designated ports. Occurs in marinas and ports which are outside the scope of the ERAEF.
	Anchoring/ mooring	1	May have a localized effect on sediment, anchoring only occurs on the shelf in shallow waters.
	Navigation/ steaming	1	Has potential to mix waters, disturb sediments in shallow locations.
External Hazards	Other capture fishery methods	1	Other fisheries operate in the same region, e.g., Skipjack, SBT, SPF, WCPO Tuna fisheries, recreational fisheries, State inshore fisheries (NSW).
	Aquaculture	0	No operations that are known to interfere with this fishery or the species targeted.
	Coastal development	1	There are major coastal development along Australia's east coast. However, given this is an offshore fishery, assumed to be independent from coastal activities.
	Other extractive activities	1	Fishery covers a large area there are activities such as oil and gas exploration in the eastern Bass Strait that may be close to the shelf where fishing occurs.

Table 2.32: *(continued)*

Direct impact of Fishing	Fishing Activity	Presence (1) Absence (0)	Documentation of Rationale
	Other non-extractive activities	1	Fishery covers a large area examples of activities includes use by the navy (live ammunition testing). Commercial shipping also common throughout the region.
	Other anthropogenic activities	1	Fishery covers a large area wide range of uses and so activities like whale watching and recreational boating may cause impacts in the same region. Probably too far offshore for overlap with the majority of other anthropogenic activities.

2.2.6 Bibliography (Step 5)

All references used in the scoping assessment are included in the References section. Key documents can be found on the AFMA web page at www.afma.gov.au and include the following:

- Assessment Reports: see Table 0.3 and references within.
- Management Plan https://www.legislation.gov.au/Details/F2011L00120
- Management Regulations: https://www.legislation.gov.au/Series/F2019L00383
- Management Plan and Regulation Guidelines
- AFMA At a glance web page https://www.afma.gov.au/fisheries/eastern-tuna-and-billfish-fishery
- Bycatch and Discard Workplan
- Australian Tuna and Billfish Fisheries Bycatch and Discarding Workplan 1 July 2014-30 June 2016 https://www.afma.gov.au/sites/default/files/2023-02/Australian%20Tuna%20and%20Billfish%20Fisheries%20Bycatch%20and%20Discard%20Workplan.pdf
- Ecological Risk Management Report (AFMA, 2012)
- Ecological Risk Assessment Report (Sporcic et al., 2019)

Other publications that provided information include:

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

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

2.2.7 Decision Rules to Move to Level 1 (Step 6)

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

In this case, 24 out of 26 possible internal activities were identified as occurring in this fishery. Five out of six external activities were identified. Thus, a total of 29 activity-component scenarios will be considered at Level 1. This results in 145 total scenarios (of 160 possible) to be developed and evaluated using the unit lists (species, habitats, communities).

3 Level 1: Scale, Intensity and Consequence Analysis (SICA)

Level 1 aims to identify which hazards lead to a significant impact on any species, habitat or community. Analysis at Level 1 is for whole components (key and secondary; bycatch and byproduct; protected species; habitats; and communities), not individual sub-components. Since Level 1 is used mainly as a rapid screening tool, a "worst case" approach is used to ensure that elements screened out as low risk (either activities or components) are genuinely low risk. Analysis at Level 1 for each component is accomplished by considering the most vulnerable sub-component and the most vulnerable unit of analysis (e.g., most vulnerable species, habitat type or community). This is known as credible scenario evaluation (Richard Stocklosa e-systems Pty Ltd (March 2003) Review of CSIRO Risk Assessment Methodology: ecological risk assessment for the effects of fishing) in conventional risk assessment. In addition, where judgments about risk are uncertain, the highest level of risk that is still regarded as plausible is chosen. For this reason, the measures of risk produced at Level 1 cannot be regarded as absolute.

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

- Step1. Record the hazard identification score (absence (0) presence (1) scores) identified at step 3 at the scoping level (Scoping Document S3) onto the SICA table
- Step 2. Score spatial scale of the activity
- Step 3. Score temporal scale of the activity
- Step 4. Choose the sub-component most likely to be affected by activity
- Step 5. Choose the most vulnerable unit of analysis for the component e.g., species, habitat type or community assemblage
- Step 6. Select the most appropriate operational objective
- Step 7. Score the intensity of the activity for that sub-component
- Step 8. Score the consequence resulting from the intensity for that sub component
- Step 9. Record confidence/uncertainty for the consequence scores
- Step 10. Document rationale for each of the above steps
- Step 11. Summary of SICA results
- Step 12. Evaluation/discussion of Level 1
- Step 13. Components to be examined at Level 2

3.1 Record the Hazard Identification Score (Absence (0) Presence (1) Scores) Identified at Step 3 in the Scoping Level onto the SICA Document (Step 1)

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

3.2 Score Spatial Scale of Activity (Step 2)

The greatest spatial extent must be used for determining the spatial scale score for each identified hazard (Table 3.1). For example, if fishing (e.g., capture by longline) takes place within an area of 200 nm by 300 nm, then the spatial scale is scored as 4. The score is then recorded onto the SICA Document and the rationale documented.

Table 3.1: Spatial scale score of activity.

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

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

3.3 Score Temporal Scale of Activity (Step 3)

The highest frequency must be used for determining the temporal scale score for each identified hazard (Table 3.2). If the fishing activity occurs daily, the temporal scale is scored as 6. If oil spillage occurs about once per year, then the temporal scale of that hazard scores a 3. The score is then recorded onto the SICA Document and the rationale documented.

Table 3.2: Temporal scale score of activity.

Decadal	Every several years	Annual	Quarterly	Weekly	Daily
(1 day every 10 years or so)	(1 day every several years)	(1-100 days per year)	(100-200 days per year)	(200-300 days per year)	(300-365 days per year)
1	2	3	4	5	6

It may be more logical for some activities to consider the aggregate number of days that an activity occurs. For example, if the activity "fishing" was undertaken by 10 boats during the same 150 days of the year, the score is 4. If the same 10 boats each spend 30 non-overlapping days fishing, the temporal scale of the activity is a sum of 300 days, indicating that a score of 6 is appropriate. In the case where the activity occurs over many days, but only every 10 years, the number of days by the number of years in the cycle is used to determine the score. For example, 100 days of an activity every 10 years averages to 10 days every year, so a score of 3 is appropriate.

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

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

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

3.5 Choose the Unit of Analysis Most Likely to be Affected by Activity and to Have Highest Consequence Score (Step 5)

The most vulnerable 'unit of analysis' (i.e., most vulnerable species, habitat type or community) must be used for the analysis of each identified hazard. The species, habitats, or communities (depending on which component is being analysed) are selected from **Scoping Document S2 (A – C)**. This selection must be made

on the basis of the expected highest potential risk for each 'direct impact of fishing' and 'fishing activity' combination, and recorded in the 'unit of analysis' column of the SICA Document. The justification is recorded in the rationale column.

3.6 Select the Most Appropriate Operational Objective (Step 6)

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

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

The score for the intensity of an activity considers the direct impacts in line with the categories shown in the conceptual model (Figure 1.2: capture, direct impact without capture, addition/movement of biological material, addition of non-biological material, disturbance to physical processes, external hazards). The intensity of the activity is judged based on the scale of the activity, its nature and extent. Activities are scored as per intensity scores in Table 3.3.

Table 3.3: Intensity score of activity (Modified from Fletcher et al., 2002).

Level	Score	Description
Negligible	1	Remote likelihood of detection at any spatial or temporal scale
Minor	2	Occurs rarely or in few restricted locations and detectability even at these scales is rare
Moderate	3	Moderate at broader spatial scale, or severe but local
Major	4	Severe and occurs reasonably often at broad spatial scale
Severe	5	Occasional but very severe and localized or less severe but widespread and frequent
Catastrophic	6	Local to regional severity or continual and widespread

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

3.8 Score the Consequence of Intensity for that Component (Step 8)

The consequence of the activity is a measure of the likelihood of not achieving the operational objective for the selected sub-component and unit of analysis. It considers the flow-on effects of the direct impacts from Step 7 for the relevant indicator (e.g., decline in biomass below the selected threshold due to direct capture). Activities are scored as per consequence scores defined in Table 3.4. A more detailed description of the consequences at each level for each component (key/secondary commercial, bycatch and byproduct, protected species, habitats, and communities) is provided as a guide for scoring the consequences of the activities in the description of consequences table (see Tables B.1 to B.5 in Appendix B).

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

Table 3.4: Consequence score for ERAEF activities (Modified from Fletcher et al., 2002).

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

3.9 Record Confidence/Uncertainty for the Consequence Scores (Step 9)

The information used at this level is qualitative and each step is based on expert (fishers, managers, conservationists, scientists) judgment. The confidence rating for the consequence score is rated as 1 (low confidence) or 2 (high confidence) for the activity/component (Table 3.5). The score is recorded on the SICA Document and the rationale documented. The confidence will reflect the levels of uncertainty for each score at steps 2, 3, 7 and 8.

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

Confidence	Score	Rationale for the confidence score
Low	1	Data exists, but is considered poor or conflicting No data exists Disagreement between experts
High	2	Data exists and is considered sound Consensus between experts Consequence is constrained by logical consideration

3.10 Document Rationale for Each of the Above Steps (Step 10)

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

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

3.10.1 Key/Secondary Commercial Species Component

Table 3.6: Level 1 (SICA) Document L1.1
Key commercial/secondary commercial species. Commercial bait species are also included here.

Direct impact of fishing	Fishing Activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
Capture	Bait collection	1	4	5	Population size	Yellowtail Scad (*Trachurus novaeze-landiae*); Blue Mackerel (*Scomber australasi-cus*)	1.1, 1.3, 1.4	3	2	2	Bait fishing for live bait is restricted to inshore locations, by small purse seining. Intensity: moderate, reflects the scale at which bait fishing occurs. Consequence: minor, as the population of baitfish species is monitored by reported catch as a requirement of state licence, and AFMA. Confidence: high, constrained by logical consideration.

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

Direct impact of fishing	Fishing Activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
	Fishing	1	6	6	Population size	Striped Marlin (*Kajikia audax*); Broadbill Sword-fish;Swordfish (*Xiphias gladius*); Yellowfin Tuna (*Thunnus albacares*)	1.1, 1.3, 1.4	3			There are no key or secondary commercial species that are not assessed as part of the Western Central Pacific Ocean (WCPO) stock assessment program. It is notable that STM and SWO are subject harvest strategies and recent Research Group Assessment (RAG) meetings have considered the WCPO overfishing of Striped Marlin (STM) and the declining Australian catches as a possible trigger to re-examine the Management Strategy Evaluation (MSE) and Harvest Strategy (HS) for this species, but this action has not yet been triggered. Consequence and confidence not assessed due to the existence of regional WCPO stock assessments for each of these species. No further action is required for this activity.

Table 3.6: *(continued)*

Direct impact of fishing	Fishing Activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
	Incidental behaviour	1	6	6	Population size	Yellowfin Tuna (*Thunnus albacares*); Southern Bluefin Tuna (*Thunnus maccoyii*); Broadbill Sword-fish;Swordfish (*Xiphias gladius*)	1.1, 1.3, 1.4	1	1	2	Recreational fishing for key commercial and secondary commercial species such as Yellowfin Tuna or other bait fishing considered to be non-existent or so minor compared with commercial fishing levels, however international interest in the recreational catch of SBT has increased as the stock continues to refill into the southern margins of the ETBF. Intensity: negligible, remote likelihood of detection at any spatial-temporal scale. Consequence: negligible, impact unlikely to be detectable at the scale of each stock. Confidence high, constrained by logical consideration.
Direct impact without capture	Bait collection	1	4	5	Behaviour / Movement	Blue Mackerel (*Scomber australasi-cus*); Yellowtail Scad (*Trachurus novaeze-landiae*)	6.1	1	2	1	Bait fishing for live bait is restricted to inshore locations, by small Purse Seining. Attraction of predator species to the area where baitfish are escaping is unlikely, may lead to some dispersal of schools due to baiting activities. Intensity: negligible, remote likelihood of detection at any spatial-temporal scale. Consequence: minor, minimal impact on each stock. Confidence: low, due to lack of data, information, expertise.

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

Direct impact of fishing	Fishing Activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
	Fishing	1	4	5	Population size	Bigeye Tuna (*Thunnus obesus*); Yellowfin Tuna (*Thunnus albacares*)	1.1, 1.3, 1.4	1	1	1	Escaping key commercial species such as Bigeye Tuna are not expected to die as a result of hook ingestion, thus impacts on population size minimal. Intensity: negligible, remote likelihood of detection at any spatial-temporal scale. Consequence: negligible, impact unlikely to be detectable at the scale of each stock. Confidence: low, the amount of escaping of key commercial species is not well known.
	Incidental behaviour	1	6	5	Behaviour / Movement	Yellowfin Tuna (*Thunnus albacares*); Albacore (*Thunnus alalunga*)	6.1	1	1	2	This species used as an example of the key commercial species that may be targeted by incidental behaviour. Fishing could cause a school to aggregate around bait or disperse, but those that are not caught are likely to return to normal behaviour quickly. Intensity: negligible, remote likelihood of detection at any spatial-temporal scale. Consequence: negligible, as impact considered unlikely to be detectable at the scale of each stock. Confidence: high, constrained by logical consideration.
	Gear loss	1	6	6	Population size	Yellowfin Tuna (*Thunnus albacares*); Bigeye Tuna (*Thunnus obesus*)	1.1, 1.3, 1.4	1	1	2	Gear loss rarely occurs. Lost gear resulting in damage/ mortality most likely to affect population size of this species. Intensity: negligible, remote likelihood of detection at any spatial-temporal scale. Consequence: negligible, as impact considered unlikely to be detectable at the scale of each stock. Confidence: high, because it is known that very little gear is lost, and if so, most are retrieved (AFMA Observer, pers. comm.).

Table 3.6: *(continued)*

Direct impact of fishing	Fishing Activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
	Anchoring/ mooring	1	5	5	Behaviour / Movement	Blue Mackerel (*Scomber australasicus*); Yellowtail Scad (*Trachurus novaezelandiae*)	6.1	1	1	2	Anchoring only takes place in shallow waters. Very unlikely that these species would be adversely affected by the process of anchoring or mooring. Intensity: negligible, as the likelihood of detection of direct interaction with anchoring/ mooring lines is unlikely. Consequence: negligible, as impact considered unlikely to be detectable at the scale of this stock. Confidence: high, logical consideration of interaction.
	Navigation/ steaming	1	6	6	Population size	Yellowfin Tuna (*Thunnus albacares*)	1.2	1	1	1	This key commercial species is not known for reacting to vessels and/ or following them or changing behaviour in response to them. Intensity: negligible, remote likelihood of detection. Consequence: negligible, impact unlikely to be detectable at the scale of the stock. Confidence: low, no information.
Addition/ movement of biological material	Translocation of species	1	6	6	Population size	Southern Bluefin Tuna (*Thunnus maccoyii*)	1.3	2	2	1	Translocation of species can have major effects on local communities through imported bait, i.e., the introduction of an exotic pathogen in frozen imported bait. SBT are known the eat bait species such as slimy mackerel in the GAB. The population size of SBT may reduce should they eat diseased bait. Bait and foreign feed usage needs to be carefully monitored. Intensity: minor, dependent on targeting and bait usage, restricted spatially and temporally to SBT habitat. Consequence: minor, minimal impact on population size of this stock. Confidence: low, no information.

Table 3.6: *(continued)*

Direct impact of fishing	Fishing Activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
	On board processing	1	6	6	Behaviour / Movement	Yellowfin Tuna (*Thunnus albacares*)	6.1	3	1	1	This species is not known to follow vessels such that they could respond and feed on materials processed on board. Yellowfin Tuna considered the most likely of an unlikely set of species. This requires further investigation but plausible. Intensity: moderate, at a broader spatial scale. Consequence: negligible, impact unlikely to be detectable at the scale of the stock. Confidence: low, due to lack of direct observations and data.
	Discarding catch	1	6	6	Behaviour / Movement	Yellowfin Tuna (*Thunnus albacares*)	6.1	2	1	2	This species is not known to follow vessels to feed on materials processed on board. Yellowfin Tuna considered the most likely of an unlikely set of species. Main discards are unlikely to affect the behaviour/ movement of Yellowfin Tuna. This requires further investigation but is plausible. Intensity: minor. Consequence: negligible, impact unlikely to be detectable at the scale of the stock. Confidence: high, due to logical consideration.
	Stock enhancement	0									
	Provisioning	1	6	6	Behaviour / Movement	Yellowfin Tuna (*Thunnus albacares*)	6.1	1	1	2	Provisioning occurs through bait lost during manual or automatic baiting. This species is not known to feed on lost baits from the vessel. Yellowfin Tuna considered the most likely of an unlikely set of species. Intensity: negligible, detection is likely to be remote. Consequence: negligible, impact on the behaviour and movement of these fish is considered unlikely. Confidence: high, due to logical consideration.

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

Direct impact of fishing	Fishing Activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
	Organic waste disposal	1	6	6	Behaviour / Movement	Yellowfin Tuna (*Thunnus albacares*)	6.1	1	1	2	Vessels adhere to MARPOL regulations. Disposal of organic waste (e.g., some food scraps or dishwashing detergent) may have a minor risk on the behaviour and movement of Yellowfin Tuna via attraction (food scraps) or repulsion (raw sewage). Impact is considered negligible because although the hazard is considered over a large range, each disposal unit is considered to effect only a small area (<1nm^2). Given that this species is highly mobile, strong avoidance ability is expected. Thus any impact on the behaviour and movement of these fish considered remote. Intensity: negligible, due to unlikely and unobserved behaviours. Consequence: negligible, impact unlikely to be detectable at the scale of the stock. Confidence: high due to logical consideration.
Addition of non-biological material	Debris	1	6	6	Population size	Bigeye Tuna (*Thunnus obesus*)	1.1, 1.3, 1.4	1	1	2	Bigeye Tuna may be the most likely species to interact with debris, through ingestion of light-sticks discarded as gear is recovered. Intensity: negligible, remote likelihood of detection at any spatial or temporal scale. Consequence: negligible, even if widespread, the impact on population size (i.e., mortality) is unlikely to be detectable at the scale of the stock. The reported rate of debris loss is low. Confidence: high, logical consideration.

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

Direct impact of fishing	Fishing Activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
	Chemical pollution	1	6	6	Behaviour / Movement	Blue Mackerel (*Scomber australasicus*); Yellowtail Scad (*Trachurus novaezelandiae*)	6.1	1	2	1	Chemical pollution is considered likely to occur when vessels are in shallow water anchored up, and cleaning of the vessel is underway, thus impacts on the bait species that inhabit coastal waters is more likely than for the pelagic key/ secondary commercial species. These species may be attracted to chemical slicks in the water. Intensity: negligible, given vessels small foot print at the scale of the pelagic habitat. Consequence: minor, minimal impact on behaviour/ movement of stock. Confidence: low, no real information or logical consideration.
	Exhaust	1	6	6	Behaviour / Movement	Yellowfin Tuna (*Thunnus albacares*); Southern Bluefin Tuna (*Thunnus maccoyii*)	6.1	1	1	2	While the potential for chemicals (i.e., oil and petrol contaminants) to enter the environment from vessels is acknowledged, most cleaning and painting does not occur at sea, and dilution quickly reduces the impact of any materials entering the open sea. Intensity: negligible, remote likelihood of detection at any spatial-temporal scale, i.e., the scale of the vessels emissions to the pelagic environment. Consequence: negligible, for population size of this species considered. Confidence: low, due to lack of data. However, pelagic predators at the top of the food chain bioaccumulate toxins from lower trophic levels, so any contaminants are magnified in these key and secondary target species. Indirect impacts of broader petrochemical extraction, use and emissions and the associated contribution to ocean warming and acidification are noted - particularly when the waters of the ETBF have been identified as a global hotspot for both processes.

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

Direct impact of fishing	Fishing Activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
	Gear loss	1	6	6	Population size	Yellowfin Tuna (*Thunnus albacares*)	1.2	1	2	2	Fishery management plan requires that operators take all reasonable steps to minimise gear loss. If a line breaks off, it generally is retrieved by hauling from the other end, without substantial loss to the gear. Intensity: negligible, remote likelihood of detection at any spatial-temporal scale. Consequence: minor, double break-offs are rare for experienced skippers. Confidence: high, logical consideration.
	Navigation/ steaming	1	6	6	Behaviour / Movement	Yellowfin Tuna (*Thunnus albacares*)	6.1	1	1	1	Navigation/ steaming by introducing noise into the environment is not believed to be an issue for this species. Yellowfin Tuna considered as the most vulnerable, because they are surface orientated, and noise may interfere with their orientation of school forming behaviour. Intensity: negligible, remote likelihood of detection at any spatial-temporal scale. Consequence: negligible, impact unlikely to be detectable at the scale of the stock. Confidence: low, and no reasonable alternative scenarios can be provided.
	Activity/ presence on water	1	6	6	Behaviour / Movement	Yellowfin Tuna (*Thunnus albacares*)	6.1	1	1	1	Activity not believed to be an issue for this species. Yellowfin Tuna considered most vulnerable, because they are surface orientated, but any short-term disturbance unlikely to change behaviour and movement. Intensity: negligible, remote likelihood of detection at any spatial-temporal scale. Consequence: negligible, impact unlikely to be detectable at the scale of the stock. Confidence: low, cannot be evaluated without data.

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

Direct impact of fishing	Fishing Activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
Disturb physical processes	Bait collection	1	4	5	Behaviour / Movement	Yellowtail Scad (*Trachurus novaeze-landiae*); Blue Mackerel (*Scomber australasi-cus*)	6.1	1	2	2	Disruption of the sediments may occur when bait fishing is undertaken through the contact of Purse Seine nets with the bottom. This may create feeding opportunities for the bait species, and thus aggregate them, or resuspend materials that reduce the ability to detect predators. Intensity: negligible, the scale of this relative to natural disturbance is unlikely to be detected at any spatial-temporal scale. Consequence: minor, minimal impact on the behaviour/ movement of the stock. Confidence: high, due to logical consideration.
	Fishing	1	6	6	Population size	Striped Marlin (*Kajikia audax*)	6.1	1	2	1	The gear is heavily weighted at both ends so there could be a disturbance and damage to benthic habitat including sediments, which may affect physical processes. Also, recovering or deploying gear may disrupt the warm surface layer that marlins bask in. The detection of such effects is considered to be almost impossible. Intensity: negligible, remote likelihood of detection at any spatial-temporal scale. Consequence: minor, minimal impact on population size of stock. Confidence: low, no data.
	Boat launching	0									

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

Direct impact of fishing	Fishing Activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
	Anchoring/ mooring	1	5	5	Behaviour / Movement	Yellowtail Scad (*Trachurus novaeze-landiae*); Blue Mackerel (*Scomber australasi-cus*)	6.1	1	2	2	Disruption of the sediments may occur anchoring through the contact with the bottom. This may re-suspend materials that reduce the ability to detect predators. Intensity: negligible, remote likelihood of detection at any spatial-temporal scale. Consequence: minor, minimal impact on behaviour/ movement of stocks. Confidence: high (AFMA Observer Program).
	Navigation/ steaming	1	6	6	Behaviour / Movement	Yellowfin Tuna (*Thunnus albacares*)	6.1	1	1	2	Disruption of the surface waters through steaming may result in mixing that enhances local productivity. Intensity: negligible, remote likelihood of detection at any spatial-temporal scale. Consequence: negligible, impact unlikely to be detectable at the scale of the stock and disturb physical processes. Confidence: high, due to logical consideration.
External Impacts	Other fisheries	1	5	6	Population size	Striped Marlin (*Kajikia audax*)	1.2	4	4	1	Striped Marlin stocks are considered to be overfished (locally and international waters). The impact of that level of fishing from other fisheries is believed to have an influence on the population size. The level of catch is known from assessments with some confidence. Fishing mortality by recreational fishing is considered minor as these are controlled by bag limits. Intensity: major, could be severe and occurs reasonably often at broad spatial scale. Consequence: major, given the scale of the activity. Confidence: low, uncertain of interactions and long term cumulative impacts.
	Aquaculture	0									

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

Direct impact of fishing	Fishing Activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
	Coastal development	1	5	6	Behaviour / Movement	Blue Mackerel (*Scomber australasicus*); Yellowtail Scad (*Trachurus novaezelandiae*)	6.1	2	2	1	Both large and small centres along the coast and ongoing coastal development is likely to have minor impact as the fishery operates offshore and most stocks are offshore, well away from these developments. Sewage outfall is considered to be minor given the level of ocean mixing. This outfall may increase in primary productivity and attract the species. Intensity: minor. Consequence: minor, given the scale of the activity. Confidence: low, little data on cumulative impacts.
	Other extractive activities	1	5	6	Behaviour / Movement	Striped Marlin (*Kajikia audax*)	6.1	1	2	1	Ongoing oil and gas exploration by seismic survey and expansion of pipelines in Bass Strait may affect the behaviour and movement of the key/ secondary commercial species in this fishery. Striped Marlin considered most vulnerable in Australian waters as this species is overfished. However, fishing does not occur in Bass Strait and therefore such an activity is unlikely to impact this species. Intensity: negligible. Consequence: minor, due to the footprint of extractive activities relative to pelagic species habitats. Confidence: low, as information on cumulative impacts due to seismic surveys is unclear(Thomson et al., 2014).
	Other non extractive activities	1	6	6	Behaviour / Movement	Striped Marlin (*Kajikia audax*)	6.1	1	2	1	Ongoing shipping, naval activities and ocean dumping is likely to have minor effects on the movement and behaviour of this species. Intensity: negligible, remote detection at any spatial-temporal scale. Consequence: minor, minimal impact on behaviour/ movement of stock. Confidence: low, little information on potential effects.

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

Direct impact of fishing	Fishing Activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
	Other anthropogenic activities	1	4	5	Behaviour / Movement	Striped Marlin (*Kajikia audax*)	6.1	2	2	1	Major shipping routes, tourism, recreational boating and oil spills are likely to have minor effects on the behaviour and movement of this species. These effects are considered to be localized and only impact a small proportion of the population. Intensity: minor, could impact a wide range. Consequence: minor, minimal impact on behaviour/ movement of stock. Also, restricted area rare event short term effects. Confidence low, limited information.

3.10.2 Byproduct/Bycatch Species Component

Table 3.7: Level 1 (SICA) Document L1.2 - Byproduct and Bycatch Component.

Direct impact of fishing	Fishing Activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
Capture	Bait collection	1	4	5	Population size	Bronze Whaler (*Carcharhinus brachyurus*)	1.1, 1.3, 1.4	3	2	1	Bronze whalers attracted to burley. The inshore sharks may by captured during baited sets and captured. Intensity: moderate, occurs at broader spatial scale, or severe but local. Consequence: minor, given the potential for injury through entanglement with seine gears. Confidence: low, lack of data.

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

Direct impact of fishing	Fishing Activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
	Fishing	1	6	6	Population size	Dusky Shark; Dusky Whaler (*Carcharhinus obscurus*); Bronze Whaler (*Carcharhinus brachyurus*); Smooth Hammerhead (*Sphyrna zygaena*)	1.1, 1.3, 1.4	3	3	2	These identified shark species are all considered near threatened in the most recent FRDC report cards. Also considering the > 600 t of shark species identified at a higher taxonomic group level, including Whaler species (https:// www.fish.gov.au/ docs/ SharkReport/ FRDC*Carcharhinus*obscurus.pdf), Smooth Hammerhead (https:// fish.gov.au/ docs/ SharkReport/ FRDC*Sphyrna*zygaena.pdf) and Tiger Shark (https:// fish.gov.au/ docs/ SharkReport/ 2023*FRDC*Galeocerdo*cuvier*final.pdf) the bycatch of all shark species is of considerable concern. Intensity: moderate, occurs at broader spatial scale, or severe but local. Consequence: moderate, given the number of recorded interactions with these species, their survivorship and population characteristics. Confidence: high, given the research in other areas of the Pacific regarding shark interactions with longline gears.

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

Direct impact of fishing	Fishing Activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
	Incidental behaviour	1	6	6	Population size	Blue Shark (*Prionace glauca*); Blue Marlin (*Makaira nigricans*); Black Marlin (*Istiompax indica*)	1.1, 1.3, 1.4	1	2	2	These species are examples of byproduct species that may be targeted by recreational fishing from trolling or handlining during crew down-time. The substantial catch of Blue Shark (~2000 t & >80000 animals) within this assessment period is notable particularly with the global concern for the species and the average trip catch approaching the suggested trip limit (https:// fish.gov.au/ docs/ SharkReport/ 2023*FRDC*Prionace*glauca*final.pdf). Blue Marlin and Black Marlin are not permitted to be landed in the ETBF. There are reasonable discards each year, which has increased from the previous ERAEF (Sporcic et al., 2019). There is a spawning aggregation off the Great Barrier Reef (Domeier & Speare, 2012). Intensity: negligible, remote likelihood of detection at any spatial-temporal scale. Consequence: minor, given the likely scale of impact on each species given what is known about the population biology and dynamics of these species through assessment methods (IOTC, 2020; ISC21, 2021; Punt et al., 2015). Confidence: high, as the population size of the Black Marlin is uncertain and only part of the Indian Ocean stock overlays the ETBF (IOTC, 2020; Parker et al., 2018), while the population of Blue Marlin is not overfished and likely not subject to overfishing based on MSY reference points (ISC21, 2021). Blue Shark population assessment in WCPO in 2022 suggests that population is not currently overfished, although this is accompanied with numerous caveats regarding the need for more research on this species and the effects of fishing (Neubauer et al., 2022, https:// meetings.wcpfc.int/ node/ 12552).

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

Direct impact of fishing	Fishing Activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
Direct impact without capture	Bait collection	1	4	5	Behaviour / Movement	Bronze Whaler (*Carcharhinus brachyurus*)	6.1	1	2	1	This inshore shark species (depth range <100 m) may be entangled and then escape with injuries. Intensity: negligible, remote likelihood of detection at any spatial-temporal scale. Consequence: minor, minimal impact on each stock. Confidence: low, no information of this type of interaction with purse seine nets.
	Fishing	1	4	5	Population size	Bronze Whaler (*Carcharhinus brachyurus*); Dusky Shark; Dusky Whaler (*Carcharhinus obscurus*); Smooth Hammerhead (*Sphyrna zygaena*)	1.2	1	3	1	These identified shark species are all considered to be the most vulnerable as they are classified as near threatened in the most recent FRDC report cards. Also considering the > 600 t of poorly identified shark species, including Whaler species (https:// www.fish.gov.au/ docs/ SharkReport/ FRDC*Carcharhinus*obscurus.pdf), Smooth Hammerhead (https:// fish.gov.au/ docs/ SharkReport/ FRDC*Sphyrna*zygaena.pdf) and Tiger Shark (https:// fish.gov.au/ docs/ SharkReport/ 2023*FRDC*Galeocerdo*cuvier*final.pdf) the bycatch of all shark species is of considerable concern. Note the greatest number of bycatch by weight (> 1900 t) and number (>8000 animals) was the Blue Shark, which although is listed as sustainable in Australian waters, is considered near threatened globally. Post catch survival after interaction with longline gear varies between species and interaction type. Nylon leaders used by ETBF and dehookers increases survival, but does not reduce mortality to zero (Hutchinson et al., 2021). Intensity: negligible, remote likelihood of detection at any spatial-temporal scale. Consequence: moderate given the number of shark interactions observed in the fishery for these species and their Australian and global status. Confidence: low, due to lack of Tasman and Coral sea studies specific to ETBF.

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

Direct impact of fishing	Fishing Activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
	Incidental behaviour	1	6	5	Population size	Blue Shark (*Prionace glauca*)	1.1, 1.3, 1.4	1	1	1	This species may be captured during trolling or hand lining within its depth range to 1000 m, but little impact expected. Intensity: negligible, remote likelihood of detection at any spatial-temporal scale. Consequence: negligible, given the likely scale of the impact. Confidence: low, due to lack of data. Note the greatest number of bycatch by weight (> 1900 t) was the Blue Shark, which although is listed as sustainable in Australian waters, is considered near threatened globally.
	Gear loss	1	6	6	Population size	Dusky Shark; Dusky Whaler (*Carcharhinus obscurus*); Bronze Whaler (*Carcharhinus brachyurus*)	1.1, 1.3, 1.4	1	1	2	Loss of gear may lead to ghost fishing, as it drifts lower to the bottom, or in inshore regions, might capture sharks, such as the Dusky Whaler or Bronze Whaler. Ghost fishing considered rare for this gear, and gear is recovered if fitted with radio beacons. Intensity: negligible, remote likelihood of detection at any spatial-temporal scale. Consequence: negligible, given the scale of the likely impact. Confidence: high, because it is known that very little gear is lost, and if so, most are retrieved (AFMA Observer, pers. comm.).

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

Direct impact of fishing	Fishing Activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
	Anchoring/ mooring	1	5	5	Behaviour / Movement	Dusky Shark; Dusky Whaler (*Carcharhinus obscurus*); Bronze Whaler (*Carcharhinus brachyurus*); Smooth Hammerhead (*Sphyrna zygaena*)	6.1	1	1	2	Anchors may attract sharks (metallic objects). Sharks may bite, altering ability to forage. Intensity: negligible, as anchoring is rare and confined to shallow locations. Consequence: negligible, as sharks replace teeth frequently. Confidence: high, due to logical consideration.

Table 3.7: *(continued)*

Direct impact of fishing	Fishing Activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
	Navigation/ steaming	1	6	6	Population size	Dusky Shark; Dusky Whaler (*Carcharhinus obscurus*); Bronze Whaler (*Carcharhinus brachyurus*); Smooth Hammerhead (*Sphyrna zygaena*)	6.1	1	1	1	Navigation and steaming may lead to a change in the movement patterns and/ or behaviour of scavenging species. The impact of this on overall movement patterns is considered negligible. Intensity and Consequence: negligible, given it may not be detectable at scale of impact. Confidence: low, due to lack of data.
Addition/ movement of biological material	Translocation of species	1	6	6	Population size	Bronze Whaler (*Carcharhinus brachyurus*)	1.1, 1.3, 1.4	2	2	1	The ingestion of diseased imported bait may affect bycatch/ byproduct species. Intensity: minor providing bait dispersed, and AQIS regulations are followed. Intensity and Consequence: minor but not zero impact for bycatch and byproduct species, if pathogen is spread via ingestion. Confidence: low due, to lack of data on possible species affected.

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

Direct impact of fishing	Fishing Activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
	On board processing	1	6	6	Behaviour / Movement	Blue Shark (*Prionace glauca*)	6.1	3	2	1	Processing of catch can attract scavenging species. Processing of catch is common in the area of the fishery (moderate intensity). Consequence: minor at most, considered greatest with regard to movement and behaviour. Confidence low, due to lack of data.
	Discarding catch	1	6	6	Behaviour / Movement	Blue Shark (*Prionace glauca*); Thresher Shark (*Alopias vulpinus*)	6.1	2	2	2	Discarding of catch can attract scavenging species. Discarding of catch is common in the area of the fishery, but apparently limited volumes. Intensity: minor. Consequence: minor, is considered greatest with regard to movement and behaviour. Confidence: high, based on AFMA Observer data.
	Stock enhancement	0									
	Provisioning	1	6	6	Behaviour / Movement	Blue Shark (*Prionace glauca*); Thresher Shark (*Alopias vulpinus*)	6.1	1	2	1	Provisioning occurs through bait lost during manual or automatic baiting. Baiting the hooks can attract species that benefit by eating the provided food. They may aggregate in the area of fishing activity, with modified behaviour or movement patterns. There is a limited volume of additional food from such sources. Intensity: negligible, detection is likely to be remote. Consequence: minor (at most), and is considered greatest with regard to movement and behaviour of these stocks. Confidence: low, due to lack of data.

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

Direct impact of fishing	Fishing Activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
	Organic waste disposal	1	6	6	Behaviour / Movement	Blue Shark (*Prionace glauca*); Tiger Shark (*Galeo-cerdo cuvier*)	6.1	1	1	2	If uncontaminated, food wastes may be discharged into the sea while the fishing vessel is in transit (MARPOL regulations). This is likely to occur daily. This species was chosen since it was the most recorded shark species. 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 behaviour/ movement of this species. Confidence: high, logical consideration.
Addition of non-biological material	Debris	1	6	6	Population size	Blue Shark (*Prionace glauca*); Tiger Shark (*Galeo-cerdo cuvier*)	1.1, 1.3, 1.4	1	1	1	Debris lost from boats likely to be accidental because boats are subject to MARPOL regulations which specify all items such as bait-box straps, not to be discarded at sea. Intensity: negligible. Consequence: negligible, as loss should be accidental not intentional. Confidence: low, due to lack of available information.

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

Direct impact of fishing	Fishing Activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
	Chemical pollution	1	6	6	Population size	Dusky Shark; Dusky Whaler (*Carcharhinus obscurus*); Tiger Shark (*Galeocerdo cuvier*); Thresher Shark (*Alopias vulpinus*)	1.1, 1.3, 1.4	1	1	1	While the potential for chemicals (e.g., oil and petrol contaminants) to enter the environment from vessels is acknowledged, most cleaning and painting does not occur at sea, and dilution quickly reduces the impact of any materials entering the open sea. Consequence: negligible, for population size of this species. Confidence: low, due to lack of data. However, pelagic predators at the top of the food chain bioaccumulate toxins from lower trophic levels making them particular susceptible to contaminants (Mukai et al., 2022).

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

Direct impact of fishing	Fishing Activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
	Exhaust	1	6	6	Behaviour / Movement	Dusky Shark; Dusky Whaler (*Carcharhinus obscurus*); Bronze Whaler (*Carcharhinus brachyurus*); Thresher Shark (*Alopias vulpinus*)	6.1	1	1	2	Bycatch and byproduct species are marine, and the exhaust is mostly gas that enters the atmosphere directly, or from engines just below the surface. Dissolving exhaust particulates in the water are diluted very quickly, with the ability to detect such pollution considered extremely low at the current activity levels. Intensity: negligible, as this activity is occurring over a wide area. Consequence: negligible, as it is considered unlikely to be measurable at the scale of these stocks. Confidence: high, due to logical consideration. Indirect impacts of petrochemical use and emissions and the associated contribution to ocean warming and acidification should be stated, shark species are particularly susceptible (Mukai et al., 2022).

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

Direct impact of fishing	Fishing Activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
	Gear loss	1	6	6	Population size	Dusky Shark; Dusky Whaler (*Carcharhinus obscurus*); Bronze Whaler (*Carcharhinus brachyurus*); Thresher Shark (*Alopias vulpinus*)	1.2	1	1	2	Fishing occurs throughout the year over the ETBF. 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, as it is considered unlikely to be measurable at the scale of these stocks. Confidence: high, because it is known that very little gear is lost, and interaction with species is considered unlikely.
	Navigation/ steaming	1	6	6	Behaviour / Movement	Bronze Whaler (*Carcharhinus brachyurus*)	6.1	1	1	2	Introduction of light, noise by vessels occurs over the ETBF. Intensity: negligible for any bycatch or byproduct species due to the scale of vessels in relation to species populations. Consequence: negligible. Confidence: high, due to logical consideration.

Table 3.7: *(continued)*

Direct impact of fishing	Fishing Activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
	Activity/ presence on water	1	6	6	Behaviour / Movement	Bronze Whaler (*Carcharhinus brachyurus*)	6.1	1	1	2	Vessels attract animals, but effects on the behaviour and movement (worst case). Intensity: negligible, unlikely to be detectable at spatial temporal scale. Consequence: negligible, impact unlikely to be detectable at the scale of the stock. Confidence: high, due to logical consideration.
Disturb physical processes	Bait collection	1	4	5	Population size	Dusky Morwong (*Dactylophora nigricans*); Ruby Snapper (*Etelis carbunculus*)		1	1	1	Inshore light Purse seine is used as major bait collection technique. Some disruption of sediments may occur, unlikely to have significant footprint, and disturbance would be short term. Intensity: negligible. Consequence: negligible. Confidence: low due to lack of data.
	Fishing	1	6	6	Population size	Thresher Shark (*Alopias vulpinus*)	1.2	1	1	1	This is a pelagic fishery using longlines believed to have little disrupting effect to the water column processes. Intensity: negligible unlikely to have measurable/ detectable impact spatially or temporally on physical processes because once the gear is removed water conditions expected to return to usual state. Consequence: negligible, because considered to have remote impact on physical processes that might change behaviour and movement of this non target species. Confidence: low, because of insufficient knowledge for this fishery.
	Boat launching	0									

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

Direct impact of fishing	Fishing Activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
	Anchoring/ mooring	1	5	5	Behaviour / Movement	Dusky Shark; Dusky Whaler (*Carcharhinus obscurus*); Bronze Whaler (*Carcharhinus brachyurus*); Smooth Hammerhead (*Sphyrna zygaena*)	6.1	1	1	1	Longline vessels rarely anchor or moor in anchorages. Intensity: negligible, unlikely to directly effect non-target species but may affect benthic processes which may indirectly effect non target species. Consequence: negligible because considered to have remote impact on physical processes that might change behaviour and movement of non target species. Confidence: high, logical consideration.

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

Direct impact of fishing	Fishing Activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
	Navigation/ steaming	1	6	6	Behaviour / Movement	Bronze Whaler (*Carcharhinus brachyurus*)	6.1	1	1	2	Navigation/ steaming occurs throughout the year over the entire fishery. Intensity: negligible, because unlikely to have measurable/ detectable impact on physical processes, water mixing may occur and in shallow water stir up sediments but expected to return to normal state quickly after disturbance. Consequence: negligible, because considered to have remote impact on physical processes that might affect conditions that then change behaviour or movement non target species. Confidence: high, because it was considered unlikely for there to be strong interactions between Navigation/ steaming, physical processes and non target species, logical consideration.
External Impacts	Other fisheries	1	5	6	Population size	Bronze Whaler (*Carcharhinus brachyurus*); Thresher Shark (*Alopias vulpinus*)	1.2	4	4	1	Fishery covers a large spatial area in which many other state fisheries occur using wide range targeting methods and catch a variety of species. Some species migratory and interact with international fishing operations in Pacific ocean. Uncertainties regarding (i) mixing between Pacific Ocean and Australian EEZ, (ii) how modelled catch from stock assessments may affect domestic fishery, and (iii) domestic catches can affect these stocks (links). Intensity: major, could have measurable impact both direct and indirect on non-target species once linkages understood. Consequence: major, cumulative effects could be major and affect population size of non-target species. Confidence: low, until there is better information becomes available.
	Aquaculture	0									

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

Direct impact of fishing	Fishing Activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
	Coastal development	1	5	6	Behaviour / Movement	Thresher Shark (*Alopias vulpinus*)	6.1	2	2	1	Both large and small centres along the coast and ongoing coastal development is likely to have minor impact, as the fishery operates offshore and most stocks are offshore, well away from these developments. Sewage outfall is considered to be minor given the level of ocean mixing. This outfall may increase in primary productivity and attract the species. Intensity: minor, given the scale of the activity. Consequence: minor. Confidence: low, little data on cumulative impacts.
	Other extractive activities	1	5	6	Behaviour / Movement	Bronze Whaler (*Carcharhinus brachyurus*)	6.1	1	2	1	Ongoing development and expansion of oil and gas pipelines, oil and gas exploration and extraction drilling, and seismic survey for further oil and gas exploration occurs across southern Australia (notably Bass Strait). The auditory and lateral line sensory acuity of this species could be affected by seismic survey. Intensity: negligible, impact unlikely to be detectable at the scale of the stock. Consequence: minor, as effect on population dynamics expected to be minimal. Confidence: low, as effects are unknown.
	Other non extractive activities	1	6	6	Behaviour / Movement	Thresher Shark (*Alopias vulpinus*)	6.1	1	1	1	Fishery covers a large spatial area and occurs throughout the year. Other shipping and cable laying occurs in the area. Intensity: assumed to have negligible impact (direct and indirect) on non target species. Consequence: cumulative effects expected to be negligible and not affect population size. Confidence: low, until information becomes available.

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

Direct impact of fishing	Fishing Activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
	Other anthropogenic activities	1	4	5	Behaviour / Movement	Thresher Shark (*Alopias vulpinus*)	6.1	2	1	1	Fishery covers a large spatial area and occurs through out the year. Species may be disturbed by tourism (whale watching) and charter boats operating inshore. Intensity: assumed to have negligible impact both direct and indirect on non target species, but linkages need to be better understood. Consequence: cumulative effects expected to be negligible. Confidence: low, until information becomes available.

3.10.3 Protected Species Component

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

Direct impact of fishing	Fishing Activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
Capture	Bait collection	1	4	5	Population size	Black-Browed Albatross (*Thalas-sarche melanophrys*)	1.1	3	2	1	Bait collection is permitted for own use in fishing for key/ secondary commercial species. Purse seining, may occur at night. Use of lights at night may attract albatrosses, which can collide with vessel structures. Intensity: moderate, occurs at broader spatial scale, or severe but local. Consequence: minor, because scale. Current live bait catch is relatively low, and purse seine shots are quick so time for other protected species such as syngnathids to aggregate on gear is short. However there is need to monitor risks to species if collection of live bait increases. Level of bait catch it is unlikely to impact protected species in terms population size, unless substantial removal of prey species targeted as bait. Confidence: low, because of insufficient knowledge on live bait fish distribution and capture.

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

Direct impact of fishing	Fishing Activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
	Fishing	1	6	6	Population size, Interactions with fishery	Shortfin Mako (*Isurus oxyrinchus*)	1.1, 7.1, 7.2	3	4	2	ETBF fishing occurs throughout year and covers a large area. Approximately 15,493 recorded protected chondrichthyan interactions were reported over the 2018-2022 period. Of these, 7168 were identified Shortfin Mako Sharks (2212 alive; 499 dead; 4457 unknown). Since, Shortfin Mako (SMA) have a low population rates (e.g., slow growth rate, late maturing and low fecundity), it is particularly vulnerable to fishing pressure. Hutchinson et al. (2021) reported on projected survival times for Shortfin Mako (SMA), these varied on release condition and leader material with post release survival varying between 40 % and 80 % depending on condition and handling practices - using the precautionary principle, suggests that the SMA interactions with ETBF 2018-2022 lead to the death of between approx. 1839 and approx. 4500 animals. A preliminary assessment for SMA was attempted for the Western Central Pacific Ocean (WCPO) - however the authors state that the uncertainties of the assessment mean that it is not suitable for management advice (Large et al., 2022). Intensity: moderate, given its spatial and temporal scale impacting two critically endangered species, particularly in light of post release survival rates. Also, fishing occurs at broader spatial scale, or severe but local. Consequence: major, given the catch and interaction numbers. Confidence: high (Commonwealth Logbook database).

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

Direct impact of fishing	Fishing Activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
	Incidental behaviour	1	6	6	Population size	False Killer Whale (*Pseudorca crassidens*); Australian Sea-Lion (*Neophoca cinerea*); New Zealand Fur-Seal (*Arcto-cephalus forsteri*)	1.1	1	2	2	During discarding or recovery of gear, whales and seals may be attracted to boat and fishing operations, but rarely take caught fish from hooks. Intensity: negligible, remote likelihood of detection at any spatial-temporal scale. Consequence: minor, potential injury to seals, but of a minor consequence over the scale of the fishery. Confidence: high (Commonwealth Logbook and Observer data).

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

Direct impact of fishing	Fishing Activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
Direct impact without capture	Bait collection	1	4	5	Population size	Shy Albatross (*Thalassarche cauta*); Black-Browed Albatross (*Thalassarche melanophrys*); Grey-Headed Albatross (*Thalassarche chrysostoma*)	1.1	1	1	1	Removal of baitfish which may be food source (indirect interaction), although species might be contacted with gear resulting in injury/ stress, when bait collecting is closest to coast. Intensity: negligible (with caution) because reported incidents of interaction with bait fishery are unknown and live bait catch is relatively small scale. Consequence: negligible, because current bait catch is not primary prey species, and current level of bait catch assumed to have undetectable impact on population size of the Shy Albatross, Black-browed Albatross and Grey-headed Albatross. Confidence: low, due to insufficient knowledge on trophic relationships.

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

Direct impact of fishing	Fishing Activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
	Fishing	1	4	5	Interactions with fishery	Shortfin Mako (*Isurus oxyrinchus*); Oceanic Whitetip Shark (*Carcharhinus longimanus*)	7.1, 7.2	1	4	2	Fishing occurs throughout year in the ETBF and covers a large area. The post interaction effect on this species is unclear, however it is likely that interactions could result in impairment of function/ prey capture ability and unobserved mortality through delayed effects. Impact could influence population size in those species threatened by reduced population sizes or sustain heavy mortality via other means. The Oceanic Whitetip Sharks (OCS) is considered critically endangered globally, while only characterised as Migratory in the EPBC Act. The number of interactions for a globally listed critically endangered species is of a concern (Hutchinson et al., 2021; Mukai et al., 2022). A recent study has reported that OCS stock is overfished and subject to overfishing (Tremblay-Boyer et al., 2019). Intensity: negligible, remote likelihood of detection at any spatial-temporal scale. Consequence: major, reproductive maturity approximately eight years (males; Fishbase (2016)) and approximately 20 years (females; Fishbase (2016)) delaying recovery of species. Consequence: high (Commonwealth Logbook database).
	Incidental behaviour	1	6	5	Population size	Australian Fur Seal (*Arctocephalus pusillus doriferus*)	1.1	1	2	1	Seals are known to be inquisitive, and may be attracted by visual stimuli or discards from occasional recreational fishing during crew down-time. Entanglement with fishing lures or swallowing while stealing fish, or injuries from scaring techniques may result in subsequent mortality. Intensity: negligible, remote likelihood of detection at any spatial-temporal scale. Recreational activities are limited and such interactions a rare part of these. Consequence: minor with regard to population size of the protected species in question. Confidence: low, due to lack of data.

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

Direct impact of fishing	Fishing Activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
	Gear loss	1	6	6	Population size	Leatherback Turtle (*Dermochelys coriacea*)	1.1	1	2	2	Turtles most at risk of mortality associated with the ingestion of lost light sticks (glow mimics jellyfish prey). Longline gear is occasionally lost, although Global Positioning System (GPS) radio beacons assist gear recovery. Protected species may be entangled or caught as gear drifts. Lost gear tends to ball up reducing likelihood of entanglement. The use of circle hooks has aided the reduction of seabird mortality. Intensity: negligible, because gear is recovered whenever possible. Consequence: minor, because although it can continue to fish/ entangle, it soon forms a ball. Confidence: high, because it is known that very little gear is lost, and if so, most are retrieved (AFMA Observer, pers. comm.).
	Anchoring/ mooring	1	5	5	Behaviour / Movement	Leatherback Turtle (*Dermochelys coriacea*); Black-Browed Albatross (*Thalassarche melanophrys*)	6.1	1	1	2	Anchoring only takes place in shallow waters. Very unlikely that these species would be adversely affected by the process of anchoring or mooring. Intensity: negligible, low likelihood of direct interaction with anchoring/ mooring lines. Consequence: negligible, impact unlikely to be detectable at the scale of the stock. Confidence: high, logical consideration of interactions.

Table 3.8: *(continued)*

Direct impact of fishing	Fishing Activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
	Navigation/ steaming	1	6	6	Behaviour / Movement	Short-Finned Pilot Whale (*Globi-cephala macrorhynch* Common Dolphin (*Delphinus delphis*); False Killer Whale (*Pseudorca crassidens*)	6.1	1	1	2	Navigation/ steaming occurs throughout the year over the entire fishery. Intensity: negligible because it is unlikely to have measurable/ detectable impact e.g., collisions with whales. Consequence: negligible, because interactions remote, and impact on population size or behaviour and movement of protected species unlikely. Confidence: high due to logical consideration.
Addition/ movement of biological material	Translocation of species	1	6	6	Population size	Common Dolphin (*Delphinus delphis*)	1.1	2	2	1	Frozen imported bait could carry disease that might spread to local baitfish populations. Intensity: minor, as both squid and local bait is used more often in the fishery. Intensity: low. Consequence: minor, because translocation of species and transmission of disease to local bait species. This could affect population size of protected species dependent on these as a food source. The fishery is offshore where contact with local bait species is reduced. Confidence: low, because of a lack of data and understanding of pathogens and marine diseases.

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

Direct impact of fishing	Fishing Activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
	On board processing	1	6	6	Behaviour / Movement	Shy Albatross (*Thalassarche cauta*); Black-Browed Albatross (*Thalassarche melanophrys*) Wandering Albatross (*Diomedea exulans*)	6.1	3	2	1	On board processing occurs. TAP regulations prohibit discharge of offal during line setting or hauling to reduce attractiveness to seabirds. Intensity moderate, as waste expected to be taken up quickly by opportunistic scavengers or sink to benthos and be scavenged by benthic species. Protected species in the area might also scavenge and change behaviour, increasing opportunity of harmful interactions. Intensity: moderate, as boat-following behaviours are common. Consequence: minor, as unlikely to affect behaviour or movement of protected species for more than a few days while boats in the area. Confidence: low, due to uncertainty about the volume of on board processing and the time birds spend around vessels.

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

Direct impact of fishing	Fishing Activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
	Discarding catch	1	6	6	Behaviour / Movement	Shy Albatross (*Thalas-sarche cauta*); Black-Browed Albatross (*Thalas-sarche melanophrys*); Wandering Albatross (*Diomedea exulans*)	6.1	2	3	1	Discarding of target species due to high grading and damage by sharks or marine mammals, byproduct species of low value or lack of markets and bycatch species occurs. Intensity: moderate. Consequence: minor, as behaviour movement of protected species modified only while vessels in the area and waste expected to be taken up quickly by opportunistic scavengers and/ or sink to benthos. Confidence: low because of a lack of data on effects of discarding on protected species.
	Stock enhancement	0									
	Provisioning	1	6	6	Behaviour / Movement	False Killer Whale (*Pseudorca crassidens*)	6.1	1	1	2	Toothed cetaceans (whales and dolphins) swim along lines and pick off tuna. This behaviour can result in fishers moving to a new area. Intensity: minor, can be locally important. Consequence: minor, on behaviour and movement and considered to be temporary, although some areas appear to have animals that do this a lot. Confidence: low, due to a lack of verified observer data.

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

Direct impact of fishing	Fishing Activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
	Organic waste disposal	1	6	6	Behaviour / Movement	Shy Albatross (*Thalassarche cauta*); Black-Browed Albatross (*Thalassarche melanophrys*) Wandering Albatross (*Diomedea exulans*)	6.1	1	1	2	Fishing activity occurs throughout the year in the ETBF. Domestic boats are generally at sea for 3-7 days (or greater). Organic waste disposal possible over this scale on a daily basis. Disposal of organic waste was expected to pose greatest potential risk for the Behaviour/ movement of protected species. Seabirds were chosen because they were considered to be readily attracted toward fishing vessels dispensing organic waste. Boats subject to MARPOL regulations. Intensity: negligible, because there was remote likelihood of seabirds being adversely affected (aggregation during feeding frenzy are natural processes). Consequence: negligible, as organic waste disposal in its own right was considered to have negligible consequence on seabirds. Furthermore, it was considered that disposal of organic waste is likely to increase chances of other negative interactions e.g., collision or entanglement. Confidence: high, because organic waste disposal considered unlikely to have detectable impacts on seabirds.

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

Direct impact of fishing	Fishing Activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
Addition of non-biological material	Debris	1	6	6	Population size	Leatherback Turtle (*Dermochelys coriacea*); Green Turtle (*Chelonia mydas*); Shy Albatross (*Thalassarche cauta*)	1.1	1	2	2	Addition of debris by this fishery expected to be accidental not routine. Vessels subject to MARPOL regulations. Plastic bits consumed by turtles and seabirds can cause intestinal obstruction, transfer to chicks and/ or death through starvation. Turtles swallow light sticks (mimic prey), may lead to subsequent mortality. Entanglement is also possible. Intensity: minor, if MARPOL rules adhered to, and with new light stick clip modification to reduce loss. Intensity: minor. Consequence: minor, against background of other impacts, detectable only on autopsy, but well documented. Confidence. high.
	Chemical pollution	1	6	6	Population size	Leatherback Turtle (*Dermochelys coriacea*); Green Turtle (*Chelonia mydas*); Loggerhead Turtle (*Caretta caretta*)	1.1	1	1	2	Accidental discharge anticipated. Chemicals used during fishing activities, such as lubricants for line hauling gear, may be an issue as boats maybe out at sea for days and maintenance may be required. Protected turtle species unlikely to be affected unless there is a major spill, but then localized impact. Dilution of chemicals expected to occur quickly. Boats subject to MARPOL regulations for disposal of chemicals (prohibited). Light sticks with chemicals may also be ingested particularly by turtles mistaking them for prey. Intensity: negligible if MARPOL rules adhered to. Intensity: negligible. Consequence: negligible, due to dilution and mixing of materials. Confidence: high (AFMA).

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

Direct impact of fishing	Fishing Activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
	Exhaust	1	6	6	Behaviour / Movement	Shy Albatross (*Thalassarche cauta*); Black-Browed Albatross (*Thalassarche melanophrys*); Wandering Albatross (*Diomedea exulans*)	6.1	1	1	2	Exhaust from running engine hazard occurs over a large range/ scale. Air quality most likely affected, which may affect the behaviour and movement. Intensity: negligible, because exhaust considered low impact to protected species i.e., not physically affected, unlikely to be measurable, effects more likely to be short term and effect air quality. Intensity: negligible. Consequence: negligible, because species unlikely to avoid fumes so unlikely to affect behaviour and movement of target species. Confidence: high, because exhaust unlikely to impact on behaviour/ movement of protected species.
	Gear loss	1	6	6	Population size	Leatherback Turtle (*Dermochelys coriacea*)	1.1	1	2	1	Turtles most at risk of mortality associated with the ingestion of lost light sticks (glow mimics jellyfish prey). Longline gear is occasionally lost, although GPS radio beacons assist gear recovery. Protected species may be entangled or caught as gear drifts. Lost gear tends to ball up reducing likelihood of entanglement. Intensity: negligible, impact unlikely to be detectable at the scale of the stock. Consequence: minor, because although it can continue to fish/ entangle, it soon forms a ball. Also, it occurs occasionally and gear is recovered whenever possible. Confidence: low, due to insufficient data on this interaction type.

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

Direct impact of fishing	Fishing Activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
	Navigation/ steaming	1	6	6	Behaviour / Movement	Shy Albatross (*Thalas-sarche cauta*); Black-Browed Albatross (*Thalas-sarche melanophrys*); Wandering Albatross (*Diomedea exulans*)	6.1	1	3	1	Birds follow boats, and navigation/ steaming occurs throughout the year over the entire fishery. Navigation/ steaming is a large component of the operations and will introduce noise and visual stimuli into the environment. Intensity: negligible, impact unlikely to be detectable at the scale of each stock. Consequence: moderate, impacts on behaviour and movement, of species by temporarily moving to or away, but expect no change to long-term patterns. In the context of the current global avian flu outbreaks these concentrated aggregations behind boats are more concerning. Confidence: low, due to lack of information.

Table 3.8: *(continued)*

Direct impact of fishing	Fishing Activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
	Activity/ presence on water	1	6	6	Behaviour / Movement	Shy Albatross (*Thalassarche cauta*); Black-Browed Albatross (*Thalassarche melanophrys*) Wandering Albatross (*Diomedea exulans*)	6.1	1	2	1	The environment will be impacted by noise and visual stimuli which may affect behaviour and movement. Intensity: negligible, impact unlikely to be detectable at the scale of each stock. Consequence: minor, as behaviour modified only for hours while vessels present, animals disperse each night, may visit same area next day and then move on. Confidence: low, no robust data on time of perturbed behaviour, and therefore conservatively scored.
Disturb physical processes	Bait collection	1	4	5	Behaviour / Movement	Little Shearwater (*Puffinus assimilis*)	6.1	1	2	1	Disturbance of the sediments might lead to temporary reduction in visibility that impacts the feeding behaviour (reduced efficiency), prey detection by shearwaters. Intensity: negligible, impact unlikely to be detectable at the scale of each stock. Consequence: minor, due to the limited live bait use in fishery and therefore minimal impact to behaviour/ movement of species. Confidence: low, insufficient knowledge on live bait fish distribution, and capture, and possible effects on the physical processes.

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

Direct impact of fishing	Fishing Activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
	Fishing	1	6	6	Population size	Leatherback Turtle (*Dermochelys coriacea*)	1.1	1	1	2	This is a pelagic fishery using longlines, believed to have little disrupting effect to the water column processes. Intensity: negligible, impact unlikely to be detectable at the scale of each stock. Consequence: negligible, no changes to physical processes. Also, it is unlikely to have measurable/ detectable impact spatially or temporally on physical processes because once the gear is removed water conditions expected to return to usual state. Confidence: high, logical consideration.
	Boat launching	0									
	Anchoring/ mooring	1	5	5	Behaviour / Movement	Leatherback Turtle (*Dermochelys coriacea*); Black-Browed Albatross (*Thalassarche melanophrys*)	6.1	1	2	2	Longline vessels rarely anchor or moor in anchorages. Intensity: negligible, impact unlikely to be detectable at the scale of each stock. Consequence: minor, likely to be related to time at sea. However, unlikely to directly affect protected species but may affect benthic processes which may indirectly affect protected species. Confidence: high; logical consideration.

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

Direct impact of fishing	Fishing Activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
	Navigation/ steaming	1	6	6	Behaviour / Movement	False Killer Whale (*Pseudorca crassidens*)	6.1	1	1	2	Navigation/ steaming occurs throughout the year over the entire fishery. Intensity: negligible, impact unlikely to be detectable at the scale of each stock. Consequence: negligible, because considered to have no impact on physical processes that might affect conditions that then change behaviour or movement of protected species. Water mixing may occur and in shallow water stir up sediments but expected to return to normal state quickly after disturbance. Confidence: high, logical consideration.
External Impacts	Other fisheries	1	5	6	Population size	Leatherback Turtle (*Dermochelys coriacea*); Black-Browed Albatross (*Thalassarche melanophrys*)	1.1	4	4	1	Other fisheries operate in the same region, e.g., SBT, SPF, SKJ, WCPO Tuna fisheries, recreational fisheries NSW. Some protected species are migratory and interact with international fishing operations in Pacific Ocean. Uncertainties regarding mixing between offshore and the Australian fishery area. Intensity: major, these protected species are captured over broad spatial scales, although seabird Bycatch action plans and Turtle Mitigation Plans (TMPs) in other fisheries would mitigate against this. Consequence: cumulative effects could be major and affect population size, populations currently declining (e.g., for seabirds and mammals). Confidence: low, not clear where main consequence is expressed.
	Aquaculture	0									

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

Direct impact of fishing	Fishing Activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
	Coastal development	1	5	6	Behaviour / Movement	Leatherback Turtle (*Dermochelys coriacea*); Black-Browed Albatross (*Thalassarche melanophrys*)	6.1	2	2	1	Both large and small centres along the coast and ongoing coastal development is likely to have minor impact as the fishery operates offshore and most stocks are offshore, well away from these developments. Sewage outfall is considered to be minor given the level of ocean mixing. This outfall may increase in primary productivity and attract these species. Intensity: minor, in the context of fishery area. Consequence: minor, given the scale of the activity. Confidence: low, little data on cumulative impacts.
	Other extractive activities	1	5	6	Behaviour / Movement	Black-Browed Albatross (*Thalassarche melanophrys*); Humpback Whale (*Megaptera novaeangliae*)	6.1	1	2	2	Oil and gas pipelines, oil and gas exploration and extraction drilling, and seismic survey for further oil and gas exploration occurs across southern Australia (notably Bass Strait and western area South East Trawl (SET) shelf) most likely to affect behaviour and movement of the whales causing them to move away (Dunlop et al., 2020). Vessels and structures in marine environment impact on albatross movements and behaviour. Intensity: minor, as local effects are potentially severe but spatially or temporally confined. Consequence: minor, as likely locally server, less so at scale of fishery. Confidence: high, as marine mammal interactions with oil and gas industry heavily monitored.

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

Direct impact of fishing	Fishing Activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
	Other non extractive activities	1	6	6	Population size	Humpback Whale (*Megaptera novaeangliae*); Melon-Headed Whale (*Peponocephala electra*); False Killer Whale (*Pseudorca crassidens*)	1.1	1	2	1	Fishery covers a large spatial area and occurs throughout the year. Lots of other shipping activities in the ETBF fishing area (e.g., off Gladstone - LNG export terminal), boat propellers, collisions could occur with surfacing whales. Intensity: negligible, remote likelihood of detection at any spatial or temporal scale. Consequence: minor, as expected not to affect population size of protected species, at the scale of shipping. Confidence: low, until information becomes available.

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

Direct impact of fishing	Fishing Activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
	Other anthropogenic activities	1	4	5	Behaviour / Movement	Humpback Whale (*Megaptera novaeangliae*); Melon-Headed Whale (*Peponocephala electra*); False Killer Whale (*Pseudorca crassidens*)	6.1	2	2	1	As with above, fishery covers a large spatial area and occurs throughout the year. Lots of other shipping and maritime activities in the ETBF area (e.g., off Southport, Mooloolabah, Sydney and Wollongong), boat propellers, collisions could occur with surfacing whales. Intensity: minor, occurs in few restricted locations. Consequence: minor, minimal impact on behaviour/ movement of whales. Confidence: low, until information becomes available.

3.10.4 Habitats Component

Table 3.9: Level 1 (SICA) Document L1.4 - Habitats Component.

Direct impact of fishing	Fishing Activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
Capture	Bait collection	1	4	5	Habitat structure and function	Eastern Pelagic Province - Coastal; Inner shelf (fine sediments, wave rippled, large sponges)	5.1	3	2	1	Bait collection using purse seine method will mix water, may touch bottom but any damage expected to recover quickly, as on soft bottom. Maybe some mixing of water; benthic habitats unlikely to be disturbed in the process. Intensity: moderate; occurs at broader spatial scale. Consequence: minor; scale and intensity low, level of bait catch it is unlikely to impact water quality or habitats long term. Given the inshore nature of bait fishing and the resilience of habitats in these depths and areas of frequent nature disturbance, benthic habitats that may be disturbed are likely to recover relatively rapidly. Confidence: low because of insufficient knowledge on live bait fish distribution and the occasional gear interactions with benthos.

Table 3.9: *(continued)*

Direct impact of fishing	Fishing Activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
	Fishing	1	6	6	Habitat structure and function	Eastern Pelagic Province - Oceanic; Eastern Pelagic Province -seamount Oceanic; Eastern Pelagic provinces-coastal P1	5.1	3	1	2	Pelagic habitat, mixing of water may occur during fishing. Intensity: moderate at broader spatial scale. Consequence: negligible, fishing not likely to affect habitat structure. Water is expected to return to usual state once gear removed from water. Confidence: high, due to logical constraints.
	Incidental behaviour	1	6	6	Water quality	Eastern Pelagic Province - Oceanic; Eastern Pelagic Province -seamount Oceanic	1.1	1	2	2	Recreational activity offshore unlikely to impact pelagic habitats, although impacts on inshore benthic habitats may be possible, there was no information to assess this risk at this time. Intensity: negligible, remote likelihood of detection at any spatial-temporal scale. Consequence: minor as a conservative score. Confidence: high, given logic based on the scale and intensity of these activities.

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

Direct impact of fishing	Fishing Activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
Direct impact without capture	Bait collection	1	4	5	Habitat structure and function	Eastern Pelagic Province - Coastal	5.1	1	2	1	Bait collection using purse seine method will mix water, might touch bottom but any damage expected to recover quickly, as on soft bottom. Intensity: negligible, remote likelihood of detection at any spatial-temporal scale. Current live bait catch is low and unlikely to be any effects from water mixing, benthic habitats maybe disturbed or damaged. Consequence: minor given scale and intensity. Confidence: low because of insufficient knowledge on live bait fish distribution and the occasional gear interactions with benthos.
	Fishing	1	4	5	Habitat structure and function	Eastern Pelagic Province - Oceanic; Eastern Pelagic Province -seamount Oceanic	5.1	1	1	2	Pelagic habitat, mixing of water may occur during fishing. Intensity: negligible, unlikely to be detectable at spatial temporal scale. Water expected to return to usual state once gear removed from water. Consequence: negligible, fishing not likely to affect habitat structure. Confidence: high, due to logical constraints.

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

Direct impact of fishing	Fishing Activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
	Incidental behaviour	1	6	5	Water quality	Eastern Pelagic Province - Oceanic; Eastern Pelagic Province -seamount Oceanic	1.1	1	2	2	Recreational activity offshore unlikely to impact pelagic habitats, although impacts on inshore benthic habitats may be possible, there was no information to assess this risk at this time. Intensity: negligible, unlikely to be detectable at spatial temporal scale. Consequence: minor, as a conservative score. Confidence: high given logic based on the scale and intensity of these activities.
	Gear loss	1	6	6	Habitat structure and function	Eastern Pelagic Province -seamount Oceanic	5.1	1	2	1	Longline gear may be lost although GPS radio beacons assist recovery of large sets of gear. Gear may drift in pelagic water, if it sinks can litter benthic habitats. Intensity: negligible, unlikely to be detectable at spatial temporal scale. Consequence: minor; some benthic habitats may be damaged by gear if attached to reefs or sponge gardens. However, while gear is floating it may modify the pelagos, hence this scenario considered most vulnerable. Confidence: low because of a lack of data on extent of gear loss and breakdown times.

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

Direct impact of fishing	Fishing Activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
	Anchoring/ mooring	1	5	5	Habitat structure and function	Inner-shelf (fine sediments, wave rippled, large sponges)	5.1	1	2	2	Longline vessels rarely anchor or moor in anchorages. Direct impact (damage or mortality) that occurs when anchoring or mooring most likely to affect habitat structure of inner-shelf sponge beds and algal communities by physical contact with anchor. Intensity: negligible, unlikely to be detectable at spatial temporal scale. Consequence: minor, as anchoring considered to affect only a very small percentage of the area of the habitat, does not occur daily and more likely to occur on soft bottom. Confidence: high, because it is considered very unlikely for there to be lasting damage to a large area of inner-shelf habitat caused by anchoring/ mooring.
	Navigation/ steaming	1	6	6	Water quality	Eastern Pelagic Province - Oceanic; Eastern Pelagic Province -seamount Oceanic	1.1	1	1	2	Navigation/ steaming occurs throughout the year over the entire fishery, and does mix the water vessels are active in, but really small impacts expected. Intensity: negligible, unlikely to be detectable at spatial temporal scale. Consequence: negligible, because unlikely to affect air or water structure. Confidence: high, because it was considered unlikely for there to be strong interactions between Navigation/ steaming and habitat structure.

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

Direct impact of fishing	Fishing Activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
Addition/ movement of biological material	Translocation of species	1	6	6	Water quality	Eastern Pelagic Province - Oceanic; Eastern Pelagic Province -seamount Oceanic	1.1	2	2	1	Introduction of disease via frozen imported pilchards has resulted in infection of local bait species in SA/ WA. Might result in disturbed biogeochemical cycling in pelagic and to a lesser degree in deep water, benthic habitats, if accumulation of carcasses should lead to anoxic conditions. Intensity and consequence for habitats considered minor, as previous examples of fish kill have not impacted the habitats. Confidence: low, little information available.
	On board processing	1	6	6	Water quality	Eastern Pelagic Province - Oceanic; Eastern Pelagic Province -seamount Oceanic	1.1	3	1	2	On board processing occurs. Intensity: negligible, unlikely to be detectable at spatial temporal scale. Consequence: negligible, unlikely to impact habitats because of scavenging. Waste expected to be taken up quickly by opportunistic scavengers if sink to benthos scavenged by benthic species, vessel is underway as processing occurs, thus a scattered trail results, and not concentrated pulses, especially as water is deep. Confidence: high, expert consensus.

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

Direct impact of fishing	Fishing Activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
	Discarding catch	1	6	6	Water quality	Eastern Pelagic Province - Oceanic; Eastern Pelagic Province -seamount Oceanic	1.1	2	1	2	Discarding catch as on board processing leads to high grading. Discarding of bycatch and byproduct species of low value or lack of markets occurs. This may result in short term declines in water quality due to decomposition. Intensity: minor, impacts expected because waste expected to be taken up quickly by opportunistic scavengers, if sinks to benthos, scavenged by benthic species. Consequence: negligible, unlikely to impact pelagic habitats for long because of scavenging and scales of mixing. Confidence: high, expert consensus.
	Stock enhancement	0									
	Provisioning	1	6	6	Water quality	Eastern Pelagic Province - Oceanic; Eastern Pelagic Province -seamount Oceanic	1.1	1	1	2	Provisioning occurs through use bait and discarding. Shark and cetacean predation on longline fish relatively common. Intensity: negligible, remote likelihood of detection at any spatial or temporal scale. Consequence: negligible, because waste expected to be taken up quickly by opportunistic scavengers if sink to benthos scavenged by benthic species, lost bait may drift for a while, but again, scavenging expected. Confidence: high, expert consensus.

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

Direct impact of fishing	Fishing Activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
	Organic waste disposal	1	6	6	Water quality	Eastern Pelagic Province - Oceanic; Eastern Pelagic Province -seamount Oceanic	1.1	1	1	2	Domestic boats commonly spend 3-7 days or up to approximately three weeks at sea. Boats subject to MARPOL regulations. Intensity: negligible if MARPOL regulations adhered to. Consequence: negligible, because organic waste likely to be scavenged or break down quickly so unlikely to affect habitats. Confidence: high (AFMA Observer information).
Addition of non-biological material	Debris	1	6	6	Habitat structure and function	Eastern Pelagic Province - Oceanic; Eastern Pelagic Province -seamount Oceanic	5.1	1	1	2	Plastics may be an issue and are the most common debris item. Chemical light sticks may also be a litter issue. Boats subject to MARPOL regulations. Intensity: negligible if MARPOL regulations adhered to. Consequence: negligible because debris by this fishery expected to be accidental not routine. Confidence: high (AFMA Observer information).

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

Direct impact of fishing	Fishing Activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
	Chemical pollution	1	6	6	Water quality	Eastern Pelagic Province - Oceanic; Eastern Pelagic Province -seamount Oceanic	1.1	1	2	2	Chemicals and light sticks used during fishing activities may be an issue as boats maybe out at sea for many days. Habitats unlikely to be affected unless a major spill, but localized impact may resolve over natural mixing scale. Boats subject to MARPOL regulations. Intensity: negligible if MARPOL regulations adhered to. Consequence: minor, because chemical pollution impacts expected to be minimal and therefore unlikely to directly affect habitats. Confidence: high (AFMA Observer information).
	Exhaust	1	6	6	Air quality	Eastern Pelagic Province - Oceanic; Eastern Pelagic Province -seamount Oceanic	2.1	1	1	2	Exhaust from running engine hazard occurs over a large range/ scale. Intensity: negligible, over broad spatial and temporal scales. Consequence: negligible, because air quality likely to re-establish over very short time scales. Confidence: high, because exhaust unlikely to impact air quality due to intensity and mixing of air column and therefore not impact these pelagic habitats.

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

Direct impact of fishing	Fishing Activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
	Gear loss	1	6	6	Habitat structure and function	Eastern Pelagic Province - Oceanic; Eastern Pelagic Province -seamount Oceanic	5.1	1	2	1	Longline gear is lost although GPS radio beacons assist recovery of large sets of gear. Gear may drift in pelagic water. If it sinks, may contact the bottom and litter benthic habitats. Lost gear tends to ball up reducing likelihood of entanglement. Intensity: negligible, remote likelihood of detection at any spatial or temporal scale. Consequence: minor, but there could be cumulative impacts overtime, build up of litter, as materials may remain in environment for extended periods, with minimal break down. Also, some benthic habitats may be damaged by gear if it attaches to reefs or sponge gardens. Confidence: low, because of a lack of data on extent of gear loss and breakdown times.
	Navigation/ steaming	1	6	6	Water quality, Air quality,	Eastern Pelagic Province - Oceanic; Eastern Pelagic Province -seamount Oceanic	1.1, 2.1	1	1	2	Navigation/ steaming occurs throughout the year over the entire fishery. Intensity: negligible, remote likelihood of detection at any spatial or temporal scale. Consequence: negligible, because unlikely to affect water or air quality for a period of more than a few hours. Confidence: high, logical consideration.

Table 3.9: *(continued)*

Direct impact of fishing	Fishing Activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
	Activity/ presence on water	1	6	6	Air quality	Eastern Pelagic Province - Oceanic; Eastern Pelagic Province -seamount Oceanic	2.1	1	1	2	The environment will be impacted by noise and visual stimuli temporarily. Intensity: negligible, remote likelihood of detection at any spatial or temporal scale. Consequence: negligible, because unlikely to impact habitats. Confidence: high, logical consideration.
Disturb physical processes	Bait collection	1	4	5	Habitat structure and function	fine sediments, wave rippled, large sponges, inner-shelf	5.1	1	1	2	Bait collection is permitted for own use in fishing for scheduled species. During Purse seining, may be some mixing of water, benthic habitats will experience disturbance of the sediment layer if Purse seine net contacts the bottom. Intensity: negligible because current live bait catch is low and unlikely to be any effects from water mixing, recovery time in benthic habitats is related to depth and community structure, and is variable. Consequence: negligible, because scale and intensity low, physical impact of nets on bottom uncommon, and unlikely given the level of live bait capture. Confidence: high, logical consideration.

Table 3.9: *(continued)*

Direct impact of fishing	Fishing Activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
	Fishing	1	6	6	Habitat structure and function	Eastern Pelagic Province - Oceanic; Eastern Pelagic Province -seamount Oceanic	5.1	1	1	2	This is a pelagic fishery using longlines which do not contact the benthos, and have little detectable effect on water flow patterns. Intensity: negligible, unlikely to have measurable/ detectable impact spatially or temporally on physical processes because once the gear is removed water conditions expected to return to usual state rapidly. Consequence: negligible, considered to have remote impact on physical processes that may change habitats. Confidence: high, logical consideration.
	Boat launching	0									
	Anchoring/ mooring	1	5	5	Substrate quality	Inner-shelf (fine sediments, wave rippled, large sponges)	3.1	1	2	1	Longline vessels rarely anchor or moor in anchorages. Anchoring may disturb fine sediments in quiescent environments and to a lesser degree, coarser sediments generally. Most inner shelf sediments in anchoring depths are disturbed regularly by wave, swell and current action. Intensity: negligible, remote likelihood of detection at any spatial or temporal scale. Consequence: minor, as anchoring considered to affect only a very small percentage of the area of the habitat. It is considered very unlikely for there to be lasting damage to a large area of inner-shelf habitat caused by anchoring/ mooring. Also, anchoring/ mooring is not daily, and most likely to occur over 'soft' bottom, recovery would likely to occur within hours to days. Confidence: low, due to lack of information.

Table 3.9: *(continued)*

Direct impact of fishing	Fishing Activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
	Navigation/ steaming	1	6	6	Water quality, Air quality,	Eastern Pelagic Province - Oceanic; Eastern Pelagic Province -seamount Oceanic	1.1, 2.1	1	1	2	Navigation/ steaming occurs throughout the year over the entire fishery. Intensity: negligible, remote likelihood of detection at any spatial or temporal scale. Consequence: negligible, because unlikely to affect water or air quality for a period of more than a few hours. Confidence: high, logical consideration.
External Impacts	Other fisheries	1	5	6	Habitat structure and function	Eastern Pelagic Province -seamount Oceanic	5.1	4	1	2	Cumulative effects on pelagic habitat of activities associated with fishing are unlikely to be detectable over the spatial scale of the fishery. Inshore Purse seining for bait is more likely to be overlaid by a cumulative effect, but is not considered here as occurs within state waters. Intensity: major, severe and occurs reasonably often at broad spatial scale. Consequence: negligible, impact unlikely to be detectable at the scale of the habitat. Confidence: high.
	Aquaculture	0									
	Coastal development	1	5	6	Habitat structure and function	Eastern Pelagic Province - Coastal	5.1	2	2	1	Both large and small centres along the coast and ongoing coastal development is likely to have minor impact as the fishery operates offshore and most stocks are offshore, well away from these developments. Sewage outfall is considered to be minor given the level of ocean mixing. This outfall may increase in primary productivity and attract the species. Intensity: minor. Consequence: minor, given the scale of the activity. Confidence: low, little data on cumulative impacts.

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

Direct impact of fishing	Fishing Activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
	Other extractive activities	1	5	6	Habitat structure and function	Eastern Pelagic Province - Oceanic	5.1	1	2	1	Activities such as oil drilling and cable laying may have impact that exceeds fishing. Intensity: negligible. Consequence: minor, based on the spatial and temporal scale of the activity. Confidence: low, due to lack of information.
	Other non extractive activities	1	6	6	Habitat structure and function	Eastern Pelagic Province - Oceanic; Eastern Pelagic Province -seamount Oceanic	5.1	1	2	1	Non-extractive activities, such as shipping occur throughout the fishery. Consequence: minor, the impact of other non-extractive activities, such as shipping, may have some impacts, but expected to be minor in the region of the fishery. Confidence: low, due to lack of information.
	Other anthropogenic activities	1	4	5	Habitat structure and function	Inner shelf benthic habitats	5.1	2	1	1	The fishery takes place offshore, away from the tourism and recreational activities associated with tourism. Intensity: minor, occurs rarely or in few restricted locations and detectability even at these scales is rare. Consequence: negligible, impact unlikely to be detectable at the scale of the habitat. Confidence: low, due to lack of information.

3.10.5 Communities Component

Table 3.10: Level 1 (SICA) Document L1.5 - Communities Component.

Direct impact of fishing	Fishing Activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
Capture	Bait collection	1	4	5	Species composition	Central Eastern Province inner shelf	1.1	3	2	1	Bait collection is permitted for own use in fishing for scheduled species. May affect bait fish communities but at these levels unlikely to affect communities (food source). Intensity: moderate at broader spatial scale. Consequence: minor, unlikely to impact species composition more than 5%. Current live bait catch is low impact, unlikely to be detectable against background variability. Confidence: low because of insufficient knowledge on live bait fish distribution, and capture. Need to consider overall stock status of bait fish with regard to capture by other fisheries.
	Fishing	1	6	6	Functional group composition	Eastern oceanic (2) pelagic; Eastern oceanic (2) seamount	2.1	3	3	1	Fishery occurs throughout year and covers a large area. Most target and non target species taken are high trophic level pelagic species. Intensity: major, the domestic fishery. This level of fishing may affect the state of the Eastern oceanic pelagic (2) community (~34% effort overlap with this community over the last five years) and the Eastern oceanic (2) seamount community (33% effort overlap with community over the last five years). Also, the intensity of fishing over Eastern oceanic (2) seamount community appears to be relatively high (GIS and logbook analyses). Intensity: moderate at broader spatial scale. Consequence: moderate, because of the intensity and spatial scale of the fishery. Need to establish whether this level of catch is sustainable so that communities, particularly seamounts are not affected over time. Fishing targets apex predators and might result in functional group composition. Confidence: low. No community studies with information at this stage.

Table 3.10: ***(continued)***

Direct impact of fishing	Fishing Activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
	Incidental behaviour	1	6	6	Species composition	Central Eastern Province outer shelf	1.1	1	1	1	Offshore fishery unlikely that activities might impact communities. Intensity: negligible, remote likelihood of detection at any spatial-temporal scale. Consequence: negligible, at this stage assumed unlikely to affect communities. Confidence: high (AFMA logbook and related information).
Direct impact without capture	Bait collection	1	4	5	Species composition	Central Eastern Province inner shelf	1.1	1	2	1	Bait collection is permitted for own use in fishing for scheduled species. Fishery occurs throughout year and covers a large area "Purse seine" method. Fewer individuals will escape and impact the community. Intensity: negligible because current live bait catch is low, impact expected to be negligible, unlikely to be detectable against background variability. Consequence: minor because scale and intensity low, level of bait catch it is unlikely to impact community composition. Confidence: low because of insufficient knowledge on live bait fish distribution, and capture. Need to consider overall stock status of bait fish with regard to capture by other fisheries.
	Fishing	1	4	5	Functional group composition	Eastern oceanic (2) pelagic; Eastern oceanic (2) seamount	2.1	1	2	1	Fishery occurs throughout the year and covers a large area, including seamounts. Intensity: minor, as fishing activity unlikely to affect the state of communities when animals are not captured, although see some of the specific fishery activities below. Consequence: minor, because of the intensity and spatial scale of the activity. Need to establish this level of catch is sustainable so that communities are not affected over time. Confidence: low due to insufficient data.
	Incidental behaviour	1	6	5	Species composition	Central Eastern Province outer shelf	1.1	1	1	2	Offshore fishery unlikely that activities occur that might impact communities. Intensity: negligible. Consequence: negligible at this stage assumed unlikely to affect communities Confidence high due to consensus.

Table 3.10: ***(continued)***

Direct impact of fishing	Fishing Activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
	Gear loss	1	6	6	Species composition	Central Eastern Province outer shelf	1.1	1	2	1	A variety of longline gear is lost although GPS radio beacons assist recovery of major parts of gear. Key/ secondary commercial and non-targeted species may be caught as gear drifts. Lost gear tends to ball up reducing likelihood of entanglement. Intensity: negligible, even though lost gear can continue to fish once lost, for this fishery direct impact expected to be minimal unlikely to be detectable against background variability. Consequence: minor, level unlikely to impact species composition. Confidence: low, because of a lack of data on interactions.
	Anchoring/ mooring	1	5	5	Species composition	Central Eastern Province outer shelf	1.1	1	1	2	Longline vessels rarely anchor or moor in anchorages. If it occurs, it is unlikely to impact communities. Intensity: negligible, because the likelihood of impact is expected to be very unlikely, to be detectable against background variability. Consequence: negligible, because the scale and intensity is considered negligible, it is unlikely to impact communities. Confidence: high, because activity itself is unlikely, and consensus opinion.
	Navigation/ steaming	1	6	6	Distribution of community	Eastern oceanic (2) pelagic; Eastern oceanic (2) seamount	3.1	1	2	2	Navigation/ steaming occurs throughout the year over the entire fishery, including seamounts. Intensity: negligible, unlikely to be detectable at spatial temporal scale. Consequence: minor impact on communities, as activity may lead to some animals following the vessel, changing the distribution of those animals. Confidence: high, because it was considered unlikely for there to be strong interactions between navigation/ steaming and communities given expert opinion.

Table 3.10: ***(continued)***

Direct impact of fishing	Fishing Activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
Addition/ movement of biological material	Translocation of species	1	6	6	Species composition	Eastern coastal pelagic	1.1	2	4	1	Broadbill Swordfish and Bigeye Tuna targeted using squid, other target species use scalefish, which may be frozen imports. If dead bait imported disease could be a problem as occurred in SBT, which may impact communities. Intensity: minor. Consequence: major, as the translocation of disease could possibly affect communities. This risk is high for all fisheries importing baitfish. Confidence: low, because of a lack of data or information.
	On board processing	1	6	6	Distribution of community	Eastern oceanic (2) pelagic; Eastern oceanic (2) seamount	3.1	3	1	2	On board processing occurs throughout the fishery. Intensity: minor, as waste expected to be taken up quickly by opportunistic scavengers or sink to benthos and scavenged by benthic species, will be scattered as vessel is underway and water very deep. Consequence: negligible. Confidence: high, consensus.
	Discarding catch	1	6	6	Distribution of community	Eastern oceanic (2) pelagic; Eastern oceanic (2) seamount	3.1	2	1	2	Discarding target species due to high grading and damage by sharks or marine mammals, and discarding non-target species of low value or lack of markets occurs. Intensity: negligible, impacts expected because waste expected to be taken up quickly by opportunistic scavengers or sink to benthos and scavenged by benthic species. Consequence: negligible for communities in terms of addition of biological material. Confidence: high (AFMA Observer information).
	Stock enhancement	0									

Table 3.10: ***(continued)***

Direct impact of fishing	Fishing Activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
	Provisioning	1	6	6	Distribution of community	Eastern oceanic (2) pelagic; Eastern oceanic (2) seamount	3.1	1	1	1	Provisioning occurs through use of bait and discarding. Intensity: negligible, unlikely to be detectable at spatial temporal scale. Consequence: negligible, waste expected to be taken up quickly by opportunistic scavengers or sink to benthos and scavenged by benthic species. Confidence: low, because of a lack of information.
	Organic waste disposal	1	6	6	Distribution of community	Eastern oceanic (2) pelagic; Eastern oceanic (2) seamount	3.1	1	1	2	Boats subject to MARPOL regulations. Intensity: negligible, if MARPOL regulations followed. Consequence: negligible, because organic waste likely to be scavenged or break down quickly. Confidence: high, observer data indicate crews diligent regarding waste.
Addition of non-biological material	Debris	1	6	6	Species composition	Eastern oceanic (2) pelagic; Eastern oceanic (2) seamount	1.1	1	1	2	Plastics may be an issue, entanglement, ingestion, litter, however vessels are subject to MARPOL regulations. Intensity: negligible if MARPOL regulations followed. Consequence: negligible community effect, if rare species were killed then might get a change in species composition in a region. Debris by this fishery expected to be accidental and not routine. Confidence: high, domestic AFMA Observer data indicated crews are diligent regarding waste.

Table 3.10: ***(continued)***

Direct impact of fishing	Fishing Activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
	Chemical pollution	1	6	6	Species composition	Eastern oceanic (2) pelagic; Eastern oceanic (2) seamount	1.1	1	1	2	Light sticks may be ingested. Chemicals used during fishing activities may be an issue as boats may be out at sea up to approximately three weeks. Communities unlikely to be affected unless a major spill, but localized impact as small vessels. Boats subject to MARPOL regulations. Intensity: negligible if MARPOL regulations followed. Consequence: negligible, because chemical pollution impacts expected to be minimal and therefore unlikely to directly impact communities. Confidence: high, domestic Observer data indicated crews are diligent with regard to waste.
	Exhaust	1	6	6	Distribution of community	Eastern oceanic (2) pelagic; Eastern oceanic (2) seamount	3.1	1	1	2	Exhaust from running engine hazard occurs over a large range/ scale. Intensity: negligible, because exhaust considered low impact to pelagic communities including seamounts i.e., physically affected, unlikely to be measurable, effects more likely to be short term and affect air quality. Consequence: negligible, because distribution of communities not likely to be affected. Confidence: high, logical consensus.
	Gear loss	1	6	6	Distribution of community	Eastern oceanic (2) pelagic; Eastern oceanic (2) seamount	3.1	1	1	2	A variety of longline gear is lost although GPS radio beacons assist recovery of major parts of gear. Target and non target species may be caught as gear drifts. Lost gear tends to ball up reducing likelihood of entanglement. Intensity: negligible. Consequence: negligible in terms of impact on community composition or change distribution of communities. Confidence: high, due to logical consideration.

Table 3.10: ***(continued)***

Direct impact of fishing	Fishing Activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
	Navigation/ steaming	1	6	6	Distribution of community	Eastern oceanic (2) pelagic; Eastern oceanic (2) seamount	3.1	1	2	1	Navigation/ steaming is a large component of the operations. Intensity: moderate, occurs frequently in all locations. Consequence: minor, seabirds follow boats, but changes not persistent beyond a day. Confidence: low, limited information.
	Activity/ presence on water	1	6	6	Distribution of community	Eastern oceanic (2) pelagic; Eastern oceanic (2) seamount	3.1	1	2	1	The environment will be impacted by noise and visual stimuli that could temporarily effect distribution of some community members such as seabirds. Intensity: moderate, is frequent. Consequence: minor, limited persistence of effect. Confidence: low, limited data.
Disturb physical processes	Bait collection	1	4	5	Distribution of community	Central Eastern Province outer shelf	3.1	1	2	1	Bait collection is with small purse seine nets, mixing of water may occur, gear may touch bottom. Intensity: minor disturbance of physical processes. Consequence: minor because considered to have minimal impact on physical process that might impact communities. Confidence: low, because of insufficient knowledge on live bait fish distribution, and capture, and possible effects on the physical processes.
	Fishing	1	6	6	Distribution of community	Eastern oceanic (2) pelagic; Eastern oceanic (2) seamount	3.1	1	1	2	Fishery occurs throughout year and covers a large area, which includes seamounts. Intensity: negligible detectable effect on the physical processes important to the pelagic communities. Consequence: negligible. Confidence: high, logical consideration.

Table 3.10: ***(continued)***

Direct impact of fishing	Fishing Activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
	Boat launching	0									
	Anchoring/ mooring	1	5	5	Distribution of community	Central Eastern Province outer shelf	3.1	1	1	2	Longline vessels rarely anchor or moor in anchorages. Intensity: negligible. Consequence: negligible, because scale and intensity physical processes expected to recover after disturbance. Confidence: high, logical consideration given scale of some other natural processes.
	Navigation/ steaming	1	6	6	Distribution of community	Eastern oceanic (2) pelagic; Eastern oceanic (2) seamount	3.1	1	1	2	Navigation/ steaming occurs throughout the year over the entire fishery including seamounts. Intensity: negligible. Consequence: negligible. Confidence: high because it was considered unlikely for there to be strong interactions between Navigation/ steaming and communities.
External Impacts	Other fisheries	1	5	6	Trophic size structure	Eastern oceanic (2) pelagic; Eastern oceanic (2) seamount	4.1	4	3	1	Fishery covers a large spatial area in which many other state fisheries occur using wide range targeting methods and catch species. Some species migratory and interact with international fishing operations in the Pacific Ocean. Uncertainties regarding mixing between Pacific Ocean and Australian EEZ, and regarding stock assessments these catches may affect domestic fishery, and domestic catches can affect these stocks (links). Intensity: major, could have detectable major impact both direct and indirect on communities once linkages understood. Occurs reasonably often at broad spatial scale. Consequence: moderate, cumulative effects, but could be major and affect many communities. Confidence: low, until there is better information.
	Aquaculture	0									

Table 3.10: ***(continued)***

Direct impact of fishing	Fishing Activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
	Coastal development	1	5	6	Species composition	Southern coastal pelagic	1.1	2	2	1	Coastal development occurs across the range of the fishery, beyond the boundaries of current effort but not in all areas (e.g., central Bass Strait). Frequent, local impacts at small spatial scales should have most obvious impact on the species composition of the areas affected, the impacts should be local and their consequences only minor to the entire Southern Oceanic Pelagic community. Intensity: minor, occurs rarely or in few restricted locations and detectability even at these scales is rare. Consequence: minor, impacted species do not play a keystone role – only minor changes in relative abundance of other constituents. Confidence: low, because of a lack of data.
	Other extractive activities	1	5	6	Distribution of community	Central Eastern Province outer shelf	3.1	1	1	1	Fishery covers a large area where there are activities such as oil and gas exploration in the eastern Bass Strait, eastern Victoria and Queensland, but does not occur where actual fishery effort occurs. There may be pollution from petrochemical industry in both shallow and deep water, and associated noise and visual stimuli. Intensity: assumed to have negligible effect on communities, but linkages need to be better understood. Consequence: cumulative effects may exist, but minor at this time given offshore area. Confidence: low, until there is better information.
	Other non extractive activities	1	6	6	Distribution of community	Eastern coastal pelagic	3.1	1	2	1	Shipping and other similar activities not believed to play an important role in this offshore area. Intensity: negligible. Consequence: minor. Confidence: low, due to limited information.

Table 3.10: *(continued)*

Direct impact of fishing	Fishing Activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
	Other anthropogenic activities	1	4	5	Distribution of community	Eastern coastal pelagic	3.1	2	2	1	Fishery covers a large spatial area and occurs throughout the year. Communities may be disturbed by tourism (whale watching) charter boats. Intensity: minor, as main fishery is offshore. Consequence: even cumulative effects expected to be minor and not affect communities. Confidence: low, until there is better information.

3.11 Summary of SICA Results

A summary table (**Level 1 (SICA) Document L1.6**) of consequence scores for all activity/component combinations and a table showing those that scored 3 or above for consequence (shaded) and differentiating those that did so with high confidence (in bold) is outlined in Table 3.11.

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

Impact	Activity	Key/ secondary commercial species	Bycatch/ byproduct species	Protected species	Habitat	Communities
Capture	Bait collection	**2**	2	2	2	2
	Fishing	*	**3**	**4**	**1**	3
	Incidental behaviour	**1**	**2**	**2**	**2**	1
Direct impact without capture	Bait collection	2	2	1	2	2
	Fishing	1	3	**4**	**1**	2
	Incidental behaviour	**1**	1	2	**2**	**1**
	Gear loss	**1**	**1**	**2**	2	2
	Anchoring/ mooring	**1**	**1**	**1**	**2**	**1**
	Navigation/ steaming	1	1	**1**	**1**	**2**
Addition/ movement of biological material	Translocation of species	2	2	2	2	4
	On board processing	1	2	2	**1**	**1**
	Discarding catch	**1**	**2**	3	**1**	**1**
	Stock enhancement	0	0	0	0	0
	Provisioning	**1**	2	**1**	**1**	1
	Organic waste disposal	**1**	**1**	**1**	**1**	**1**
Addition of non-biological material	Debris	**1**	1	**2**	**1**	**1**
	Chemical pollution	2	1	**1**	**2**	**1**
	Exhaust	**1**	**1**	**1**	**1**	**1**
	Gear loss	**2**	**1**	2	2	**1**
	Navigation/ steaming	1	**1**	3	**1**	2
	Activity/ presence on water	1	**1**	2	**1**	2
Disturb physical processes	Bait collection	**2**	1	2	**1**	2
	Fishing	2	1	**1**	**1**	**1**
	Boat launching	0	0	0	0	0
	Anchoring/ mooring	**2**	1	**2**	2	**1**
	Navigation/ steaming	**1**	**1**	**1**	**1**	**1**
External Impacts	Other fisheries	4	4	4	**1**	3
	Aquaculture	0	0	0	0	0
	Coastal development	2	2	2	2	2
	Other extractive activities	2	2	**2**	2	1
	Other non extractive activities	2	1	2	2	2
	Other anthropogenic activities	2	1	2	1	2

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

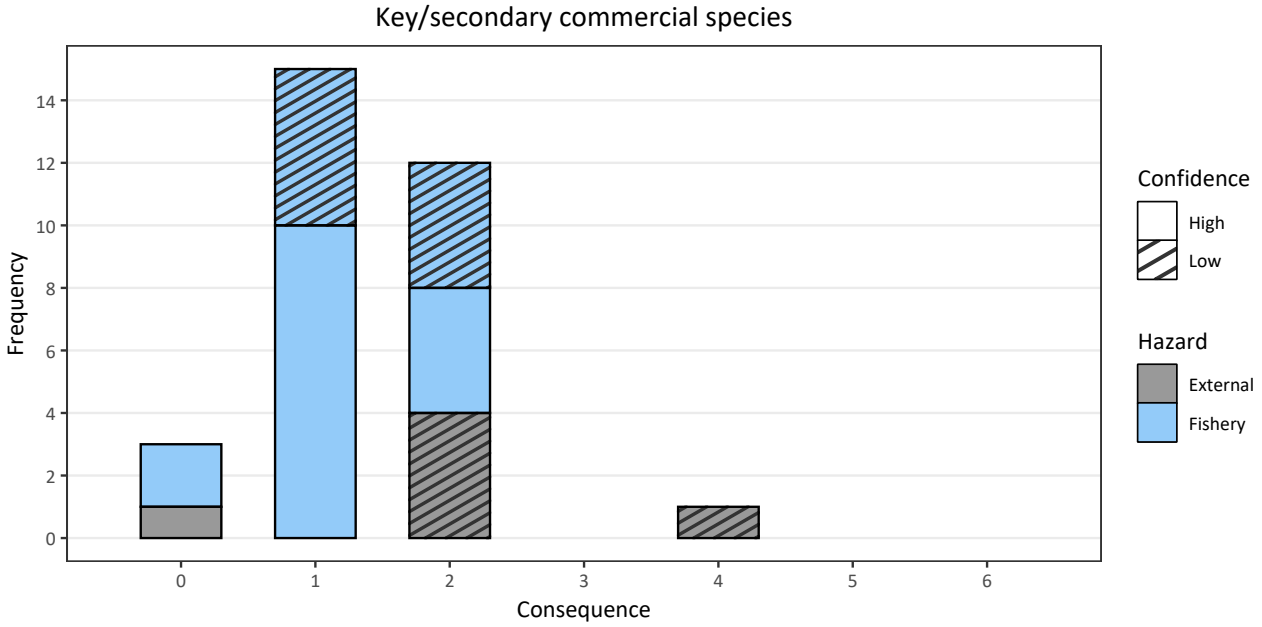

Figure 3.1: Key/secondary commercial species component: Frequency of consequence score by high and low confidence.

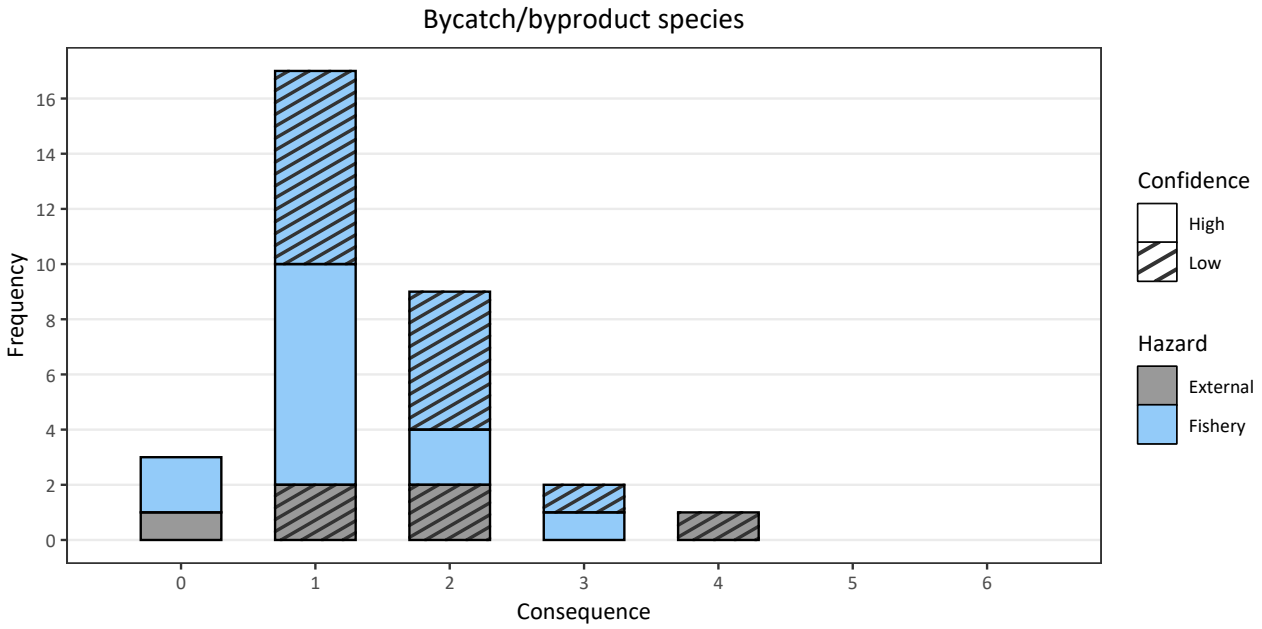

Figure 3.2: Bycatch/byproduct species component: Frequency of consequence score by high and low confidence.

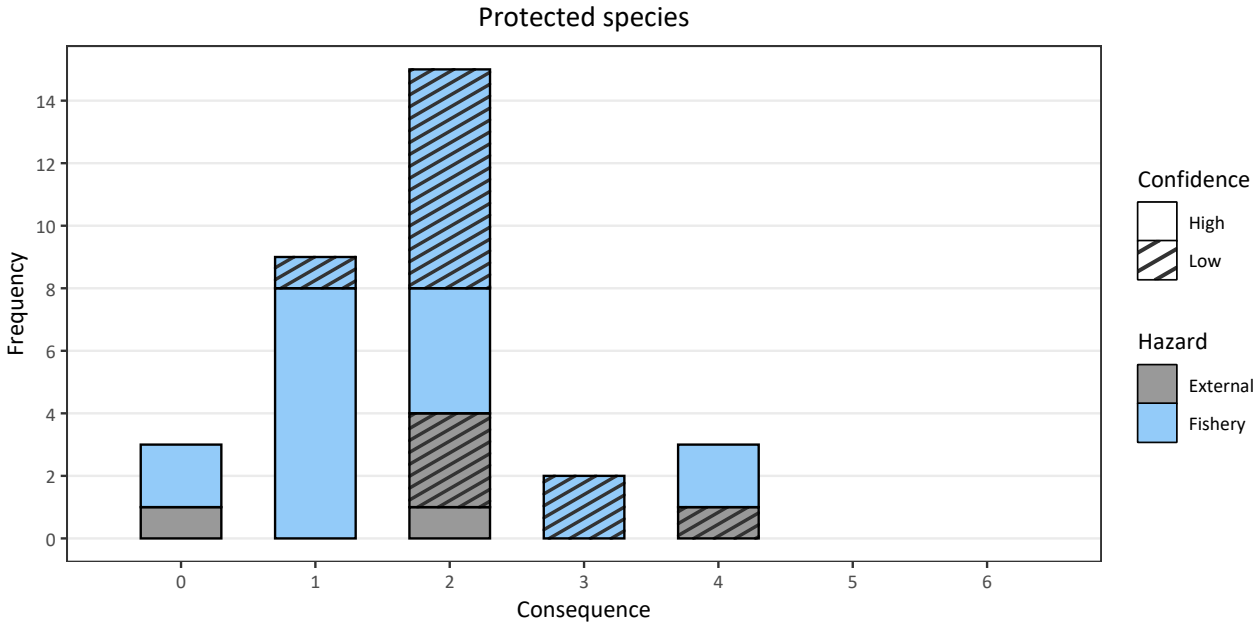

Figure 3.3: Protected species component: Frequency of consequence score by high and low confidence.

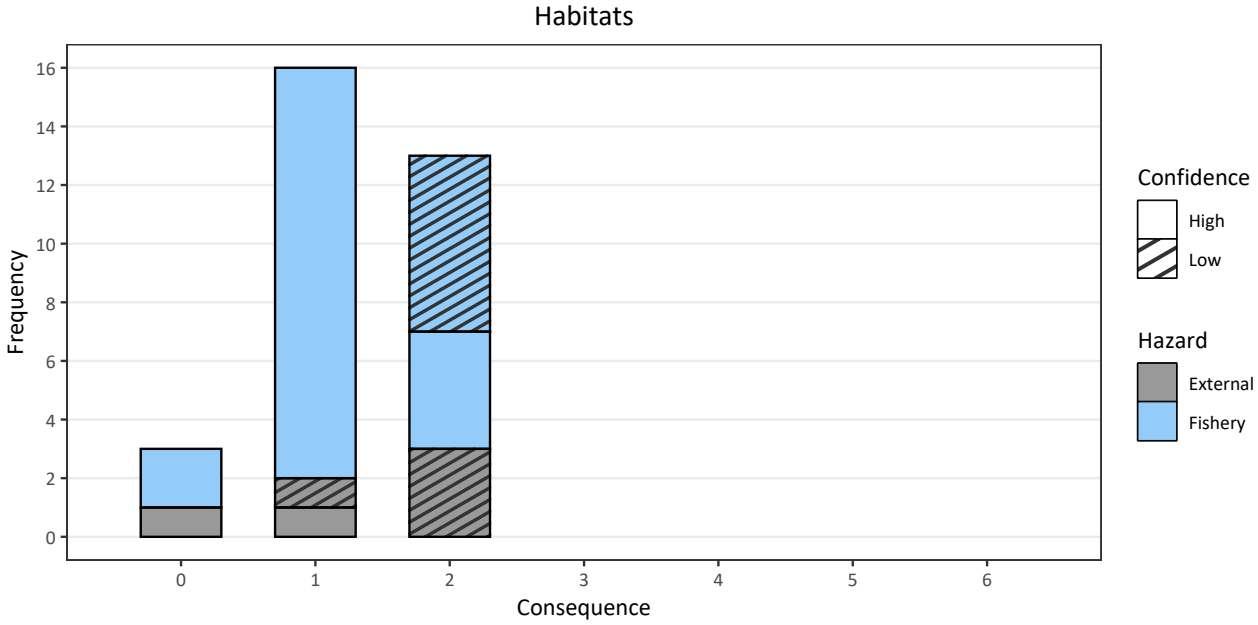

Figure 3.4: Habitats component: Frequency of consequence score by high and low confidence.

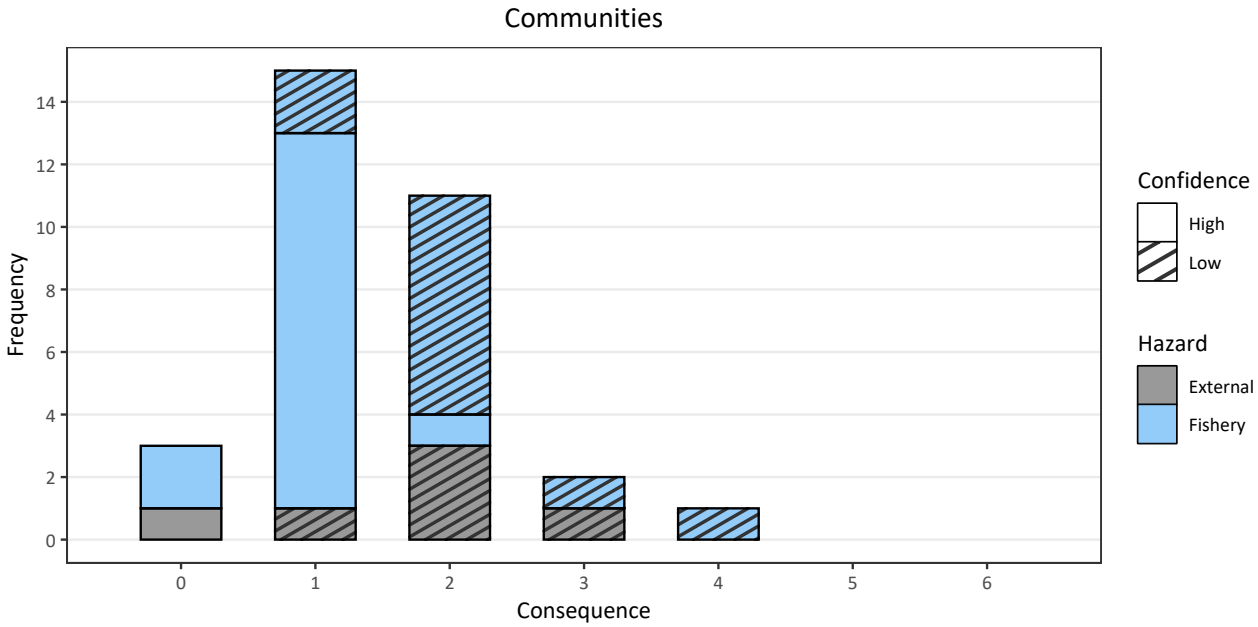

Figure 3.5: Communities component: Frequency of consequence score by high and low confidence.

3.12 Evaluation/Discussion of Level 1

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

- Direct impact/capture from fishing (Byproduct & bycatch species; protected species and communities)
- Direct impact/without capture from fishing (Byproduct & bycatch species; protected species)
- Addition/movement of biological material from discarding (protected species)
- Addition/movement of biological material from translocation of species (communities)
- Addition of non-biological material from navigation/steaming (protected species)
- External impacts from other fisheries (all ecological components except habitats)

The direct impacts of fishing hazard was scored as moderate for byproduct and bycatch and communities components and major for the protected species component, with a high confidence scores for both species components. A major risk (risk score 4) was also assessed due to indirect fishing impacts on protected species.

The major risk and high confidence scores for the protected species component (i.e., Shortfin Mako), for both fishing with and without capture was based on reported interactions from the Commonwealth Logbook database.

Translocation of species was considered a major risk (4) to Communities, due to the potential for the introduction of pathogens using imported baits. Evidence of pathogens in other fishery areas has previously shown the consequence of this hazard (Gaughan, 2001). The Communities component triggered a Level 2 analysis but was analysed in this assessment. This SICA has removed the Habitat component from further analysis, as it was identified as low risk based on consequence scores by the set of activities considered. Significant (i.e., risk score of at least moderate) external hazards included impacts from other fisheries in the region for all ecological components except habitats.

Hazards assessed as majorly affected from external impacts consisted of other fisheries in the region also capturing the same Key/secondary commercial species, or byproduct/bycatch species and on protected species. The communities ecological component was moderately impacted by other fisheries.

3.13 Components to be Examined at Level 2

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

- Byproduct and bycatch
- Protected species
- Communities

This SICA has removed the habitats component from further analysis, as it was judged to be impacted with low risk consequence scores <3 by the set of activities considered.

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

4 Level 2

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

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

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

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

4.1 Level 2 Productivity and Susceptibility Analysis (PSA)

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

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

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

Species

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

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

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

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

Table 4.2: Attributes that measure productivity and susceptibility.

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

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

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

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

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

Habitats

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

Communities

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

- Step 1. Identify the units excluded from analysis and document the reason for exclusion (see Table 2.26)
- Step 2. Score units for productivity
- Step 3. Score units for susceptibility
- Step 4. Plot individual units of analysis onto a PSA Plot
- Step 5. Ranking of overall risk of each unit
- Step 6. Evaluation of the PSA results
- Step 7. Decision rules to move from Level 2 to Level 3

Table 4.3: Description of susceptibility attributes for habitats.

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

4.1.1 Level 2 PSA (Steps 2 and 3)

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

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

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

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

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 Electronic Monitoring(EM) program has replaced the Observer monitoring program and has been operating since July 2015. There is 100% coverage for vessels operating for more than 30 days per year. The percentage of hooks reviewed is between 10-12% per year over this assessment period, which is considered to be low. 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., records of turtles, shearwaters, petrels, shearwaters and whales).

Summary of Habitats PSA results

The habitats component was not assessed at Level 2 as it was not triggered.

Summary of Communities PSA results

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

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

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

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

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

4.1.3 Uncertainty Analysis Ranking of Overall Risk (Step 5)

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

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

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

4.1.4 PSA Results and Discussion

Productivity Attributes

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

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

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

Susceptibility Attributes

Table 4.5: 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)

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

Post Capture Mortality

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

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

– syngnathids: score is 1

Table 4.6: Post capture mortality attribute risk score for the Eastern Tuna and Billfish Fishery - Pelagic longline for the ERAEF L2 PSA and bSAFE methods. High: H; medium: M; Low: L. Risk scores that are not assigned by taxa (not specific) for each ERAEF classification are in italics.

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

Key Commercial Species

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

Secondary Commercial Species

There are no secondary commercial species to be assessed at Level 2 in this fishery.

Commercial Bait Species

The commercial bait species component was not evaluated in this assessment since it was eliminated at Level 1.

Byproduct Species

There were no byproduct species considered in the PSA. Instead, 23 out of 25 byproduct species were assessed using the bSAFE method.

Bycatch Species

A total of six out of 186 bycatch species were assessed in the PSA. Of these, five were unassessable in bSAFE. Of all assessed bycatch species, one was at high risk (Sicklefin Weasel Shark *Hemigaleus australiensis*), four were at medium risk, and one was at low risk (Figure 4.1 and Table 4.7 and 4.8). Of these, none were non-robust (i.e., data deficient) species (Figure 4.1). Of the one high risk species, none have all 11 attributes, one is missing one to three attributes, and none are non-robust (i.e., missing more than three attributes). A residual risk analysis was performed on one species (Table 4.7 and 4.8; see also Section 4.6). Following the residual risk analysis, none of the one species remained at high risk, i.e., all species was reduced to medium (0) or low (1) risk. Therefore, overall, there were no high risk species, four medium risk species and two low risk species.

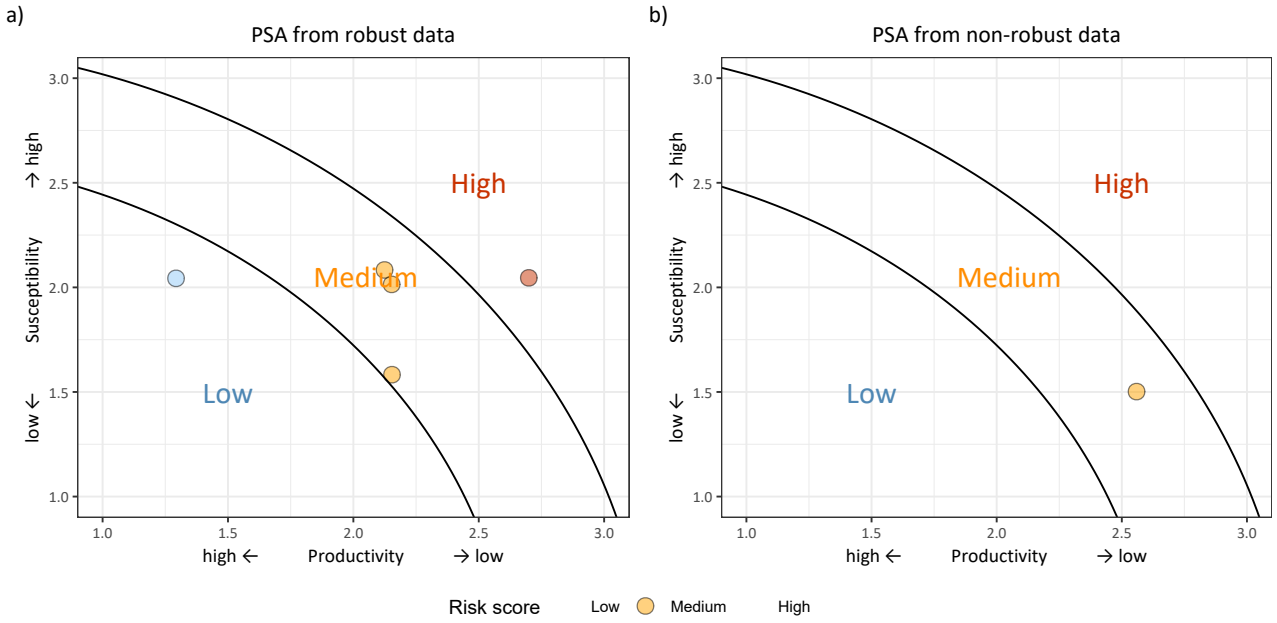

Figure 4.1: PSA plot for bycatch species in the Eastern Tuna and Billfish Fishery - Pelagic longline for (a) robust [left, less than three missing attributes] and (b) data deficient species [right, three or more missing attributes].

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

CAAB code	Scientific name	Common name	P1	P2	P3	P4	P5	P6	P7	S1	S2	S3	S4	Prod. score	Susc. score	Missing attributes	PSA 2D	Risk category
23636004	*Nototodarus gouldi*	Gould's Squid	1	1	1	1	1	2	2	3	3	1	2	1.29	2.06	1	2.43	Low

Table 4.8: Summary of the 'unassessable species in bSAFE' PSA scores on the set of productivity and susceptibility attributes for bycatch species and residual risk (RR) for high risk species. Five BC species (listed at the top of the table) were found to be unassessable in bSAFE and were assessed in PSA instead. Productivity attributes (P1-P7) are listed in Table 4.4. Susceptibility attributes (S1-S4) are listed in Table 4.5. Missing attributes are highlighted (red). Productivity score (Prod. score); Susceptibility score (Susc. score). No. interactions (No. Int. 2018-2022) reported for high risk scores only (source: Commonwealth logbook (LOG) and Electronic Monitoring (EM) databases). Residual risk guidelines drawn from document "Revision of residual risk guidelines to reflect updated Ecological Risk Assessment Methodology" - version Oct 12, 2016. See numbers in Table 4.1. NE: not entered. Ret: retained; dis: discarded. A: alive. D: dead. kg: kilograms. EPBC Act: Environment Protection and Biodiversity Act. IUCN: International Union of Conservation of Nature.

CAAB code	Scientific name	Common name	P1	P2	P3	P4	P5	P6	P7	S1	S2	S3	S4	Prod. score	Susc. score	Missing attributes	PSA 2D	Risk category	Interaction Numbers	Risk score following Residual Risk	Final risk score
37018020	*Hemigaleus australiensis*	Sicklefin Weasel Shark	3	3	3	2	2	3	3	1	3	3	2	2.71	2.06	2	3.4	High	A proportion of 37018000 (Whaler and weasel sharks- Carcharhinidae, Hemigaleidae - undifferentiated): LOG: 13,268 kg dis., 762 Individuals dis. EM: 928 kg dis., 21 individuals dis.	Expanded from 37018000: "Carcharhinidae, Hemigaleidae - undifferentiated", LOG, EM. This species is commonly caught by prawn and trawl fisheries, and less by gillnet fisheries and longline fisheries (https://fishesofaustralia.net.au/home/species/3258) Therefore, risk category is reduced to Low.	Low
37271001	*Trachipterus jacksonensis*	Southern Ribbonfish	3	3	1	2	3	1	2	1	2.7	3	2	2.14	2.01	2	2.94	Medium	NE	No RR required	Medium
37271002	*Desmodema polystictum*	Spotted Ribbonfish	3	3	1	2	2	1	3	1.1	3	3	2	2.14	2.09	2	2.99	Medium	NE	No RR required	Medium
37271003	*Zu cristatus*	Scalloped Ribbonfish	3	3	1	2	2	1	3	1	1	3	2	2.14	1.57	2	2.65	Medium	NE	No RR required	Medium
37272002	*Regalecus glesne*	Oarfish ("King Of Herrings")	3	3	3	3	3	1	2	1	2.7	1	2	2.57	1.52	3	2.99	Medium	NE	No RR required	Medium

Protected Species

A total of 74 out of 84 protected species were assessed in the PSA. Of all assessed protected species, 20 were at high risk, 47 were at medium risk, and seven were at low risk (Figure 4.2 and Table 4.9). Of these, one was a non-robust (i.e., data deficient) species (White Tern *Gygis alba*, Figure 4.2). Of the 20 high risk species, 18 have all 11 attributes, one is missing one to three attributes, and one is non-robust (i.e., missing more than three attributes). A residual risk analysis was performed on 20 species (Table 4.9; see also Section 4.6). Following the residual risk analysis, seven of the 20 species remained at high risk, i.e., 13 species were reduced to medium (0) or low (13) risk. Therefore, overall, there were a total of seven high risk species, 47 medium risk species and 20 low risk species.

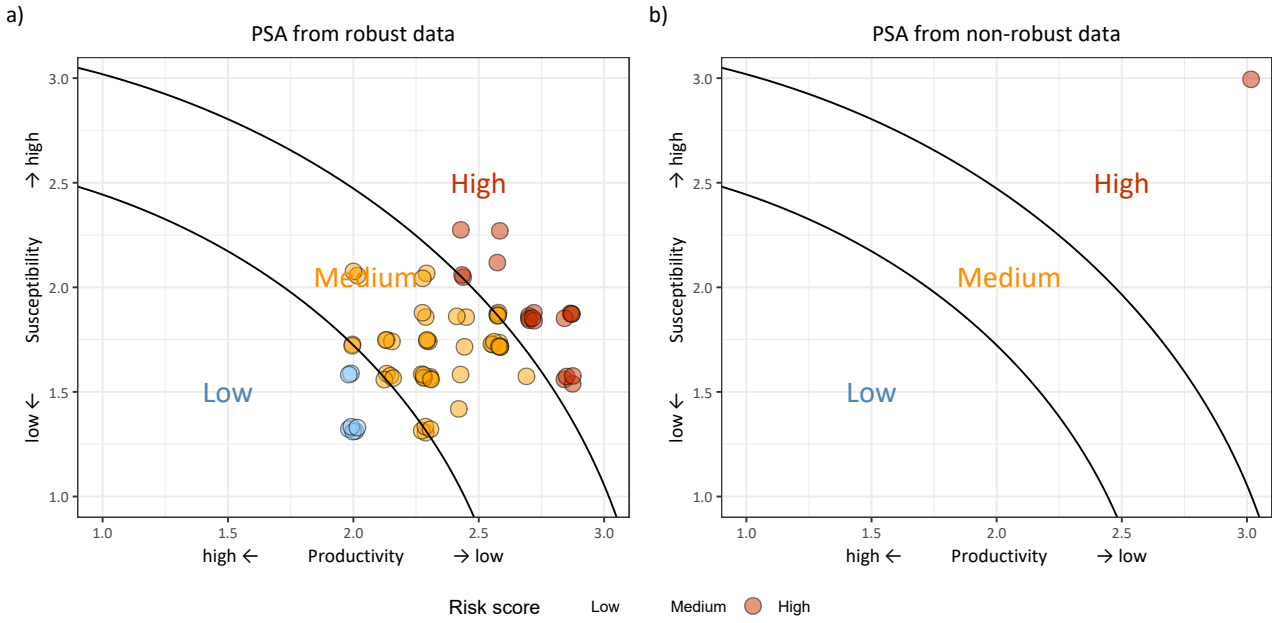

Figure 4.2: PSA plot for protected species in the Eastern Tuna and Billfish Fishery - Pelagic longline for (a) robust [left, less than three missing attributes] and (b) data deficient species [right, three or more missing attributes].

Table 4.9: Summary of the regular PSA scores on the set of productivity and susceptibility attributes for protected species and residual risk (RR) for high risk species. Productivity attributes (P1-P7) are listed in Table 4.4. Susceptibility attributes (S1-S4) are listed in Table 4.5. Missing attributes are highlighted (red). Productivity score (Prod. score); Susceptibility score (Susc. score). No. interactions (No. Int. 2018-2022) reported for high risk scores only (source: Commonwealth logbook (LOG) and Electronic Monitoring (EM) databases). Residual risk guidelines drawn from document "Revision of residual risk guidelines to reflect updated Ecological Risk Assessment Methodology" - version Oct 12, 2016. See numbers in Table 4.1. NE: not entered. Ret: retained; dis: discarded. A: alive. D: dead. kg: kilograms. EPBC Act: Environment Protection and Biodiversity Act. IUCN: International Union of Conservation of Nature.

CAAB code	Scientific name	Common name	P1	P2	P3	P4	P5	P6	P7	S1	S2	S3	S4	Prod. score	Susc. score	Missing attributes	PSA 2D	Risk category	Interaction Numbers	Risk score following Residual Risk	Final risk score
39020001	*Caretta caretta*	Loggerhead Turtle	2	3	2	2	2	3	3	1	3	3	2	2.43	2.06	0	3.19	High	LOG: Total: 66 (52 A, 13 D, 1 U). Also, a proportion of 39001001 (Turtles - order Testudines, except family Testunididae), Total: 119 (94 A, 24 D, 1 U).	Listed as Endangered (EPBC Act, Australia). Listed as Vulnerable (IUCN Red List). Nesting sites exist for a single genetic stock (South-western Pacific: southern Qld, northern NSW) (CWTH., 2017, and references within). National Recovery Plan exists for Turtles (CWTH., 2017, and references within). Mitigation measures exist for line-caught turtles (i.e., all Australian longline vessels are required to carry de-hookers and line cutters to facilitate quick release of turtles). National Recovery Plan exists for Turtles (CWTH., 2017, and references within).	High

Table 4.9: *(continued)*

CAAB code	Scientific name	Common name	P1	P2	P3	P4	P5	P6	P7	S1	S2	S3	S4	Prod. score	Susc. score	Missing at-tributes	PSA 2D	Risk cate-gory	Interaction Numbers	Risk score following Residual Risk	Final risk score
		Loggerhead Turtle (*continued*)																High		Mortality (across 14 identified threats, e.g., climate change/variability, marine debris ingestion, international take, domestic fisheries bycatch) ranges from low to very high risk and is of concern. Specifically, mortality due to domestic fisheries bycatch is likely to be moderate risk (CWTH., 2017). Stock status likely to be declining (CWTH., 2017). 2- at risk due to external factors (cumulative risks). 3- Interaction rate and life status (mostly alive). Risk remains High.	High

Table 4.9: *(continued)*

CAAB code	Scientific name	Common name	P1	P2	P3	P4	P5	P6	P7	S1	S2	S3	S4	Prod. score	Susc. score	Missing at-tributes	PSA 2D	Risk cate-gory	Interaction Numbers	Risk score following Residual Risk	Final risk score
39020002	*Chelonia mydas*	Green Turtle	3	3	2	2	2	3	2	1	3	3	3	2.43	2.28	0	3.33	High	LOG: Total: 164 (137 A, 27 D). Also, a proportion of 39001001 (Turtles - order Testudines, except family Testunididae), Total: 119 (94 A, 24 D, 1 U).	Listed as Vulnerable (EPBC Act, Australia). Listed as Endangered (IUCN Red List). Green turtles take 30-50 years to reach sexual maturity, after which females will only nest every 5-8 years. Although clutches may contain as many as 120 eggs, it's estimated that as few as 1 in 1,000 hatchlings survive to adulthood. There are key nesting sites for about three genetic stocks along Australia's east coast that overlap the ETBF (e.g., southern and northern GBR (e.g., Raine Island (the world's largest remaining rookery); Coral Sea (e.g., Elizabeth and Middleton Reefs)). Reduced hatchling production has declined since the 1990s at Raine Island (Smithers & Dawson, 2023). Habitat loss and sea level rise remains a risk.	High

Table 4.9: *(continued)*

CAAB code	Scientific name	Common name	P1	P2	P3	P4	P5	P6	P7	S1	S2	S3	S4	Prod. score	Susc. score	Missing at-tributes	PSA 2D	Risk cate-gory	Interaction Numbers	Risk score following Residual Risk	Final risk score
		Green Turtle (*continued*)																High		National Recovery Plan exists for Turtles (CWTH., 2017, and references within). Mitigation measures exist for line-caught turtles (i.e., all Australian longline vessels are required to carry de-hookers and line cutters to facilitate quick release). National Recovery Plan exists for Turtles (CWTH., 2017, and references within). Mortality (across 14 identified threats, e.g., climate change/variability, marine debris ingestion, international take, domestic fisheries bycatch) ranges from low to very high risk and is of concern. Specifically, mortality due to domestic fisheries bycatch is likely to be low to moderate risk across the stocks (CWTH., 2017). Stock status is largely unknown across the separate stocks except for southern GBR (recovering) and northern GBR (decreasing) (CWTH., 2017).	High

Table 4.9: *(continued)*

CAAB code	Scientific name	Common name	P1	P2	P3	P4	P5	P6	P7	S1	S2	S3	S4	Prod. score	Susc. score	Missing at-tributes	PSA 2D	Risk cate-gory	Interaction Numbers	Risk score following Residual Risk	Final risk score
		Green Turtle (*continued*)																High		Population: Raine Island: 100,000 nesting females (https://en.wikipedia.org/wiki/Green*sea*turtle). Recent estimates of hatchling production has increased by 640,000 over ~ 2017-21 period (Smithers & Dawson, 2023). 2- at risk due to external factors (cumulative risks). 3- Interaction rate and life status (mostly alive). Risk remains High.	High

Table 4.9: *(continued)*

CAAB code	Scientific name	Common name	P1	P2	P3	P4	P5	P6	P7	S1	S2	S3	S4	Prod. score	Susc. score	Missing at-tributes	PSA 2D	Risk cate-gory	Interaction Numbers	Risk score following Residual Risk	Final risk score
39020003	*Eretmochelys imbricata*	Hawksbill Turtle	3	3	2	2	2	3	2	1	3	2	3	2.43	2.06	0	3.19	High	LOG: Total: 18 (11 A, 6 D, 1 U). Also, a proportion of 39001001 (Turtles - order Testunididae, except family Testunididae), Total: 119 (94 A, 24 D, 1 U).	Listed as Vulnerable (EPBC Act, Australia). Listed as Critically Endangered (IUCN Red List). Nesting sites exist for two genetic stocks: (1) northern Qld (i.e., from Cape York-Gulf of Carpentaria to northern NSW) and (2) Australia-unknown (CWTH., 2017, and references within). Mitigation measures exist for line-caught turtles (i.e., all Australian longline vessels are required to carry de-hookers and line cutters to facilitate quick release). National Recovery Plan exists for Turtles (CWTH., 2017, and references within). Mortality (across 14 identified threats, e.g., climate change/variability, marine debris ingestion, international take, domestic fisheries bycatch) ranges from low to very high risk and is of concern.	High

Table 4.9: *(continued)*

CAAB code	Scientific name	Common name	P1	P2	P3	P4	P5	P6	P7	S1	S2	S3	S4	Prod. score	Susc. score	Missing at-tributes	PSA 2D	Risk cate-gory	Interaction Numbers	Risk score following Residual Risk	Final risk score
		Hawksbill Turtle (*continued*)																High		Specifically, mortality due to domestic fisheries bycatch is likely to be moderate risk (CWTH., 2017). Stock status likely to be declining (CWTH., 2017). 2- at risk due to external factors (cumulative risks). 3- Interaction rate and life status (mostly alive). Risk remains High.	High

Table 4.9: *(continued)*

CAAB code	Scientific name	Common name	P1	P2	P3	P4	P5	P6	P7	S1	S2	S3	S4	Prod. score	Susc. score	Missing at-tributes	PSA 2D	Risk cate-gory	Interaction Numbers	Risk score following Residual Risk	Final risk score
39020005	*Natator depressus*	Flatback Turtle	2	3	3	2	2	3	3	1	3	3	3	2.57	2.28	1	3.44	High	LOG: Total: 2 (2 D). Also, a proportion of 39001001 (Turtles - order Testudines, except family Testunididae), Total: 119 (94 A, 24 D, 1 U).	Listed as Vulnerable (EPBC Act, Australia). Listed as Data Deficient (IUCN Red List). Nesting sites exist for two genetic stocks: (1) eastern Qld; (2) Arafura Sea (Cape York and eastern Gulf of Carpentaria) and (3) Australia-unknown (CWTH., 2017, and references within). Mitigation measures exist for line-caught turtles (i.e., all Australian longline vessels are required to carry de-hookers and line cutters to facilitate quick release). National Recovery Plan exists for Turtles (CWTH., 2017, and references within). Mortality (across 14 identified threats, e.g., climate change/variability, marine debris ingestion, international take, domestic fisheries bycatch) ranges from low to high risk and is of concern.	High

Table 4.9: *(continued)*

CAAB code	Scientific name	Common name	P1	P2	P3	P4	P5	P6	P7	S1	S2	S3	S4	Prod. score	Susc. score	Missing at-tributes	PSA 2D	Risk cate-gory	Interaction Numbers	Risk score following Residual Risk	Final risk score
		Flatback Turtle (*continued*)																High		Specifically, mortality due to domestic fisheries bycatch is likely to be moderate risk (CWTH., 2017). Stock status likely to be stable (CWTH., 2017). 2- at risk due to external factors (cumulative risks). 3- Interaction rate and life status (mostly alive). Risk remains High.	High

Table 4.9: *(continued)*

CAAB code	Scientific name	Common name	P1	P2	P3	P4	P5	P6	P7	S1	S2	S3	S4	Prod. score	Susc. score	Missing at-tributes	PSA 2D	Risk cate-gory	Interaction Numbers	Risk score following Residual Risk	Final risk score
39021001	*Dermochelys coriacea*	Leatherback Turtle	3	3	2	2	2	3	3	1	2.3	3	3	2.57	2.13	0	3.34	High	LOG: Total: 189 (183 A, 5 D, 1 U). Also, a proportion of 39001001 (Turtles - order Testudines, except family Testunididae), Total: 119 (94 A, 24 D, 1 U).	Listed as Endangered (EPBC Act, Australia). Listed as Vulnerable (IUCN Red List). Nesting sites exist for an eastern Australia-unknown genetic stock (from Queensland and NSW) (CWTH., 2017, and references within). Also, at risk from plastic ingestion. Monitoring recommended (CWTH., 2017). Mitigation measures exist for line-caught turtles (i.e., all Australian longline vessels are required to carry de-hookers and line cutters to facilitate quick release). National Recovery Plan exists for Turtles (CWTH., 2017, and references within). Mortality (across 14 identified threats, e.g., climate change/variability, marine debris ingestion, international take, domestic fisheries bycatch) ranges from low to high risk and is of concern.	High

Table 4.9: *(continued)*

CAAB code	Scientific name	Common name	P1	P2	P3	P4	P5	P6	P7	S1	S2	S3	S4	Prod. score	Susc. score	Missing at-tributes	PSA 2D	Risk cate-gory	Interaction Numbers	Risk score following Residual Risk	Final risk score
		Leatherback Turtle (*continued*)																High		Specifically, mortality due to domestic fisheries bycatch is likely to be high risk (CWTH., 2017). Stock status likely to be declining (CWTH., 2017). 2- at risk due to external factors (cumulative risks). 3-Interaction rate and life status (mostly alive). Risk remains High.	High

Table 4.9: *(continued)*

CAAB code	Scientific name	Common name	P1	P2	P3	P4	P5	P6	P7	S1	S2	S3	S4	Prod. score	Susc. score	Missing at-tributes	PSA 2D	Risk cate-gory	Interaction Numbers	Risk score following Residual Risk	Final risk score
41116013	*Pseudorca crassidens*	False Killer Whale	2	3	3	3	3	3	3	1	3	1	2	2.86	1.57	0	3.26	High	LOG: Total: 8 (8 A, 0 D). Also, a proportion of 41116000 (Dolphins - Delphinidae), LOG: Total: 21 (18 A, 3 D).	Listed as Near Threatened Globally (IUCN Red List). Population trend is unknown. Australian abundance estimates unknown, but available throughout its' wider range. East tropical Pacific abundance: 38,900 for 1986-91 (Wade & Gerrodette, 1993); western North Pacific: 16,668 (Miyashita, 1993); Gulf of Mexico: 381 for 1991-94, 1038 for 1996-2001, 777 for 2003-04 (Waring et al., 2013); US: 442 for 2011 (Waring et al., 2013); New Zealand: 111 for 2005-11 (Zaeschmar, 2014); Hawaiian Archipelago: 1540 (Bradford et al., 2014). Generally, these delphinids are the least abundant even in their highest density areas. It was estimated that there was a >50% decline in abundance in less than two generations for the main Hawaiian Island insular stock (Oleson et al., 2010).	High

Table 4.9: *(continued)*

CAAB code	Scientific name	Common name	P1	P2	P3	P4	P5	P6	P7	S1	S2	S3	S4	Prod. score	Susc. score	Missing at-tributes	PSA 2D	Risk cate-gory	Interaction Numbers	Risk score following Residual Risk	Final risk score
		False Killer Whale (*continued*)																High		1 - Risk rating due to missing (data deficient), incorrect or out of date information. 2- at risk due to external factors (decline in Hawaiian stock) Risk category remains High.	High

Table 4.9: *(continued)*

CAAB code	Scientific name	Common name	P1	P2	P3	P4	P5	P6	P7	S1	S2	S3	S4	Prod. score	Susc. score	Missing at-tributes	PSA 2D	Risk cate-gory	Interaction Numbers	Risk score following Residual Risk	Final risk score
41116014	*Sousa sahulensis*	Australian Humpback Dolphin	2	3	3	2	3	3	3	1	3	2	2	2.71	1.86	0	3.29	High	Expanded from 41116000: "Dolphins - Delphinidae", AFMA. A proportion of 41116000 (Dolphins - Delphinidae), LOG: Total: 21 (18 A, 3 D).	Listed as Migratory (EPBC Act, Australia). Listed as Vulnerable (IUCN Red List). Listed as Near Threatened in Queensland. Estimates of abundance are available from several discrete locations across Australia. Available abundance estimates indicate that these dolphins occur in small subpopulations (average: 54-89 individuals; 0.1-0.19 individuals per km^2) and live in small and localized subpopulations connected by limited gene flow. No subpopulation to date is estimated to contain >104 mature individuals (MI). Therefore, overall, there could <10,000 MI (Assessed in 2017; https://www.iucnredlist.org/species/82031667/82031671). The low reproductive rates make them vulnerable to low rates of anthropogenic mortality.	High

Table 4.9: *(continued)*

CAAB code	Scientific name	Common name	P1	P2	P3	P4	P5	P6	P7	S1	S2	S3	S4	Prod. score	Susc. score	Missing at-tributes	PSA 2D	Risk cate-gory	Interaction Numbers	Risk score following Residual Risk	Final risk score
		Australian Humpback Dolphin (*continued*)																High		Therefore, risk category remains High.	High
40128009	*Gygis alba*	White Tern	3	3	3	3	3	3	3	3	3	3	3	3	3	9	4.24	High	A proportion of 40128901 (Terns - Laridaae), AFMA. LOG: Total: 1 (0 A, 1 D)	Expanded from 40128901: "Terns - Laridae", AFMA. 3-Low interaction rate and life status (alive), risk category is reduced to Low.	Low
41116002	*Feresa attenuata*	Pygmy Killer Whale	2	3	3	3	3	3	3	1	3	2	2	2.86	1.86	0	3.41	High	Expanded from 41116000: "Dolphins - Delphinidae", AFMA. A proportion of 41116000 (Dolphins - Delphinidae), LOG: Total: 21 (18 A, 3 D).	Listed as Least Concern (IUCN Red List). Population trend unknown (Assessed in 2017; https://www.iucnredlist.org/species/8551/ 50354433). No known abundance estimates for Australia. 3-Low interaction rate and life status (alive), risk category is reduced to Low.	Low

Table 4.9: *(continued)*

CAAB code	Scientific name	Common name	P1	P2	P3	P4	P5	P6	P7	S1	S2	S3	S4	Prod. score	Susc. score	Missing at-tributes	PSA 2D	Risk cate-gory	Interaction Numbers	Risk score following Residual Risk	Final risk score
41116003	*Globicephala macrorhynchus*	Short-Finned Pilot Whale	2	3	3	3	3	3	3	1	3	1	2	2.86	1.57	0	3.26	High	LOG: Total: 18 (14 A, 3 D, 1 U). Also, a proportion of 41116000 (Dolphins - Delphinidae), LOG: Total: 21 (18 A, 3 D).	Listed as Least Concern (IUCN Red List). It has a wide distribution, in both tropical and temperate waters. It remains data-poor in much of its range, especially in Southern Hemisphere and in large parts of the tropical and warm temperate North Atlantic Ocean. Total available abundance estimate: ~700,000 but large parts of the species range have not been surveyed and therefore actual abundance must be considerably greater than this. Information on abundance trends at the global scale is lacking, and a lack of threats over much of the range does not suggest declining trends.	Low

Table 4.9: *(continued)*

CAAB code	Scientific name	Common name	P1	P2	P3	P4	P5	P6	P7	S1	S2	S3	S4	Prod. score	Susc. score	Missing at-tributes	PSA 2D	Risk cate-gory	Interaction Numbers	Risk score following Residual Risk	Final risk score
		Short-Finned Pilot Whale (*continued*)																High		They are widely distributed in warm waters of all oceans, they appear to be relatively abundant in many parts of their range, and no threats are considered significant or pervasive throughout the range of the species. Its' exploitation may have caused a significant decline in at least the near-shore waters of Japan. There is no indication of large-scale mortality (other than by mass stranding, which is characteristic of both species of *Globicephala*) or population declines at present (Assessed in 2018, IUCN: https://www.iucnredlist.org, species/9249/ 50355227). 3- Low interaction rate and life status (mostly alive), risk category is reduced to Low.	Low

Table 4.9: *(continued)*

CAAB code	Scientific name	Common name	P1	P2	P3	P4	P5	P6	P7	S1	S2	S3	S4	Prod. score	Susc. score	Missing at-tributes	PSA 2D	Risk cate-gory	Interaction Numbers	Risk score following Residual Risk	Final risk score
41116004	*Globicephala melas*	Long-Finned Pilot Whale	2	3	3	3	3	3	3	1	2.7	1	2	2.86	1.53	0	3.24	High	LOG: Total: 4 (4 A, 0 D). Also, a proportion of 41116000 (Dolphins - Delphinidae), LOG: Total: 21 (18 A, 3 D).	Listed as Least Concern (IUCN Red List). It has a relatively wide distribution in temperate and subpolar waters of Southern Hemisphere (SH) and North Atlantic Ocean and appears to be relatively abundant in many parts of its' range. It remains data-poor in much of its range, especially in SH. No reliable abundance estimates in areas where this and Short-finned Pilot Whale overlap, due to identification issue. Total abundance estimate: ~one million individuals, likely to be considerably greater than this as large parts of species' range in the SH not surveyed. No threats due to harvesting are considered significant or pervasive throughout the species range (except in Faroes and Greenland).	Low

Table 4.9: *(continued)*

CAAB code	Scientific name	Common name	P1	P2	P3	P4	P5	P6	P7	S1	S2	S3	S4	Prod. score	Susc. score	Missing at-tributes	PSA 2D	Risk cate-gory	Interaction Numbers	Risk score following Residual Risk	Final risk score
		Long-Finned Pilot Whale (*continued*)																High		Currently no indication of large-scale mortality (other than by mass stranding, which is characteristic of both species of *Globicephala*) or population declines (Assessed 2018, IUCN: https://www.iucnredlist.org, species/9250/ 50356171). 3- Low interaction rate and life status (mostly alive), risk category is reduced to Low.	Low

Table 4.9: *(continued)*

CAAB code	Scientific name	Common name	P1	P2	P3	P4	P5	P6	P7	S1	S2	S3	S4	Prod. score	Susc. score	Missing at-tributes	PSA 2D	Risk cate-gory	Interaction Numbers	Risk score following Residual Risk	Final risk score
41116005	*Grampus griseus*	Risso's Dolphin	2	3	3	3	3	3	3	1	3	2	2	2.86	1.86	0	3.41	High	Expanded from 41116000: "Dolphins - Delphinidae", AFMA. A proportion of 41116000 (Dolphins - Delphinidae), LOG: Total: 21 (18 A, 3 D).	Widely distributed in tropic and temperate regions in both hemispheres. Total abundance estimates: ~350,000 individuals, noting these are from only a small fraction of the total species distribution range. Therefore, actual abundance is likely much higher. Threats that may be causing declines include bycatch in offshore gillnets, pelagic longlines and other fishing gear (Assessed in 2018, IUCN: https://www.iucnredlist.org /species/9461/ 50356660). 3- Low interaction rate and life status (alive), risk category is reduced to Low.	Low

Table 4.9: *(continued)*

CAAB code	Scientific name	Common name	P1	P2	P3	P4	P5	P6	P7	S1	S2	S3	S4	Prod. score	Susc. score	Missing at-tributes	PSA 2D	Risk cate-gory	Interaction Numbers	Risk score following Residual Risk	Final risk score
41116006	*Lagenodelphis hosei*	Fraser's Dolphin	2	3	3	2	3	3	3	1	3	2	2	2.71	1.86	0	3.29	High	Expanded from 41116000: "Dolphins - Delphinidae", AFMA. A proportion of 41116000 (Dolphins - Delphinidae), LOG: Total: 21 (18 A, 3 D).	Population trend is unknown. The sum of known abundance estimates is about 320,000 individuals (eastern tropical Pacific, northern Gulf of Mexico, Hawaiian Islands, Philippines, northern and western Indian Ocean). However, these reported surveys covered only a small fraction of the total range of the species. So, total abundance likely to be considerably higher (IUCN: https://www.iucnredlist.org, species/11140/ 50360282). 3- Low interaction rate and life status (alive), risk category is reduced to Low.	Low

Table 4.9: *(continued)*

CAAB code	Scientific name	Common name	P1	P2	P3	P4	P5	P6	P7	S1	S2	S3	S4	Prod. score	Susc. score	Missing at-tributes	PSA 2D	Risk cate-gory	Interaction Numbers	Risk score following Residual Risk	Final risk score
41116009	*Lissodelphis peronii*	Southern Right Whale Dolphin	2	3	3	2	3	3	3	1	3	2	2	2.71	1.86	0	3.29	High	Expanded from 41116000: "Dolphins - Delphinidae", AFMA. A proportion of 41116000 (Dolphins - Delphinidae), LOG: Total: 21 (18 A, 3 D).	There are no abundance estimates for this species and virtually nothing is known of population structure or status, although they are considered fairly common throughout their range particularly in Chile (Assessed in 2018, IUCN: https://www.iucnredlist.org/species/12126/50362558). 3- Low interaction rate and life status (alive), risk category is reduced to Low.	Low

Table 4.9: *(continued)*

CAAB code	Scientific name	Common name	P1	P2	P3	P4	P5	P6	P7	S1	S2	S3	S4	Prod. score	Susc. score	Missing at-tributes	PSA 2D	Risk cate-gory	Interaction Numbers	Risk score following Residual Risk	Final risk score
41116010	*Orcaella heinsohni*	Australian Snubfin Dolphin	2	3	3	2	3	3	3	1	3	2	2	2.71	1.86	0	3.29	High	Expanded from 41116000: "Dolphins - Delphinidae", AFMA. A proportion of 41116000 (Dolphins - Delphinidae), LOG: Total: 21 (18 A, 3 D).	Listed as Migratory (EPBC Act, Australia).Listed as Vulnerable (IUCN Red List). It has a restricted and discontinuous spatial distribution, occurs mainly over a narrow strip of shallow coastal waters, occurs in relatively small subpopulations (at most, 250 mature individuals), which are relatively isolated with limited gene flow among them. Therefore, it is highly likely that the largest subpopulation has <1,000 mature individuals and that there could be <10,000 mature individuals across its' range (IUCN: https://www.iucnredlist.org/species/136315/123793740) They are long-lived (28-30 years), have slow rates of increase (0.037, range 0.02-0.06), late reproductive maturity (8-10 years) and low reproductive rates (Moore, 2015).	Low

Table 4.9: *(continued)*

CAAB code	Scientific name	Common name	P1	P2	P3	P4	P5	P6	P7	S1	S2	S3	S4	Prod. score	Susc. score	Missing at-tributes	PSA 2D	Risk cate-gory	Interaction Numbers	Risk score following Residual Risk	Final risk score
		Australian Snubfin Dolphin (*continued*)																High		Population trend: decreasing. The restricted distribution mainly along coastal waters suggests that it is less likely to interact with ETBF operations. 3- Low interaction rate and life status (alive), risk category is reduced to Low.	Low
41116011	*Orcinus orca*	Killer Whale	2	3	3	3	3	3	3	1	3	1	2	2.86	1.57	0	3.26	High	Expanded from 41116000: "Dolphins - Delphinidae", AFMA. A proportion of 41116000 (Dolphins - Delphinidae), LOG: Total: 21 (18 A, 3 D).	Listed as Migratory (EPBC Act, Australia). Listed as Data Deficient (IUCN Red List). Population trend is unknown (Assessed 2017; IUCN: https://www.iucnredlist.org/species/15421/503681253) 3- Low interaction rate and life status (alive), risk category is reduced to Low.	Low

Table 4.9: *(continued)*

CAAB code	Scientific name	Common name	P1	P2	P3	P4	P5	P6	P7	S1	S2	S3	S4	Prod. score	Susc. score	Missing at-tributes	PSA 2D	Risk cate-gory	Interaction Numbers	Risk score following Residual Risk	Final risk score
41116012	*Peponocephala electra*	Melon-Headed Whale	2	3	3	2	3	3	3	1	3	2	2	2.71	1.86	0	3.29	High	LOG: Total: 2 (2 A, 0 D). Also, a proportion of 41116000 (Dolphins - Delphinidae), LOG: Total: 21 (18 A, 3 D).	Listed as Least Concern (IUCN Red List). Population trend is unknown and no known estimates from Australia. However, there are abundance estimates throughout its range (Assessed in 2019, IUCN: https:// www.iucnredlist.org/species/16564/50369125). 3- Low interaction rate and life status (alive), risk category is reduced to Low.	Low

Table 4.9: *(continued)*

CAAB code	Scientific name	Common name	P1	P2	P3	P4	P5	P6	P7	S1	S2	S3	S4	Prod. score	Susc. score	Missing at-tributes	PSA 2D	Risk cate-gory	Interaction Numbers	Risk score following Residual Risk	Final risk score
41116018	*Steno bredanensis*	Rough-Toothed Dolphin	2	3	3	2	3	3	3	1	3	2	2	2.71	1.86	0	3.29	High	Expanded from 41116000: "Dolphins - Delphinidae", AFMA. A proportion of 41116000 (Dolphins - Delphinidae), LOG: Total: 21 (18 A, 3 D).	Listed as Least Concern (IUCN Red List). Population trend unknown. Abundance estimates for a relatively small proportion of their range e.g., Eastern Pacific: 145,900 between 1986-90 (Wade & Gerrodette, 1993); Hawaiian Island EEZ: 72,528 (Bradford et al., 2017); northern Gulf of Mexico: 624 (Garrison, 2016); central Florida: 271 (Hayes et al., 2017). Total abundance estimate: 221,186, but this is less than the actual total abundance as large parts of their range not surveyed (Assessed 2018; https://www.iucnredlist.org/species/20738/178929751). 3- Low interaction rate and life status (mostly alive) and total abundance expected to be greater than reported. Therefore, risk category is reduced to Low.	Low

Table 4.9: *(continued)*

CAAB code	Scientific name	Common name	P1	P2	P3	P4	P5	P6	P7	S1	S2	S3	S4	Prod. score	Susc. score	Missing at-tributes	PSA 2D	Risk cate-gory	Interaction Numbers	Risk score following Residual Risk	Final risk score
41116019	*Tursiops truncatus*	Bottlenose Dolphin	2	3	3	3	3	3	3	1	3	2	2	2.86	1.86	0	3.41	High	LOG: Total: 3 (3 A, 0 D). Also, a proportion of 41116000 (Dolphins - Delphinidae), LOG: Total: 21 (18 A, 3 D).	Listed as Least Concern (IUCN Red List). Population trend unknown. Abundance estimated for several parts of species range. Minimum world-wide abundance estimate: 750,000, but most of species range not surveyed for abundance estimation, and some estimates included in the total are out of date (Assessed in 2018; https://www.iucnredlist.org/species/22563/156932432). In offshore waters of Western Indian Ocean, majority of this species were the most common cetaceans observed (Ballance & Pitman, 1998). 3- Low interaction rate and life status (alive), risk category is reduced to Low.	Low

Table 4.9: *(continued)*

CAAB code	Scientific name	Common name	P1	P2	P3	P4	P5	P6	P7	S1	S2	S3	S4	Prod. score	Susc. score	Missing at-tributes	PSA 2D	Risk cate-gory	Interaction Numbers	Risk score following Residual Risk	Final risk score
41116020	*Tursiops aduncus*	Indian Ocean Bottlenose Dolphin	2	3	3	3	3	3	3	1	3	2	2	2.86	1.86	0	3.41	High	Expanded from 41116000: "Dolphins - Delphinidae", AFMA. A proportion of 41116000 (Dolphins - Delphinidae), LOG: Total: 21 (18 A, 3 D).	Listed as Near Threatened (IUCN Red List). In Australian waters, estimates of local populations indicate that this species is common mainly in inshore and nearshore waters. Therefore they are less likely to interact with ETBF operations. Also, 3- Low interaction rate and life status (alive). Therefore, risk category is reduced to Low.	Low
39020004	*Lepidochelys olivacea*	Olive Ridley Turtle	3	3	3	1	2	3	3	1	3	2	2	2.57	1.86	0	3.17	Medium	NE	No RR required	Medium
40040001	*Thalassarche bulleri platei*	Buller's Albatross	2	3	3	1	1	3	3	1	1	2	3	2.29	1.57	1	2.78	Medium	NE	No RR required	Medium
40040002	*Thalassarche cauta*	Shy Albatross	2	3	3	1	1	3	3	1	1	2	3	2.29	1.57	1	2.78	Medium	NE	No RR required	Medium
40040004	*Thalassarche chrysostoma*	Grey-Headed Albatross	2	3	3	1	1	3	3	1	1	2	3	2.29	1.57	1	2.78	Medium	NE	No RR required	Medium
40040005	*Diomedea epomophora*	Southern Royal Albatross	2	3	3	2	2	3	3	1	1	3	3	2.57	1.73	1	3.1	Medium	NE	No RR required	Medium
40040006	*Diomedea exulans*	Wandering Albatross	2	3	3	2	2	3	3	1	1	3	3	2.57	1.73	1	3.1	Medium	NE	No RR required	Medium
40040007	*Thalassarche melanophris*	Black-Browed Albatross	2	3	3	1	1	3	3	1	1	2	3	2.29	1.57	1	2.78	Medium	NE	No RR required	Medium

Table 4.9: *(continued)*

CAAB code	Scientific name	Common name	P1	P2	P3	P4	P5	P6	P7	S1	S2	S3	S4	Prod. score	Susc. score	Missing at-tributes	PSA 2D	Risk cate-gory	Interaction Numbers	Risk score following Residual Risk	Final risk score
40040008	*Phoebetria fusca*	Sooty Albatross	2	2	3	1	1	3	3	1	1	2	3	2.14	1.57	1	2.65	Medium	NE	No RR required	Medium
40040009	*Phoebetria palpebrata*	Light-Mantled Albatross;Light-Mantled Sooty Albatross	2	3	3	1	1	3	3	1	1	2	3	2.29	1.57	1	2.78	Medium	NE	No RR required	Medium
40040010	*Diomedea gibsoni*	Gibson's Albatross	2	3	3	2	2	3	3	1	1	3	3	2.57	1.73	1	3.1	Medium	NE	No RR required	Medium
40040011	*Diomedea antipodensis*	Antipodean Albatross	2	3	3	2	2	3	3	1	1	3	3	2.57	1.73	1	3.1	Medium	NE	No RR required	Medium
40040012	*Diomedea sanfordi*	Northern Royal Albatross	2	3	3	2	2	3	3	1	1	3	3	2.57	1.73	1	3.1	Medium	NE	No RR required	Medium
40040013	*Thalassarche impavida*	Campbell Albatross	2	3	3	2	2	3	3	1	1	3	3	2.57	1.73	1	3.1	Medium	NE	No RR required	Medium
40040014	*Thalassarche carteri*	Indian Yellow-Nosed Albatross	1	3	3	1	1	3	3	1	1	2	3	2.14	1.57	1	2.65	Medium	NE	No RR required	Medium
40040016	*Thalassarche salvini*	Salvin's Albatross	2	3	3	1	1	3	3	1	1	2	3	2.29	1.57	1	2.78	Medium	NE	No RR required	Medium
40040017	*Thalassarche eremita*	Chatham Albatross	2	3	3	1	1	3	3	1	1	2	3	2.29	1.57	1	2.78	Medium	NE	No RR required	Medium
40040018	*Diomedea amsterdamensis*	Amsterdam Albatross	2	3	3	2	2	3	3	1	1	3	3	2.57	1.73	1	3.1	Medium	NE	No RR required	Medium
40040019	*Diomedea dabbenena*	Tristan Albatross	2	3	3	2	2	3	3	1	1	3	3	2.57	1.73	1	3.1	Medium	NE	No RR required	Medium
40041003	*Daption capense*	Cape Petrel	2	2	3	1	2	3	3	1	1	1	3	2.29	1.32	1	2.64	Medium	NE	No RR required	Medium
40041036	*Puffinus assimilis*	Little Shearwater	1	3	3	1	2	3	3	1	1	1	3	2.29	1.32	1	2.64	Medium	NE	No RR required	Medium

Table 4.9: *(continued)*

CAAB code	Scientific name	Common name	P1	P2	P3	P4	P5	P6	P7	S1	S2	S3	S4	Prod. score	Susc. score	Missing at-tributes	PSA 2D	Risk cate-gory	Interaction Numbers	Risk score following Residual Risk	Final risk score
40041038	*Ardenna carneipes*	Flesh-Footed Shearwater	1	3	3	1	2	3	3	1	3	2	3	2.29	2.06	1	3.08	Medium	NE	No RR required	Medium
40041040	*Puffinus gavia*	Fluttering Shearwater	1	3	3	1	2	3	3	1	3	1	3	2.29	1.73	1	2.87	Medium	NE	No RR required	Medium
40041042	*Ardenna griseus*	Sooty Shearwater	1	3	3	1	2	3	3	1	1	1	3	2.29	1.32	1	2.64	Medium	NE	No RR required	Medium
40041043	*Puffinus huttoni*	Hutton's Shearwater	1	3	3	1	2	3	3	1	3	1	3	2.29	1.73	1	2.87	Medium	NE	No RR required	Medium
40041047	*Ardenna tenuirostris*	Short-Tailed Shearwater	2	3	3	1	2	3	3	1	3	1	3	2.43	1.73	1	2.98	Medium	NE	No RR required	Medium
40047002	*Morus serrator*	Australasian Gannet	1	3	3	1	1	3	3	1	1	2	3	2.14	1.57	1	2.65	Medium	NE	No RR required	Medium
40128006	*Chlidonias hybrida*	Whiskered Tern	1	2	3	1	1	3	3	3	1	2	3	2	2.06	2	2.87	Medium	NE	No RR required	Medium
40128007	*Chlidonias leucopterus*	White-Winged Black Tern	1	2	3	1	1	3	3	3	1	2	3	2	2.06	2	2.87	Medium	NE	No RR required	Medium
40128018	*Procelsterna cerulea*	Grey Ternlet	2	2	3	1	1	3	3	1	1	2	3	2.14	1.57	1	2.65	Medium	NE	No RR required	Medium
40128024	*Thalasseus bengalensis*	Lesser Crested Tern	1	2	3	1	1	3	3	3	1	1	3	2	1.73	2	2.64	Medium	NE	No RR required	Medium
40128025	*Thalasseus bergii*	Crested Tern	1	3	3	1	2	3	3	3	1	1	3	2.29	1.73	2	2.87	Medium	NE	No RR required	Medium
40128026	*Hydroprogne caspia*	Caspian Tern	1	3	3	1	2	3	3	1	1	1	3	2.29	1.32	1	2.64	Medium	NE	No RR required	Medium
40128028	*Onychoprion fuscatus*	Sooty Tern	1	3	3	1	1	3	3	3	1	1	3	2.14	1.73	2	2.75	Medium	NE	No RR required	Medium
40128029	*Sterna hirundo*	Common Tern	1	3	3	1	1	3	3	3	1	1	3	2.14	1.73	2	2.75	Medium	NE	No RR required	Medium
40128030	*Sternula nereis*	Fairy Tern	1	2	3	1	1	3	3	3	1	1	3	2	1.73	2	2.64	Medium	NE	No RR required	Medium

Table 4.9: *(continued)*

CAAB code	Scientific name	Common name	P1	P2	P3	P4	P5	P6	P7	S1	S2	S3	S4	Prod. score	Susc. score	Missing at-tributes	PSA 2D	Risk cate-gory	Interaction Numbers	Risk score following Residual Risk	Final risk score
40128032	*Sterna paradisaea*	Arctic Tern	1	3	3	1	1	3	3	3	1	1	3	2.14	1.73	2	2.75	Medium	NE	No RR required	Medium
41112006	*Megaptera novaeangliae*	Humpback Whale	1	3	3	3	3	3	3	1	3	1	2	2.71	1.57	0	3.13	Medium	NE	No RR required	Medium
41116001	*Delphinus delphis*	Common Dolphin	1	2	3	2	2	3	3	1	3	2	2	2.29	1.86	0	2.95	Medium	NE	No RR required	Medium
41116007	*Lagenorhynchus cruciger*	Hourglass Dolphin	1	3	3	2	2	3	3	1	1	3	2	2.43	1.57	0	2.89	Medium	NE	No RR required	Medium
41116008	*Lagenorhynchus obscurus*	Dusky Dolphin	1	3	3	2	2	3	3	1	1	2	2	2.43	1.41	0	2.81	Medium	NE	No RR required	Medium
41116015	*Stenella attenuata*	Spotted Dolphin	2	3	3	2	2	3	3	1	3	2	2	2.57	1.86	0	3.17	Medium	NE	No RR required	Medium
41116016	*Stenella coeruleoalba*	Striped Dolphin	2	3	3	2	2	3	3	1	3	2	2	2.57	1.86	0	3.17	Medium	NE	No RR required	Medium
41116017	*Stenella longirostris*	Spinner Dolphin	2	3	3	2	2	3	3	1	3	2	2	2.57	1.86	0	3.17	Medium	NE	No RR required	Medium
41131001	*Arctocephalus forsteri*	New Zealand Fur-Seal	2	2	3	2	2	3	3	1	3	2	2	2.43	1.86	0	3.06	Medium	NE	No RR required	Medium
41131003	*Arctocephalus pusillus doriferus*	Australian Fur Seal	1	2	3	2	2	3	3	1	3	2	2	2.29	1.86	0	2.95	Medium	NE	No RR required	Medium
41131004	*Arctocephalus tropicalis*	Subantarctic Fur-Seal	1	2	3	2	2	3	3	1	3	3	2	2.29	2.06	0	3.08	Medium	NE	No RR required	Medium
41131005	*Neophoca cinerea*	Australian Sea-Lion	2	2	3	2	2	3	3	1	3	2	2	2.43	1.86	0	3.06	Medium	NE	No RR required	Medium
40128001	*Anous minutus*	Black Noddy	1	2	3	1	1	3	3	1	1	2	3	2	1.57	1	2.54	Low	NE	No RR required	Low
40128002	*Anous stolidus*	Common Noddy	1	2	3	1	1	3	3	1	1	2	3	2	1.57	1	2.54	Low	NE	No RR required	Low
40128022	*Sterna albifrons*	Little Tern	1	2	3	1	1	3	3	1	1	1	3	2	1.32	1	2.4	Low	NE	No RR required	Low

Table 4.9: *(continued)*

CAAB code	Scientific name	Common name	P1	P2	P3	P4	P5	P6	P7	S1	S2	S3	S4	Prod. score	Susc. score	Missing at-tributes	PSA 2D	Risk cate-gory	Interaction Numbers	Risk score following Residual Risk	Final risk score
40128023	*Onychoprion anaethetus*	Bridled Tern	1	2	3	1	1	3	3	1	1	1	3	2	1.32	1	2.4	Low	NE	No RR required	Low
40128027	*Sterna dougallii*	Roseate Tern	1	2	3	1	1	3	3	1	1	1	3	2	1.32	1	2.4	Low	NE	No RR required	Low
40128033	*Sterna striata*	White-Fronted Tern	1	2	3	1	1	3	3	1	1	1	3	2	1.32	1	2.4	Low	NE	No RR required	Low
40128034	*Sterna sumatrana*	Black-Naped Tern	1	2	3	1	1	3	3	1	1	1	3	2	1.32	1	2.4	Low	NE	No RR required	Low

4.2 bSAFE Results and Discussion

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

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

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

4.2.1 Manually Excluded Species

Two species were not assessed at Level 2 (bSAFE) in this ERA, as stock assessments have been undertaken for them (see stock assessment table in the Executive Summary). These comprise: Skipjack Tuna *Katsuwonus pelamis* and Blue Shark *Prionace glauca*.

4.2.2 bSAFE – Key Commercial Species

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

4.2.3 bSAFE - Secondary Commercial Species

There are no secondary commercial species to be assessed at Level 2 in this fishery.

4.2.4 bSAFE - Commercial Bait Species

The commercial bait species component was not evaluated in this assessment since it was eliminated at Level 1.

4.2.5 bSAFE - Byproduct Species

There were 23 out of 25 byproduct species assessed in the bSAFE (Figure 4.3 and Table 4.11). Twenty-two species were below the three reference points (low risk), one was medium risk (i.e., above the bSAFE-MSM reference point, Dusky Whaler *Carcharhinus obscurus*), and none were high or extreme risk (i.e., above the bSAFE-MSM and bSAFE-LIM reference points, Table 4.11). A residual risk analysis was performed on the medium, high and extreme risk species (one species, Table 4.11; see also Section 4.6). After the residual risk analysis, 22 species were below the three reference points (low risk), one remained at medium risk (i.e., above the bSAFE-MSM reference point, Dusky Whaler *Carcharhinus obscurus*), none remained at high or extreme risk (i.e., above the bSAFE-MSM and bSAFE-LIM reference points, Table 4.11).

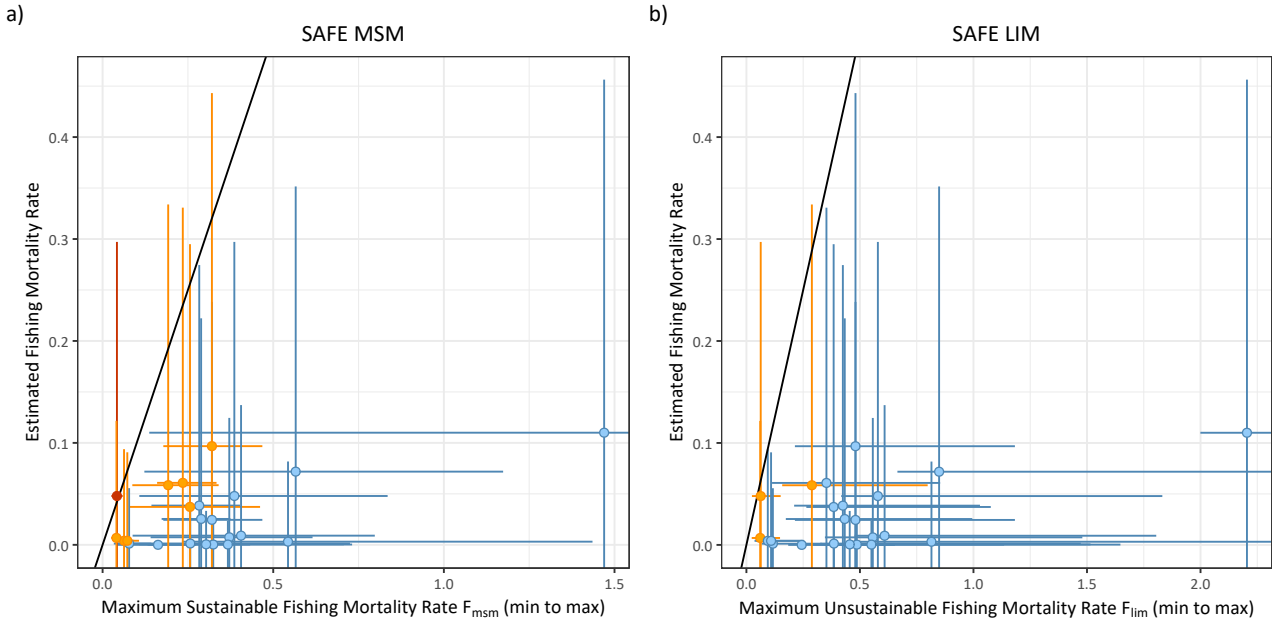

Figure 4.3: SAFE plot for byproduct species in the Eastern Tuna and Billfish Fishery - Pelagic longline for (a) bSAFE-MSM reference point [left] and (b) bSAFE limit (LIM) [right] reference point. Red: Best estimate of mortality rate is above reference point; orange: best estimate of mortality rate is below reference point, but the top of the uncertainty range is above the reference point; blue: mortality rate is below reference point for the given uncertainty.

Table 4.11: bSAFE risk categories for byproduct species ecological component for F_{MSM}, F_{Lim}, and F_{Crash}. A residual risk (RR) analysis was conducted for extreme, high, and medium risk species. Catch (numbers) from Commonwealth logbook (LOG) and Electronic Monitoring (EM) databases. Residual risk guidelines drawn from document "Revision of residual risk guidelines to reflect updated Ecological Risk Assessment Methodology" - version Oct 12, 2016. See numbers in Table 4.1. NE: not entered. Ret: retained; dis: discarded.

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 and other information	Risk score following Residual Risk	Final risk score
37018003	*Carcharhinus obscurus*	Dusky Shark; Dusky Whaler	0.048	0.042	Above	0.063	Below	0.0841	Below	Medium	LOG: 77 kg ret.; 46,034 kg dis.; 6008 animals dis. EM: 55 kg ret.; 7075 kg dis.; 8 animals ret.; 656 animals disc. Catch Disposal Records: 861 kg ret.; 28 animals ret. Also a proportion of 37018000 (Whaler and Weasel Sharks - Carcharhinidae, Hemigaleidae - undifferentiated, LOG: 13268 kg dis.; 762 animals dis. EM: 928 kg dis.; 21 animals disc. Also, a proportion of 37018901 (Blacktip sharks (mixed) - Carcharhinus, Loxodon & Rhizoprionodon spp., LOG: 3 kg dis.; 6 animals dis. EM: 1 kg dis.; 1 animals dis.	Dusky sharks are one of the slowest-growing and latest-maturing sharks, not reaching adulthood until around 20 years of age. The eastern stock is sustainable and estimated to be ~35,000 individuals (Blower, 2020). See https://www.fish.gov.au/Archived-Reports/2020/Dusky%20Whaler.pdf. Risk remains at Medium.	Medium
37017008	*Galeorhinus galeus*	School Shark	0.004	0.0628	Below	0.0942	Below	0.1256	Below	Low	NE	No RR required	Low
37018001	*Carcharhinus brachyurus*	Bronze Whaler	0.007	0.0406	Below	0.0609	Below	0.0812	Below	Low	NE	No RR required	Low

Table 4.11: *(continued)*

CAAB code	Scientific name	Common name	Susceptibility	F MSM	F MSM risk	F Lim	F Lim risk	F Crash	F Crash risk	F overall risk	Catch and other information	Risk score following Residual Risk	Final risk score
37018022	*Galeocerdo cuvier*	Tiger Shark	0.001	0.0777	Below	0.1166	Below	0.1555	Below	Low	NE	No RR required	Low
37018030	*Carcharhinus amblyrhynchos*	Grey Reef Shark	0.004	0.0724	Below	0.1086	Below	0.1447	Below	Low	NE	No RR required	Low
37268001	*Lampris australensis*	Opah	0.061	0.235	Below	0.3525	Below	0.47	Below	Low	NE	No RR required	Low
37337006	*Seriola lalandi*	Yellowtail Kingfish	0.007	0.3712	Below	0.5567	Below	0.7423	Below	Low	NE	No RR required	Low
37338001	*Coryphaena hippurus*	Dolphin Fish;Mahi Mahi	0.110	1.4696	Below	2.2045	Below	2.9393	Below	Low	NE	No RR required	Low
37342001	*Brama brama*	Ray's Bream	0.038	0.2832	Below	0.4248	Below	0.5664	Below	Low	NE	No RR required	Low
37346005	*Lutjanus erythropterus*	Crimson Snapper	<0.001	0.3242	Below	0.4863	Below	0.6484	Below	Low	NE	No RR required	Low
37346029	*Lutjanus bohar*	Red Bass	0.000	0.3033	Below	0.455	Below	0.6066	Below	Low	NE	No RR required	Low
37346043	*Lutjanus fulvus*	Blacktail Snapper	<0.001	0.3671	Below	0.5506	Below	0.7341	Below	Low	NE	No RR required	Low
37377005	*Dactylophora nigricans*	Dusky Morwong	<0.001	0.1624	Below	0.2436	Below	0.3248	Below	Low	NE	No RR required	Low
37378001	*Latris lineata*	Striped Trumpeter	0.001	0.2569	Below	0.3854	Below	0.5139	Below	Low	NE	No RR required	Low
37439003	*Ruvettus pretiosus*	Oilfish	0.097	0.3203	Below	0.4804	Below	0.6405	Below	Low	NE	No RR required	Low
37439008	*Lepidocybium flavobrunneum*	Escolar	0.024	0.3203	Below	0.4804	Below	0.6405	Below	Low	NE	No RR required	Low
37441014	*Scomberomorus queenslandicus*	School Mackerel	0.003	0.5433	Below	0.815	Below	1.0867	Below	Low	NE	No RR required	Low
37441020	*Sarda australis*	Australian Bonito	0.009	0.4057	Below	0.6086	Below	0.8115	Below	Low	NE	No RR required	Low

Table 4.11: *(continued)*

CAAB code	Scientific name	Common name	Susceptibility	F MSM	F MSM risk	F Lim	F Lim risk	F Crash	F Crash risk	F overall risk	Catch and other information	Risk score following Residual Risk	Final risk score
37441024	*Acanthocybium solandri*	Wahoo	0.072	0.5658	Below	0.8487	Below	1.1316	Below	Low	NE	No RR required	Low
37441026	*Thunnus orientalis*	Pacific Northern Bluefin Tuna; Pacific Bluefin Tuna;Northern Bluefin Tuna	0.058	0.1922	Below	0.2883	Below	0.3845	Below	Low	NE	No RR required	Low
37444005	*Istiophorus platypterus*	Sailfish	0.048	0.386	Below	0.579	Below	0.772	Below	Low	NE	No RR required	Low
37444007	*Tetrapturus angustirostris*	Shortbill Spearfish	0.037	0.2561	Below	0.3842	Below	0.5122	Below	Low	NE	No RR required	Low
37445004	*Centrolophus niger*	Rudderfish	0.025	0.2887	Below	0.4331	Below	0.5774	Below	Low	NE	No RR required	Low

4.2.6 bSAFE - Bycatch Species

There were 185 out of 186 bycatch species considered in the bSAFE (Figure 4.4 and Table 4.12). Five species were unassessable due to missing biological attributes employed in the bSAFE method (classified as NA - not assessable in Table 4.12). Of the remaining 180 species, 179 species were below the three reference points (low risk), none were medium risk (i.e., above the bSAFE-MSM reference point), and none were high risk (i.e., above the bSAFE-MSM and bSAFE-LIM reference points) and one species was extreme risk (i.e., above all three bSAFE reference points, Largetooth Cookiecutter Shark *Isistius plutodus*, Table 4.12). A residual risk analysis was performed on the medium, high and extreme risk species (one species, Table 4.12; see also Section 4.6). After the residual risk analysis, 180 species were below the three reference points (low risk), none remained at medium risk (i.e., above the bSAFE-MSM reference point), none remained at high or extreme risk (i.e., above the bSAFE-MSM and bSAFE-LIM reference points, Table 4.12).

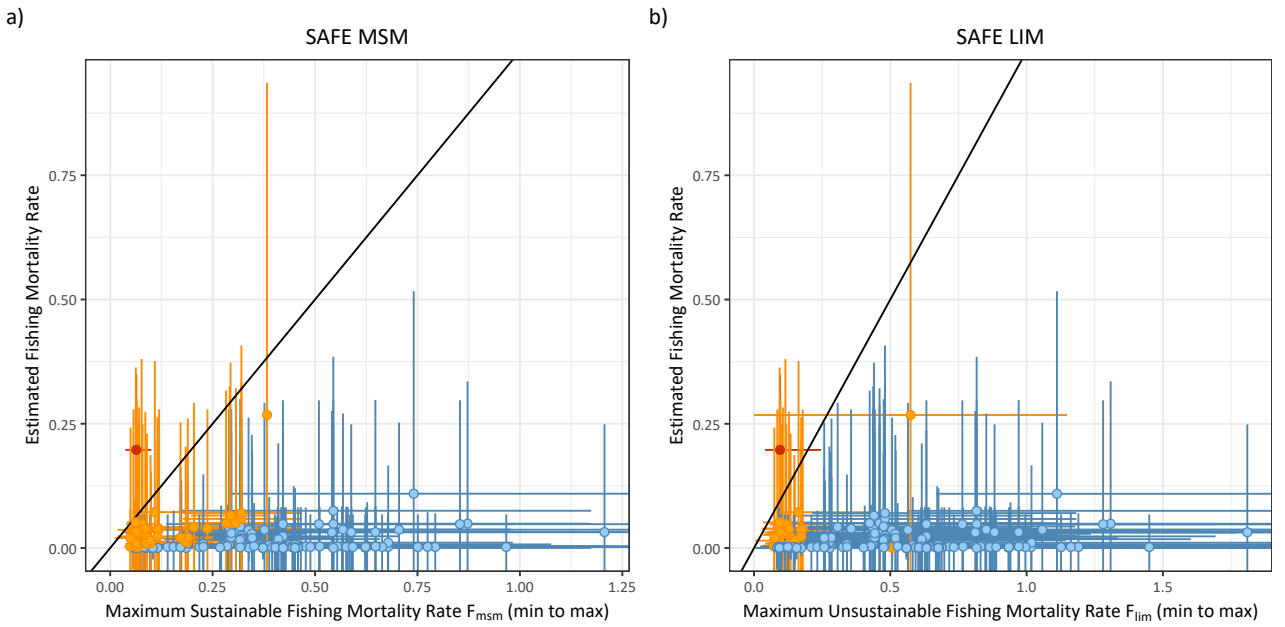

Figure 4.4: SAFE plot for bycatch species in the Eastern Tuna and Billfish Fishery - Pelagic longline for (a) bSAFE-MSM reference point [left] and (b) bSAFE limit (LIM) [right] reference point. Six species (out of a total of 185 species) have missing data and may not be shown in the figure. Five of these are unassessable in bSAFE and have been assessed in PSA instead; one of these lacks some biological data but has a susceptibility of 0 and therefore a low risk. Red: Best estimate of mortality rate is above reference point; orange: best estimate of mortality rate is below reference point, but the top of the uncertainty range is above the reference point; blue: mortality rate is below reference point for the given uncertainty.

Table 4.12: bSAFE risk categories for bycatch species ecological component for F_{MSM}, F_{Lim}, and F_{Crash}. Five BC species (listed at the top of the table) were found to be unassessable in bSAFE and were assessed in PSA instead. A residual risk (RR) analysis was conducted for extreme, high, and medium risk species. Catch (numbers) from Commonwealth logbook (LOG) and Electronic Monitoring (EM) databases. Residual risk guidelines drawn from document "Revision of residual risk guidelines to reflect updated Ecological Risk Assessment Methodology" - version Oct 12, 2016. See numbers in Table 4.1. NE: not entered. Ret: retained; dis: discarded.

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 and other information	Risk score following Residual Risk	Final risk score
37018020	*Hemigaleus australiensis*	Sicklefin Weasel Shark	0.001	-	NA	-	NA	-	NA	NA	-	-	Assessed in PSA (Table 4.7)
37271001	*Trachipterus jacksonensis*	Southern Ribbonfish	0.063	-	NA	-	NA	-	NA	NA	-	-	Assessed in PSA (Table 4.7)
37271002	*Desmodema polystictum*	Spotted Ribbonfish	0.105	-	NA	-	NA	-	NA	NA	-	-	Assessed in PSA (Table 4.7)
37271003	*Zu cristatus*	Scalloped Ribbonfish	0.020	-	NA	-	NA	-	NA	NA	-	-	Assessed in PSA (Table 4.7)
37272002	*Regalecus glesne*	Oarfish ("King Of Herrings")	0.020	-	NA	-	NA	-	NA	NA	-	-	Assessed in PSA (Table 4.7)

Table 4.12: *(continued)*

CAAB code	Scientific name	Common name	Susceptibility	F MSM	F MSM risk	F Lim	F Lim risk	F Crash	F Crash risk	F overall risk	Catch and other information	Risk score following Residual Risk	Final risk score
37020043	*Isistius plutodus*	Largetooth Cookiecutter Shark	0.197	0.0637	Above	0.0955	Above	0.1273	Above	Extreme	LOG: 477 kg dis; 17 animals dis.	Expanded from 37020000 (Gulper sharks, Sleeper sharks, Dogfishes), LOG and previous ERA. Listed as Least Concern (IUCN Redlist). 3- Low interaction/capture. Therefore risk reduced to Low.	Low
37005002	*Notorynchus cepedianus*	Broadnose Shark	<0.001	0.0999	Below	0.1499	Below	0.1998	Below	Low	NE	No RR required	Low
37005005	*Hexanchus griseus*	Bluntnose Sixgill Shark	0.010	0.0996	Below	0.1494	Below	0.1992	Below	Low	NE	No RR required	Low
37008003	*Odontaspis ferox*	Smalltooth Sandtiger Shark;Sandtiger Shark	0.048	0.0768	Below	0.1152	Below	0.1536	Below	Low	NE	No RR required	Low
37009003	*Pseudocarcharias kamoharai*	Crocodile Shark	0.039	0.1192	Below	0.1788	Below	0.2384	Below	Low	NE	No RR required	Low
37012001	*Alopias vulpinus*	Thresher Shark	0.022	0.0896	Below	0.1343	Below	0.1791	Below	Low	NE	No RR required	Low
37012002	*Alopias superciliosus*	Bigeye Thresher	0.039	0.0569	Below	0.0853	Below	0.1138	Below	Low	NE	No RR required	Low
37012003	*Alopias pelagicus*	Pelagic Thresher	0.039	0.0635	Below	0.0953	Below	0.127	Below	Low	NE	No RR required	Low
37018006	*Rhizoprionodon acutus*	Milk Shark	0.002	0.2177	Below	0.3265	Below	0.4353	Below	Low	NE	No RR required	Low

Table 4.12: *(continued)*

CAAB code	Scientific name	Common name	Susceptibility	F MSM	F MSM risk	F Lim	F Lim risk	F Crash	F Crash risk	F overall risk	Catch and other information	Risk score following Residual Risk	Final risk score
37018009	*Carcharhinus coatesi*	Whitecheek Shark	<0.001	0.0847	Below	0.1271	Below	0.1694	Below	Low	NE	No RR required	Low
37018011	*Hemipristis elongata*	Fossil Shark	<0.001	0.3383	Below	0.5074	Below	0.6765	Below	Low	NE	No RR required	Low
37018012	*Carcharhinus altimus*	Bignose Shark	0.003	0.0608	Below	0.0913	Below	0.1217	Below	Low	NE	No RR required	Low
37018013	*Carcharhinus sorrah*	Spot-Tail Shark	0.002	0.1403	Below	0.2105	Below	0.2807	Below	Low	NE	No RR required	Low
37018014	*Carcharhinus tilstoni*	Australian Blacktip Shark	0.002	0.0989	Below	0.1483	Below	0.1978	Below	Low	NE	No RR required	Low
37018021	*Carcharhinus leucas*	Bull Shark	0.001	0.0561	Below	0.0841	Below	0.1122	Below	Low	NE	No RR required	Low
37018023	*Carcharhinus brevipinna*	Spinner Shark	0.002	0.0754	Below	0.1131	Below	0.1508	Below	Low	NE	No RR required	Low
37018026	*Carcharhinus amboinensis*	Pigeye Shark	0.002	0.0667	Below	0.1001	Below	0.1335	Below	Low	NE	No RR required	Low
37018027	*Carcharhinus albimarginatus*	Silvertip Shark	0.026	0.0667	Below	0.1001	Below	0.1335	Below	Low	NE	No RR required	Low
37018029	*Negaprion acutidens*	Lemon Shark	<0.001	0.1156	Below	0.1734	Below	0.2311	Below	Low	NE	No RR required	Low
37018034	*Carcharhinus cautus*	Nervous Shark	0.002	0.0667	Below	0.1001	Below	0.1335	Below	Low	NE	No RR required	Low
37018036	*Carcharhinus melanopterus*	Blacktip Reef Shark	<0.001	0.0667	Below	0.1001	Below	0.1335	Below	Low	NE	No RR required	Low
37018038	*Triaenodon obesus*	Whitetip Reef Shark	<0.001	0.0901	Below	0.1351	Below	0.1802	Below	Low	NE	No RR required	Low
37018039	*Carcharhinus limbatus*	Blacktip Shark	0.002	0.0969	Below	0.1453	Below	0.1937	Below	Low	NE	No RR required	Low

Table 4.12: *(continued)*

CAAB code	Scientific name	Common name	Susceptibility	F MSM	F MSM risk	F Lim	F Lim risk	F Crash	F Crash risk	F overall risk	Catch and other information	Risk score following Residual Risk	Final risk score
37019001	*Sphyrna lewini*	Scalloped Hammerhead	0.032	0.068	Below	0.1021	Below	0.1361	Below	Low	NE	No RR required	Low
37019002	*Sphyrna mokarran*	Great Hammerhead	0.032	0.079	Below	0.1185	Below	0.158	Below	Low	NE	No RR required	Low
37019004	*Sphyrna zygaena*	Smooth Hammerhead	0.038	0.0857	Below	0.1286	Below	0.1714	Below	Low	NE	No RR required	Low
37020001	*Centrophorus moluccensis*	Endeavour Dogfish	0.003	0.0493	Below	0.074	Below	0.0987	Below	Low	NE	No RR required	Low
37020002	*Dalatias licha*	Black Shark	0.030	0.0706	Below	0.1059	Below	0.1411	Below	Low	NE	No RR required	Low
37020003	*Deania calceus*	Brier Shark, Birdbeak Dogfish	0.052	0.0626	Below	0.094	Below	0.1253	Below	Low	NE	No RR required	Low
37020006	*Squalus megalops*	Piked Spurdog;Spikey Dogfish	0.004	0.0591	Below	0.0886	Below	0.1182	Below	Low	NE	No RR required	Low
37020014	*Isistius brasiliensis*	Smalltooth Cookiecutter Shark	0.009	0.0637	Below	0.0955	Below	0.1273	Below	Low	NE	No RR required	Low
37020017	*Squaliolus aliae*	Smalleye Pygmy Shark	0.031	0.0626	Below	0.0939	Below	0.1252	Below	Low	NE	No RR required	Low
37020019	*Centroscymnus owstonii*	Owston's Dogfish	0.020	0.0497	Below	0.0745	Below	0.0994	Below	Low	NE	No RR required	Low
37020027	*Etmopterus bigelowi*	Smooth Lanternshark	0.033	0.0648	Below	0.0972	Below	0.1296	Below	Low	NE	No RR required	Low
37022001	*Echinorhinus brucus*	Bramble Shark	<0.001	0.0603	Below	0.0905	Below	0.1206	Below	Low	NE	No RR required	Low
37035010	*Pteroplatytrygon violacea*	Pelagic Stingray	0.072	0.1089	Below	0.1633	Below	0.2178	Below	Low	NE	No RR required	Low

Table 4.12: *(continued)*

CAAB code	Scientific name	Common name	Susceptibility	F MSM	F MSM risk	F Lim	F Lim risk	F Crash	F Crash risk	F overall risk	Catch and other information	Risk score following Residual Risk	Final risk score
37035027	*Urogymnus asperrimus*	Porcupine Ray	<0.001	0.1041	Below	0.1562	Below	0.2083	Below	Low	NE	No RR required	Low
37038007	*Urolophus viridis*	Greenback Stingaree	0.002	0.1549	Below	0.2323	Below	0.3098	Below	Low	NE	No RR required	Low
37039001	*Myliobatis tenuicaudatus*	New Zealand Eagle Ray; Southern Eagle Ray	0.001	0.0623	Below	0.0934	Below	0.1246	Below	Low	NE	No RR required	Low
37039003	*Aetobatus ocellatus*	Spotted Eagle Ray	0.002	0.0828	Below	0.1242	Below	0.1656	Below	Low	NE	No RR required	Low
37042001	*Chimaera ogilbyi*	Ogilby's Ghostshark	0.008	0.0876	Below	0.1314	Below	0.1753	Below	Low	NE	No RR required	Low
37042006	*Chimaera obscura*	Shortspine Chimaera	0.010	0.0883	Below	0.1324	Below	0.1765	Below	Low	NE	No RR required	Low
37067035	*Ariosoma anagoides*	Sea Conger	0.008	0.2272	Below	0.3408	Below	0.4544	Below	Low	NE	No RR required	Low
37067038	*Ariosoma howensis*	Lord Howe Conger	0.002	0.2272	Below	0.3408	Below	0.4544	Below	Low	NE	No RR required	Low
37126004	*Magnisudis prionosa*	Southern Barracudina	0.049	0.8722	Below	1.3083	Below	1.7444	Below	Low	NE	No RR required	Low
37128001	*Alepisaurus ferox*	Long Snouted Lancetfish;Longn Lancetfish	0.015	0.0984	Below	0.1477	Below	0.1969	Below	Low	NE	No RR required	Low
37128002	*Alepisaurus brevirostris*	Short Snouted Lancetfish;Shortnose Lancetfish	<0.001	0.1852	Below	0.2777	Below	0.3703	Below	Low	NE	No RR required	Low
37232003	*Coelorinchus mirus*	Gargoyle Fish	0.009	0.1894	Below	0.2842	Below	0.3789	Below	Low	NE	No RR required	Low

Table 4.12: *(continued)*

CAAB code	Scientific name	Common name	Susceptibility	F MSM	F MSM risk	F Lim	F Lim risk	F Crash	F Crash risk	F overall risk	Catch and other information	Risk score following Residual Risk	Final risk score
37232004	*Lepidorhynchus denticulatus*	Toothed Whiptail	0.013	0.1884	Below	0.2826	Below	0.3768	Below	Low	NE	No RR required	Low
37232005	*Lucigadus nigromaculatus*	Blackspot Whiptail	0.007	0.1716	Below	0.2575	Below	0.3433	Below	Low	NE	No RR required	Low
37232007	*Malacocephalus laevis*	Softhead Grenadier;Smooth Whiptail	0.006	0.173	Below	0.2594	Below	0.3459	Below	Low	NE	No RR required	Low
37232016	*Coryphaenoides subserrulatus*	Long-Rayed Whiptail	0.011	0.1842	Below	0.2764	Below	0.3685	Below	Low	NE	No RR required	Low
37232039	*Coryphaenoides dossenus*	Humpback Whiptail	0.005	0.173	Below	0.2594	Below	0.3459	Below	Low	NE	No RR required	Low
37232040	*Coelorinchus kermadecus*	Kermadec Whiptail	0.021	0.1894	Below	0.2842	Below	0.3789	Below	Low	NE	No RR required	Low
37232041	*Odontomacrurus murrayi*	Largefang Whiptail	0.004	0.1716	Below	0.2575	Below	0.3433	Below	Low	NE	No RR required	Low
37232045	*Coelorinchus maurofasciatus*	Falseband Whiptail	0.004	0.1732	Below	0.2599	Below	0.3465	Below	Low	NE	No RR required	Low
37232047	*Coelorinchus gormani*	Little Whiptail	0.006	0.1732	Below	0.2599	Below	0.3465	Below	Low	NE	No RR required	Low
37232062	*Kuronezumia leonis*	Snubnose Whiptail	0.021	0.1716	Below	0.2575	Below	0.3433	Below	Low	NE	No RR required	Low
37232072	*Lucigadus microlepis*	Smallfin Whiptail	0.001	0.1716	Below	0.2575	Below	0.3433	Below	Low	NE	No RR required	Low
37232119	*Gadomus aoteanus*	Filamentous Rat Tail	0.268	0.3827	Below	0.5741	Below	0.7655	Below	Low	NE	No RR required	Low
37264003	*Zenopsis nebulosa*	Mirror Dory	0.004	0.2852	Below	0.4277	Below	0.5703	Below	Low	NE	No RR required	Low

Table 4.12: *(continued)*

CAAB code	Scientific name	Common name	Susceptibility	F MSM	F MSM risk	F Lim	F Lim risk	F Crash	F Crash risk	F overall risk	Catch and other information	Risk score following Residual Risk	Final risk score
37296001	*Platycephalus richardsoni*	Tiger Flathead	0.002	0.4069	Below	0.6104	Below	0.8139	Below	Low	NE	No RR required	Low
37311095	*Caprodon longimanus*	Longfin Perch	0.004	0.32	Below	0.4799	Below	0.6399	Below	Low	NE	No RR required	Low
37327002	*Dinolestes lewini*	Longfin Pike	<0.001	-	Below	-	Below	-	Below	Low	NE	No RR required	Low
37335001	*Rachycentron canadum*	Cobia	0.036	0.3377	Below	0.5065	Below	0.6753	Below	Low	NE	No RR required	Low
37337005	*Carangoides malabaricus*	Malabar Trevally	0.002	0.6778	Below	1.0168	Below	1.3557	Below	Low	NE	No RR required	Low
37337007	*Seriola hippos*	Samsonfish	0.024	0.4216	Below	0.6324	Below	0.8432	Below	Low	NE	No RR required	Low
37337008	*Selar boops*	Oxeye Scad	0.002	0.7934	Below	1.19	Below	1.5867	Below	Low	NE	No RR required	Low
37337010	*Alepes apercna*	Smallmouth Scad	0.011	0.6786	Below	1.0179	Below	1.3572	Below	Low	NE	No RR required	Low
37337011	*Carangoides chrysophrys*	Longnose Trevally	0.003	0.5656	Below	0.8484	Below	1.1312	Below	Low	NE	No RR required	Low
37337012	*Gnathanodon speciosus*	Golden Trevally	0.003	0.5114	Below	0.7671	Below	1.0228	Below	Low	NE	No RR required	Low
37337013	*Carangoides equula*	Whitefin Trevally	0.004	0.6272	Below	0.9409	Below	1.2545	Below	Low	NE	No RR required	Low
37337014	*Seriolina nigrofasciata*	Blackbanded Trevally, Blackbanded Amberjack	0.003	0.5768	Below	0.8652	Below	1.1536	Below	Low	NE	No RR required	Low
37337015	*Selaroides leptolepis*	Yellowstripe Scad	0.002	0.9667	Below	1.45	Below	1.9334	Below	Low	NE	No RR required	Low
37337016	*Caranx bucculentus*	Bluespotted Trevally	0.003	0.4653	Below	0.698	Below	0.9307	Below	Low	NE	No RR required	Low

Table 4.12: *(continued)*

CAAB code	Scientific name	Common name	Susceptibility	F MSM	F MSM risk	F Lim	F Lim risk	F Crash	F Crash risk	F overall risk	Catch and other information	Risk score following Residual Risk	Final risk score
37337017	*Decapterus macrosoma*	Shortfin Scad, Slender Scad	0.002	0.7747	Below	1.1621	Below	1.5494	Below	Low	NE	No RR required	Low
37337018	*Alectis ciliaris*	African Pompano, Pennantfish	0.003	0.4773	Below	0.716	Below	0.9547	Below	Low	NE	No RR required	Low
37337020	*Uraspis uraspis*	Whitemouth Jack	0.003	0.6473	Below	0.9709	Below	1.2945	Below	Low	NE	No RR required	Low
37337021	*Carangoides caeruleopinnatus*	Coastal Trevally	0.003	0.5798	Below	0.8697	Below	1.1596	Below	Low	NE	No RR required	Low
37337022	*Turrum gymnostethus*	Bludger, Bludger Trevally	0.002	0.6232	Below	0.9348	Below	1.2465	Below	Low	NE	No RR required	Low
37337023	*Decapterus russelli*	Indian Scad	0.003	0.6238	Below	0.9356	Below	1.2475	Below	Low	NE	No RR required	Low
37337024	*Atule mate*	Barred Yellowtail Scad	0.001	0.6226	Below	0.9339	Below	1.2452	Below	Low	NE	No RR required	Low
37337025	*Seriola dumerilli*	Amberjack	0.036	0.3766	Below	0.5649	Below	0.7532	Below	Low	NE	No RR required	Low
37337027	*Caranx ignobilis*	Giant Trevally	0.003	0.4183	Below	0.6274	Below	0.8365	Below	Low	NE	No RR required	Low
37337028	*Megalaspis cordyla*	Torpedo Scad, Finny Scad	0.003	0.5766	Below	0.865	Below	1.1533	Below	Low	NE	No RR required	Low
37337029	*Elagatis bipinnulata*	Rainbow Runner	0.048	0.5095	Below	0.7643	Below	1.019	Below	Low	NE	No RR required	Low
37337032	*Scomberoides commersonnianus*	Talang Queenfish	0.003	0.4587	Below	0.688	Below	0.9173	Below	Low	NE	No RR required	Low

Table 4.12: *(continued)*

CAAB code	Scientific name	Common name	Susceptibility	F MSM	F MSM risk	F Lim	F Lim risk	F Crash	F Crash risk	F overall risk	Catch and other information	Risk score following Residual Risk	Final risk score
37337037	*Carangoides fulvoguttatus*	Yellowspotted Trevally, Turrum	0.002	0.6232	Below	0.9348	Below	1.2465	Below	Low	NE	No RR required	Low
37337039	*Caranx sexfasciatus*	Bigeye Trevally	0.003	0.4177	Below	0.6266	Below	0.8354	Below	Low	NE	No RR required	Low
37337040	*Naucrates ductor*	Pilotfish	0.048	0.8537	Below	1.2806	Below	1.7075	Below	Low	NE	No RR required	Low
37337044	*Scomberoides tol*	Needlescaled Queenfish, Needleskin Queenfish	0.003	0.589	Below	0.8834	Below	1.1779	Below	Low	NE	No RR required	Low
37337050	*Caranx melampygus*	Bluefin Trevally	0.003	0.4088	Below	0.6132	Below	0.8176	Below	Low	NE	No RR required	Low
37337052	*Seriola rivoliana*	Highfin Amberjack	0.048	0.4216	Below	0.6324	Below	0.8432	Below	Low	NE	No RR required	Low
37337053	*Caranx lugubris*	Black Trevally	0.005	0.3881	Below	0.5822	Below	0.7762	Below	Low	NE	No RR required	Low
37337055	*Decapterus macarellus*	Mackerel Scad	0.002	0.7509	Below	1.1264	Below	1.5019	Below	Low	NE	No RR required	Low
37337056	*Decapterus kurroides*	Redtail Scad	0.037	0.705	Below	1.0576	Below	1.4101	Below	Low	NE	No RR required	Low
37337057	*Carangoides orthogrammus*	Thicklip Trevally; Island Trevally	0.002	0.584	Below	0.876	Below	1.1681	Below	Low	NE	No RR required	Low
37337059	*Uraspis secunda*	Cottonmouth Trevally	0.032	0.6473	Below	0.9709	Below	1.2945	Below	Low	NE	No RR required	Low
37337060	*Decapterus tabl*	Rough-Ear Scad	0.109	0.7408	Below	1.1113	Below	1.4817	Below	Low	NE	No RR required	Low

Table 4.12: *(continued)*

CAAB code	Scientific name	Common name	Susceptibility	F MSM	F MSM risk	F Lim	F Lim risk	F Crash	F Crash risk	F overall risk	Catch and other information	Risk score following Residual Risk	Final risk score
37337062	*Pseudocaranx georgianus*	Silver Trevally	0.003	0.2708	Below	0.4062	Below	0.5416	Below	Low	NE	No RR required	Low
37337064	*Caranx papuensis*	Brassy Trevally	0.003	0.4246	Below	0.6369	Below	0.8492	Below	Low	NE	No RR required	Low
37337068	*Ferdauia ferdau*	Blue Trevally	0.003	0.5423	Below	0.8135	Below	1.0846	Below	Low	NE	No RR required	Low
37337072	*Parastromateus niger*	Black Pomfret	0.003	0.5541	Below	0.8312	Below	1.1082	Below	Low	NE	No RR required	Low
37337073	*Trachinotus anak*	Giant Oystercracker	0.002	0.5768	Below	0.8652	Below	1.1536	Below	Low	NE	No RR required	Low
37342002	*Xenobrama microlepis*	Golden Pomfret	0.025	0.2915	Below	0.4372	Below	0.583	Below	Low	NE	No RR required	Low
37342003	*Taractichthys longipinnis*	Bigscale Pomfret	0.050	0.2915	Below	0.4372	Below	0.583	Below	Low	NE	No RR required	Low
37342004	*Brama orcini*	Bigbelly Pomfret	0.039	0.2936	Below	0.4403	Below	0.5871	Below	Low	NE	No RR required	Low
37342006	*Pteraclis velifera*	Southern Fanfish	0.015	0.2915	Below	0.4372	Below	0.583	Below	Low	NE	No RR required	Low
37342007	*Pterycombus petersii*	Prickly Fanfish	0.039	0.2915	Below	0.4372	Below	0.583	Below	Low	NE	No RR required	Low
37342008	*Taractes asper*	Flathead Pomfret	0.018	0.2915	Below	0.4372	Below	0.583	Below	Low	NE	No RR required	Low
37342009	*Brama pauciradiata*	Shortfin Pomfret	0.065	0.2936	Below	0.4403	Below	0.5871	Below	Low	NE	No RR required	Low
37342010	*Brama australis*	Southern Ray's Bream	0.023	0.3183	Below	0.4775	Below	0.6367	Below	Low	NE	No RR required	Low
37342011	*Brama dussumieri*	Lesser Bream	0.039	0.2936	Below	0.4403	Below	0.5871	Below	Low	NE	No RR required	Low

Table 4.12: *(continued)*

CAAB code	Scientific name	Common name	Susceptibility	F MSM	F MSM risk	F Lim	F Lim risk	F Crash	F Crash risk	F overall risk	Catch and other information	Risk score following Residual Risk	Final risk score
37342013	*Pteraclis aesticola*	Pacific Fanfish	0.039	0.2915	Below	0.4372	Below	0.583	Below	Low	NE	No RR required	Low
37342014	*Taractes rubescens*	Knifetail Pomfret	0.039	0.2915	Below	0.4372	Below	0.583	Below	Low	NE	No RR required	Low
37342015	*Taractichthys steindachneri*	Sickle Pomfret	0.039	0.2915	Below	0.4372	Below	0.583	Below	Low	NE	No RR required	Low
37346014	*Etelis carbunculus*	Ruby Snapper	0.007	0.2904	Below	0.4356	Below	0.5807	Below	Low	NE	No RR required	Low
37346038	*Etelis coruscans*	Flame Snapper	0.004	0.2855	Below	0.4283	Below	0.5711	Below	Low	NE	No RR required	Low
37353001	*Chrysophrys auratus*	Snapper	0.001	0.2679	Below	0.4019	Below	0.5359	Below	Low	NE	No RR required	Low
37362002	*Platax batavianus*	Humphead Batfish	<0.001	0.3729	Below	0.5593	Below	0.7458	Below	Low	NE	No RR required	Low
37362003	*Zabidius novemaculea-tus*	Shortfin Batfish	<0.001	0.3729	Below	0.5593	Below	0.7458	Below	Low	NE	No RR required	Low
37362004	*Platax teira*	Longfin Batfish	<0.001	0.3729	Below	0.5593	Below	0.7458	Below	Low	NE	No RR required	Low
37362005	*Drepane punctata*	Spotted Sicklefish	<0.001	0.3729	Below	0.5593	Below	0.7458	Below	Low	NE	No RR required	Low
37382001	*Sphyraena pinguis*	Striped Barracuda	0.002	0.4887	Below	0.7331	Below	0.9774	Below	Low	NE	No RR required	Low
37382003	*Sphyraena acutipinnis*	Sharpfin Barracuda	0.018	0.4103	Below	0.6154	Below	0.8205	Below	Low	NE	No RR required	Low
37382005	*Sphyraena forsteri*	Blackspot Barracuda	0.002	0.4103	Below	0.6154	Below	0.8205	Below	Low	NE	No RR required	Low
37382006	*Sphyraena putnamae*	Military Barracuda	0.002	0.4018	Below	0.6027	Below	0.8036	Below	Low	NE	No RR required	Low

Table 4.12: *(continued)*

CAAB code	Scientific name	Common name	Susceptibility	F MSM	F MSM risk	F Lim	F Lim risk	F Crash	F Crash risk	F overall risk	Catch and other information	Risk score following Residual Risk	Final risk score
37382007	*Sphyraena obtusata*	Yellowtail Barracuda	0.001	0.4581	Below	0.6871	Below	0.9162	Below	Low	NE	No RR required	Low
37382008	*Sphyraena barracuda*	Great Barracuda	0.003	0.4287	Below	0.643	Below	0.8574	Below	Low	NE	No RR required	Low
37382011	*Sphyraena helleri*	Heller's Barracuda	0.002	0.4103	Below	0.6154	Below	0.8205	Below	Low	NE	No RR required	Low
37439001	*Thyrsites atun*	Barracouta	0.029	0.3457	Below	0.5185	Below	0.6913	Below	Low	NE	No RR required	Low
37439002	*Rexea solandri*	Gemfish	0.050	0.2828	Below	0.4243	Below	0.5657	Below	Low	NE	No RR required	Low
37439006	*Rexea prometheoides*	Royal Gemfish	0.050	0.307	Below	0.4606	Below	0.6141	Below	Low	NE	No RR required	Low
37439007	*Rexea bengalensis*	Small Gemfish	0.029	0.307	Below	0.4606	Below	0.6141	Below	Low	NE	No RR required	Low
37439009	*Rexea antefurcata*	Longfin Gemfish	0.029	0.307	Below	0.4606	Below	0.6141	Below	Low	NE	No RR required	Low
37439010	*Gempylus serpens*	Snake Mackerel	0.058	0.3203	Below	0.4804	Below	0.6405	Below	Low	NE	No RR required	Low
37439011	*Nealotus tripes*	Black Snake Mackerel	0.025	0.3203	Below	0.4804	Below	0.6405	Below	Low	NE	No RR required	Low
37439012	*Nesiarchus nasutus*	Black Gemfish	0.020	0.3203	Below	0.4804	Below	0.6405	Below	Low	NE	No RR required	Low
37439013	*Promethichthys prometheus*	Singleline Gemfish	0.043	0.3173	Below	0.4759	Below	0.6346	Below	Low	NE	No RR required	Low
37439014	*Rexichthys johnpaxtoni*	Paxton's Gemfish	0.018	0.3203	Below	0.4804	Below	0.6405	Below	Low	NE	No RR required	Low
37439016	*Thyrsitoides marleyi*	Black Snoek	0.070	0.3203	Below	0.4804	Below	0.6405	Below	Low	NE	No RR required	Low
37440001	*Benthodesmus elongatus*	Slender Frostfish	0.021	0.2956	Below	0.4434	Below	0.5912	Below	Low	NE	No RR required	Low

Table 4.12: *(continued)*

CAAB code	Scientific name	Common name	Susceptibility	F MSM	F MSM risk	F Lim	F Lim risk	F Crash	F Crash risk	F overall risk	Catch and other information	Risk score following Residual Risk	Final risk score
37440002	*Lepidopus caudatus*	Southern Frost-fish;Frostfish	0.020	0.3465	Below	0.5197	Below	0.6929	Below	Low	NE	No RR required	Low
37440004	*Trichiurus lepturus*	Largehead Hairtail	0.007	0.448	Below	0.672	Below	0.896	Below	Low	NE	No RR required	Low
37440006	*Tentoriceps cristatus*	Crested Hairtail	0.004	0.3513	Below	0.5269	Below	0.7026	Below	Low	NE	No RR required	Low
37440011	*Benthodesmus tuckeri*	Tucker's Frostfish	0.030	0.2956	Below	0.4434	Below	0.5912	Below	Low	NE	No RR required	Low
37441007	*Scomberomorus commerson*	Spanish Mackerel	0.003	0.4098	Below	0.6147	Below	0.8196	Below	Low	NE	No RR required	Low
37441008	*Cybiosarda elegans*	Leaping Bonito	0.032	0.5446	Below	0.8168	Below	1.0891	Below	Low	NE	No RR required	Low
37441009	*Auxis thazard*	Frigate Mackerel	0.037	0.5681	Below	0.8522	Below	1.1362	Below	Low	NE	No RR required	Low
37441010	*Euthynnus affinis*	Mackerel Tuna	0.002	0.5923	Below	0.8885	Below	1.1846	Below	Low	NE	No RR required	Low
37441012	*Rastrelliger kanagurta*	Mouth Mackerel	0.032	1.2065	Below	1.8097	Below	2.4129	Below	Low	NE	No RR required	Low
37441013	*Thunnus tonggol*	Long-Tail Tuna	0.016	0.3168	Below	0.4752	Below	0.6336	Below	Low	NE	No RR required	Low
37441015	*Scomberomorus munroi*	Spotted Mackerel	0.002	0.6637	Below	0.9955	Below	1.3273	Below	Low	NE	No RR required	Low
37441018	*Scomberomorus semifasciatus*	Grey Mackerel	0.003	0.6478	Below	0.9717	Below	1.2956	Below	Low	NE	No RR required	Low
37441019	*Gasterochisma melampus*	Butterfly Mackerel	0.075	0.5446	Below	0.8168	Below	1.0891	Below	Low	NE	No RR required	Low
37441021	*Allothunnus fallai*	Slender Tuna	<0.001	0.5446	Below	0.8168	Below	1.0891	Below	Low	NE	No RR required	Low

Table 4.12: *(continued)*

CAAB code	Scientific name	Common name	Susceptibility	F MSM	F MSM risk	F Lim	F Lim risk	F Crash	F Crash risk	F overall risk	Catch and other information	Risk score following Residual Risk	Final risk score
37441027	*Auxis rochei*	Bullet Tuna	0.032	0.5883	Below	0.8824	Below	1.1766	Below	Low	NE	No RR required	Low
37441029	*Gymnosarda unicolor*	Dogtooth Tuna	0.048	0.5446	Below	0.8168	Below	1.0891	Below	Low	NE	No RR required	Low
37444003	*Makaira nigricans*	Blue Marlin	0.039	0.2374	Below	0.3561	Below	0.4747	Below	Low	NE	No RR required	Low
37444006	*Istiompax indica*	Black Marlin	0.042	0.2046	Below	0.3069	Below	0.4092	Below	Low	NE	No RR required	Low
37445006	*Seriolella punctata*	Silver Warehou	0.001	0.3173	Below	0.4759	Below	0.6346	Below	Low	NE	No RR required	Low
37467004	*Sphoeroides pachygaster*	Balloonfish	0.031	0.5413	Below	0.8119	Below	1.0825	Below	Low	NE	No RR required	Low
37467005	*Arothron firmamentum*	Starry Toadfish	0.002	0.422	Below	0.633	Below	0.844	Below	Low	NE	No RR required	Low
37467007	*Lagocephalus sceleratus*	Silver Toadfish	0.001	0.3952	Below	0.5928	Below	0.7904	Below	Low	NE	No RR required	Low
37467008	*Lagocephalus inermis*	Smooth Golden Toadfish	0.001	0.4447	Below	0.6671	Below	0.8895	Below	Low	NE	No RR required	Low
37467012	*Lagocephalus lunaris*	Rough Golden Toadfish	0.001	0.4031	Below	0.6046	Below	0.8061	Below	Low	NE	No RR required	Low
37467017	*Lagocephalus spadiceus*	Brownback Toadfish	0.001	0.4031	Below	0.6046	Below	0.8061	Below	Low	NE	No RR required	Low
37467018	*Canthigaster rivulata*	Ocellate Toby	<0.001	0.422	Below	0.633	Below	0.844	Below	Low	NE	No RR required	Low
37467023	*Lagocephalus lagocephalus*	Oceanic Puffer;Ocean Puffer	0.001	0.4031	Below	0.6046	Below	0.8061	Below	Low	NE	No RR required	Low
37467026	*Torquigener hicksi*	Hicks' Toadfish	0.001	0.422	Below	0.633	Below	0.844	Below	Low	NE	No RR required	Low

Table 4.12: *(continued)*

CAAB code	Scientific name	Common name	Susceptibility	F MSM	F MSM risk	F Lim	F Lim risk	F Crash	F Crash risk	F overall risk	Catch and other information	Risk score following Residual Risk	Final risk score
37467033	*Arothron hispidus*	Stars-And-Stripes Puffer	<0.001	0.422	Below	0.633	Below	0.844	Below	Low	NE	No RR required	Low
37469001	*Diodon nicthemerus*	Globefish	0.002	0.4511	Below	0.6766	Below	0.9022	Below	Low	NE	No RR required	Low
37469002	*Allomycterus pilatus*	Australian Burrfish	0.006	0.4511	Below	0.6766	Below	0.9022	Below	Low	NE	No RR required	Low
37469007	*Cyclichthys orbicularis*	Shortspine Porcupinefish	0.001	0.4511	Below	0.6766	Below	0.9022	Below	Low	NE	No RR required	Low
37469013	*Dicotylichthys punctulatus*	Three-Barred Porcupinefish	<0.001	0.4511	Below	0.6766	Below	0.9022	Below	Low	NE	No RR required	Low
37469014	*Chilomycterus reticulatus*	Spotfin Porcupinefish	0.001	0.4511	Below	0.6766	Below	0.9022	Below	Low	NE	No RR required	Low
37469015	*Diodon hystrix*	Spotted Porcupinefish	<0.001	0.4511	Below	0.6766	Below	0.9022	Below	Low	NE	No RR required	Low
37469016	*Diodon liturosus*	Blackblotched Porcupinefish	<0.001	0.4511	Below	0.6766	Below	0.9022	Below	Low	NE	No RR required	Low
37470001	*Mola alexandrini*	Bumphead Sunfish	0.037	0.1154	Below	0.173	Below	0.2307	Below	Low	NE	No RR required	Low
37470002	*Mola mola*	Ocean Sunfish	0.023	0.1154	Below	0.173	Below	0.2307	Below	Low	NE	No RR required	Low

4.2.7 bSAFE - Protected Species

There were 10 out of 84 protected species assessed in the bSAFE (Figure 4.5 and Table 4.13). No species were above the limit (bSAFE-MSM and bSAFE-LIM) reference points (Table 4.13), i.e., all were assessed at low risk.

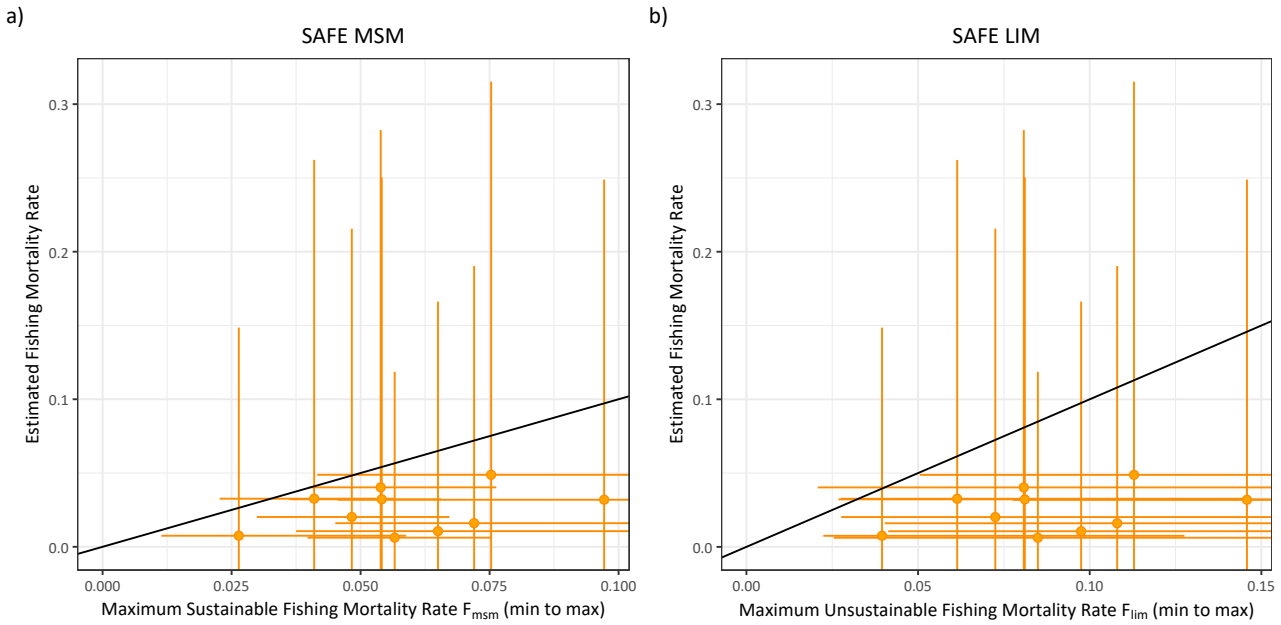

Figure 4.5: SAFE plot for protected species in the Eastern Tuna and Billfish Fishery - Pelagic longline for (a) bSAFE-MSM reference point [left] and (b) bSAFE limit (LIM) [right] reference point. Red: Best estimate of mortality rate is above reference point; orange: best estimate of mortality rate is below reference point, but the top of the uncertainty range is above the reference point; blue: mortality rate is below reference point for the given uncertainty.

Table 4.13: bSAFE risk categories for protected species ecological component for F_{MSM}, F_{Lim}, and F_{Crash}.

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
37010001	*Isurus oxyrinchus*	Shortfin Mako	0.032	0.0541	Below	0.0811	Below	0.1082	Below	Low
37010002	*Isurus paucus*	Longfin Mako	0.020	0.0483	Below	0.0725	Below	0.0966	Below	Low
37010003	*Carcharodon carcharias*	White Shark	0.033	0.041	Below	0.0614	Below	0.0819	Below	Low
37010004	*Lamna nasus*	Porbeagle Shark	0.006	0.0566	Below	0.0849	Below	0.1132	Below	Low
37014001	*Rhincodon typus*	Whale Shark	0.007	0.0264	Below	0.0395	Below	0.0527	Below	Low
37018007	*Carcharhinus plumbeus*	Sandbar Shark	0.040	0.0539	Below	0.0808	Below	0.1078	Below	Low
37018008	*Carcharhinus falciformis*	Silky Shark	0.011	0.065	Below	0.0975	Below	0.13	Below	Low
37018032	*Carcharhinus longimanus*	Oceanic Whitetip Shark	0.049	0.0753	Below	0.1129	Below	0.1505	Below	Low
37041004	*Mobula birostris*	Giant Manta Ray	0.016	0.072	Below	0.108	Below	0.144	Below	Low
37041005	*Mobula alfredi*	Manta Ray	0.032	0.0972	Below	0.1458	Below	0.1943	Below	Low

4.3 Habitats Component

The habitats component was not evaluated in this assessment since it was eliminated at Level 1.

4.4 Communities Component

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

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

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

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

- The risk of a unit of analysis within a component (e.g., single species or habitat type) is not high, the rationale is documented, and the impact of the fishing activity on this unit need not be assessed at a higher level unless management or the fishery changes.
- The risk of a unit is high but management strategies are introduced rapidly that will reduce this risk, this unit need not be assessed further unless the management or the fishery changes.
- The risk of a unit is high but there is additional information that can be used to determine if Level 3, or even a new management action is required. This information should be sought before action is taken
- The risk of a unit is high and there are no planned management interventions that would remove this risk, therefore the reasons are documented and the assessment moves to Level 3. At the conclusion of the Level 2 analysis, a fishery can decide to further investigate the risk of fishing to the species via a Level 3 assessment or implement a management response to mitigate the risk. To ensure all fisheries follow a consistent process in responding to the results of the risk assessment, AFMA has developed an ecological risk management framework. The framework makes use of the existing AFMA management structures to enable the ERAs to become a part of normal fisheries management, including the involvement of fisheries consultative committees (Figure 4.6). A separate document, the ERM report, will be developed that outlines the reasons why species are at high risk and what actions the fishery will implement to respond to the risks.

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

4.6.1 PSA

Byproduct species

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

Bycatch species

A residual risk analysis was performed on the one high risk species, resulting in the one species reduced to low risk due to the few interactions/capture within the assessment period (Table 4.7 and 4.8).

Protected species

A residual risk analysis was performed on the 20 high risk species, resulting in 13 species reduced to low risk due to the few interactions/capture within the assessment period (Table 4.9). Consequently, seven species remained at high risk.

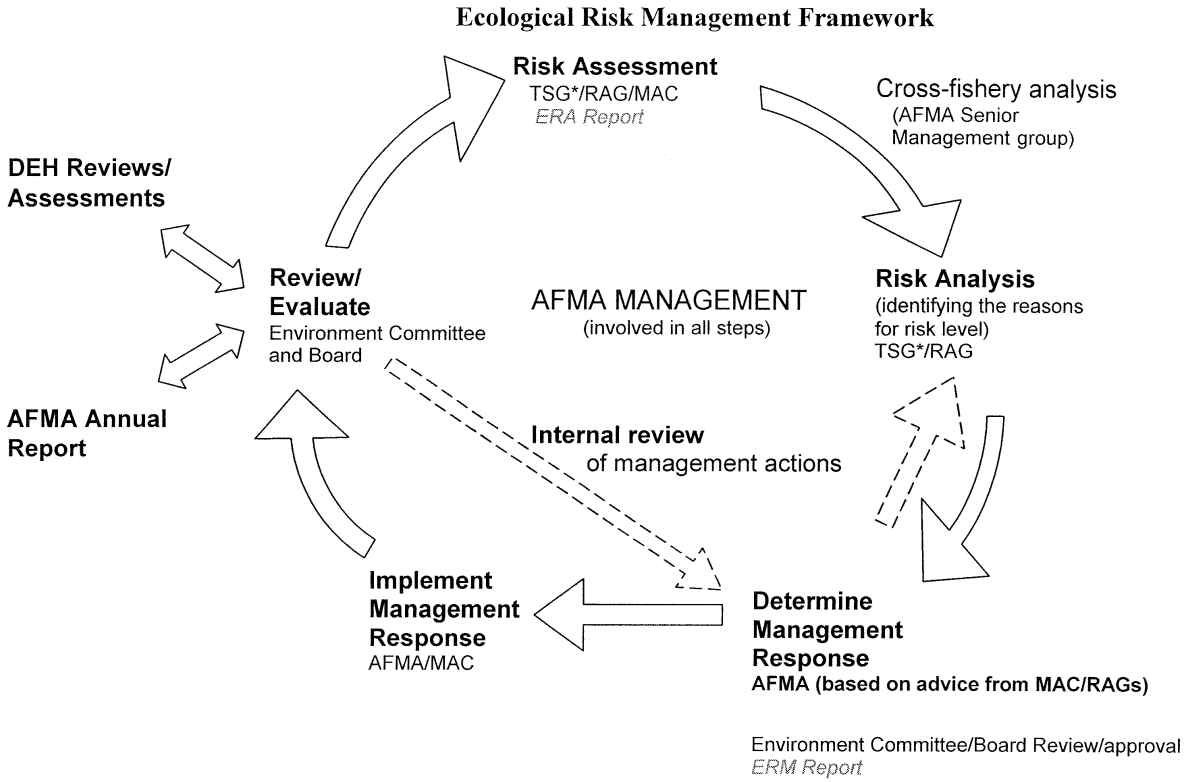

Figure 4.6: Schematic of the Ecological risk management cycle. TSG – Technical Support Group.

4.6.2 bSAFE

Byproduct species

The Dusky Whaler *Carcharhinus obscurus* remained at medium risk following a residual risk analysis (Table 4.11).

Bycatch species

The Largetooth Cookiecutter Shark *Isistius plutodus* was reduced from extreme to low risk following a residual risk analysis (Table 4.12).

Protected species

All 10 protected species were low risk following a bSAFE analysis, so no residual risk analysis was conducted (Table 4.13).

5 General Discussion and Research Implications

5.1 Level 1

More than 90 % of all assessed hazards (fishing activities) were eliminated at Level 1 (risk scores 1 or 2; Table 3.11; Figure 3.1-Figure 3.5). Those remaining consist of:

- Direct impact/capture from fishing (byproduct & bycatch species; protected species and communities)
- Direct impact/without capture from fishing (byproduct & bycatch species; protected species)
- Addition/movement of biological material from discarding (protected species)
- Addition/movement of biological material from translocation of species (communities)
- Addition of non-biological material from navigation/steaming (protected species)
- External impacts from other fisheries (all ecological components except habitats)

The ecological components that triggered a Level 2 analysis for this current ERAEF largely matches those in the previous ERAEF (Sporcic et al., 2019). The most vulnerable byproduct species that triggered a Level 2 analysis were the Dusky Whaler *Carcharhinus obscurus*, Bronze Whaler *Carcharhinus brachyurus*, bycatch species Smooth Hammerhead Shark *Sphyrna zygaena* and the protected Shortfin Mako *Isurus oxyrinchus*. For the latter species, the major risk score from the capture from fishing was based on (i) the number of interactions with ETBF operations (7168: 2213 alive, 499 dead, 4457 unknown), (ii) low productivity (slow growth rate, late maturing and low fecundity) and (iii) post release survival rates varying between 40 % and 80 % depending on condition and handling practices. The hazard in the key/secondary commercial species ecological component was the external impacts of from other fisheries on Striped Marlin *Kajikia audax* stocks.

Translocation of species was considered a major risk (4) to communities, due to the potential for the introduction of pathogens using imported baits. Evidence of pathogens in other fishery areas has previously shown the consequence of this hazard (Gaughan, 2001). The communities component triggered a Level 2 analysis but was analysed in this assessment. This SICA has removed the Habitat component from further analysis, as it was identified as low risk based on consequence scores by the set of activities considered. Significant (i.e., risk score of at least moderate) external hazards included impacts from other fisheries in the region for all ecological components except habitats.

Since the last ERAEF on the Australian ETBF, the Western and Central Pacific Fisheries Commission (WCPFC) has continued to develop a shark research plan for the Western Pacific Ocean (WPO) shark populations. Fortunately, elements of the WCPFC shark research plan have focused on undertaking regionally relevant stock assessments on some of the shark species recorded in the protected and byproduct & bycatch species ecological components of this current ERAEF. The WCPFC Shark research plan was developed in the context of the vulnerability of the key shark species interacting with fisheries in the Western Pacific Ocean (WPO). This has led to the completion of population assessments on the regional stocks such as the Blue Shark *Prionace glauca* (Neubauer et al., 2021, 2022) and a basin wide sustainability assessment for Bigeye Thresher Shark *Alopias superciliosus* [Fu et al. (2016); see also Table 0.3] which have determined that current catch levels for both these species are sustainable. By contrast current catch levels for the recent assessments for the Oceanic Whitetip Shark *Carcharhinus longimanus* (Rice et al., 2021; Tremblay-Boyer et al., 2019) are not sustainable but uncertain for the Shortfin Mako *Prionace glauca* (Large et al., 2022). In the context of the current ERAEF, the Blue Shark was considered as part of the byproduct & bycatch ecological components and the Oceanic Whitetip Shark and Shortfin Mako as part of the fishing with and/or without capture hazards of the protected species ecological component.

5.2 Level 2

5.2.1 Species at Risk

PSA and Residual Risk

Bycatch species: A total of five bycatch species were assessed in this PSA. Of these, five were unassessable in bSAFE. A PSA performed on the five unassessable bSAFE species resulted in one at high risk (Sicklefin Weasel Shark *Hemigaleus australiensis*) and four at medium risk. The remaining species was low risk (Gould's Squid

Nototodarus gouldi). None of the five assessed species were non-robust (i.e., data deficient; missing more than three attributes). One species has one missing attribute, one species has three missing attributes and the remaining four species have two missing attributes. The high risk Sicklefin Weasel Shark was reduced to low risk following a residual risk analysis, due to low interaction rates over this assessment period. Therefore, overall, there were no high risk species, four medium risk species and two low risk species.

Protected species: A total of 74 protected species were assessed in this PSA. Of all assessed protected species, 20 were at high risk, 47 were at medium risk, and seven were at low risk. Of these, one was a non-robust (i.e., data deficient) species (White Tern *Gygis alba*). Of the 20 high risk species, 18 have all 11 attributes, one is missing one to three attributes, and one is non-robust (i.e., missing more than three attributes). A residual risk analysis was performed on 20 species. Following the residual risk analysis, seven of the 20 species remained at high risk, i.e., 13 species were reduced low risk. The seven high risk species comprised five marine reptiles (turtles) and two cetaceans (False Killer Whale *Pseudorca crassidens* and Australian Humpback Dolphin *Sousa sahulensis*). Therefore, overall, there were a total of seven high risk species, 47 medium risk species and 20 low risk species.

bSAFE and Residual Risk

Byproduct species: There were 23 byproduct species assessed in this bSAFE. Twenty-two species were low risk, one was medium risk (i.e., Dusky Whaler *Carcharhinus obscurus*), and none were high or extreme risk. The medium risk species Dusky Whaler *Carcharhinus obscurus* remained at medium risk following a residual risk analysis.

Bycatch species: There were 185 bycatch species considered in this bSAFE. Five species were unassessable due to missing biological attributes employed in the bSAFE method. Of the remaining 180 assessable species, 179 species were low risk, none were medium risk, none were high risk and one species was extreme risk. The extreme risk Largetooth Cookiecutter Shark *Isistius plutodus* was reduced to low risk following a residual risk analysis due to a low number of interactions during the assessment period. Overall, 180 species were low risk, none were medium, high or extreme risk.

5.2.2 Residual Risk

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

In moving from ERA to ERM, AFMA will focus resources on the highest priority species and habitats (those likely to be most at risk from fishing). To that end, and because Level 3 analyses are not yet available for most species, AFMA (with input from CSIRO and other stakeholders) has developed guidelines to assess "residual risk" for those species identified as being at high potential risk based on the PSA. The residual risk guidelines will be applied on a species by species basis, and include consideration of existing management measures not currently accounted for in the PSA, as well as additional information about the levels of direct mortality. These guidelines will also provide a transparent process for including more precise or missing information into the PSA as it becomes available.

5.2.3 Habitats at Risk

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

5.2.4 Community Assemblages at Risk

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

5.3 Key Uncertainties/Recommendations for Research and Monitoring

In assessing risk to byproduct, bycatch and protected species, it is not possible to assess absolute risk without supplementary information on either abundance or total mortality rates, and such data are not available for the vast majority of such species. However it may be possible to draw inferences from information that may be available for some species, either from catch records of occurrence from other fisheries, from fishery independent survey data, or from examination of trends in CPUE from Observer data. Such data was used and examined for the high risk PSA species and high and medium risk SAFE species identified in this assessment.

Specific recommendations arising from this assessment include further consideration of the following:

- The recorded discards (e.g., from Logbooks) for low risk species Oceanic Whitetip Shark and Shortfin Mako should continue to be monitored.
- Interactions with potential high risk turtles should continue to be monitored.
- Interactions with potential medium risk marine birds (i.e., albatrosses, petrels and shearwaters) should continue to be monitored.
- Catch and interactions to be recorded at a species taxonomic level to increase the robustness of assessments. The Electronic Monitoring (EM) program currently used in the ETBF could help provide such species-specific data from increased reviews of available footage (*cf*. 10-12% p.a. over 2018-22 period).

References

AFMA. (2012). *Ecological risk management. Report for the eastern tuna and billfish fishery, february 2012*. 15 p. Commonwealth of Australia.

AFMA. (2014). *Australian tuna and billfish fisheries bycatch and discard workplan 1 july 2014-30 june 2016.* Canberra, Commonwealth of Australia. https://www.afma.gov.au/sites/default/files/2023-02/Australian%20Tuna%20and%20Billfish%20Fisheries%20Bycatch%20and%20Discard%20Workplan.pdf

AFMA. (2017). *Guide to AFMA's ecological risk management*. 119 p. Commonwealth of Australia.

AFMA. (2018). *Ecological risk assessment: Revised residual risk guidelines*. 18 p. Commonwealth of Australia.

AFMA. (2019). *Eastern tuna and billfish fishery (ETBF) management 2019-2023 fishery management strategy*. Canberra, Commonwealth of Australia.

Althaus, F., Williams, A., Schlacher, T. A., Kloser, R. J., Green, M. A., Barker, B. A., Bax, N. J., Brodie, P., & Schlacher-Hoenlinger, M. A. (2009). Impacts of bottom trawling on deep-coral ecosystems of seamounts are long-lasting. *Marine Ecology Progress Series*, *397*, 279–294. https://doi.org/10.3354/meps08248

Ballance, L. T., & Pitman, R. L. (1998). Cetaceans of the western tropical Indian Ocean: Distribution, relative abundance, and comparisons with cetacean communities of two other tropical ecosystems. *Marine Mammal Science*, *14*, 429–459.

Blake, S., Larcombe, J., Patterson, H., & Dylewski, M. (2023). Chapter 20. Eastern Tuna and Billfish Fishery. In *Fishery status reports 2023, eds: Butler, I, Patterson, H, Bromhead, D, Galeano, D, Timmiss, T, Woodhams, J and Curtotti, R.* (pp. 317–335). Australian Bureau of Agricultural; Resource Economics; Sciences. https://daff.ent.sirsidynix.net.au/client/en_AU/search/asset/1035183/21

Blower, D. (2020). *Estimating contemporary abundance, demography, and vulnerability to change for long-lived species with effective population size and population simulation*. 280 p. The University of Queensland, Australia. https://doi.org/10.14264/uql.2020.760

Bradford, A. L., Forney, K. A., Oleson, E. M., & Barlow, J. (2014). *Accounting for subgroup structure in line-transect abundance estimates of false killer whales (Pseudorca crassidens) in Hawaiian waters.* PLoS ONE. https://doi.org/10.1371/journal.pone.0090464

Bradford, A. L., Forney, K. A., Oleson, E. M., & Barlow, J. (2017). Abundance estimates of cetaceans from a line-transect survey within the US Hawaiian Islands Exclusive Economic Zone. *Fishery Bulletin*, *115(2)*, 129–142.

Butler, I., Patterson, H., Bromhead, D., Galeano, D., Timmiss, T., Woodhams, J., & Curtotti, R. (2010). Eastern tuna and billfish fishery. In: Wilson d.t., curtotti r. And begg g.a. (Eds.) (2010). Fishery status reports 2009: Status of fish stocks and fisheries managed by the australian government. In *Fishery status reports 2009* (pp. 381–410). Australian Bureau of Agricultural; Resource Economics - Bureau of Rural Sciences.

Butler, I., Patterson, H., Bromhead, D., Galeano, D., Timmiss, T., Woodhams, J., & Curtotti, R. (2023). Southern bluefin tuna fishery. In *Fishery status reports 2023* (pp. 391–403). Australian Bureau of Agricultural; Resource Economics; Sciences.

Castillo-Jordán, C., Hampton, J., Ducharme-Barth, N., Xu, H., Vidal, T., Williams, P., Scott, F., Pilling, G., & Hamer, P. (2021). *Stock assessment of south pacific Albacore Tuna (revision 2). Report to the western and central pacific fisheries commission*. SPC Fisheries, Aquaculture; marine Ecosystems division (FAME).

Castillo-Jordán, C., Teears, T., Hampton, J., Davies, N., Scutt-Phillips, J., McKechnie, S., Peteman, T., MacDonald, J., Day, J., Magnusson, A., Scott, R., Scott, F., Pilling, G., & Hamer, P. (2022). *Stock assessment of Skipjack Tuna in the Western and Central Pacific Ocean: 2022, revision 5. Report to the Western and Central Pacific Fisheries Commission. WCPFC-SC18-2022/SA-WP-01*. 155 p. SPC Fisheries, Aquaculture; Marine Ecosystems division (FAME). https://meetings.wcpfc.int/node/16242

CCSBT. (2023). *Report on biology, stock status and management of Southern Bluefin Tuna: 2023*. CCSBT Document Attachment 8; 12 p. Commission for the Conservation of Southern Bluefin Tuna. https://www.ccsbt.org/sites/default/files/userfiles/file/docs_english/general/ESC28_Attachment08_ReportOnBiologyStatusManagement.pdf

Clarke, S., Langley, A., Lennert-Cody, C., Aires-da-Silva, A., & Maunder, M. (2018). *Pacific-wide Silky Shark (Carcharhinus falciformis) Stock Status Assessment. Report to the WCPFC Scientific Committee 14th Regular Session. WCPFC-SC14-2018/SA-WP-08*. 137 p. Western; Central Pacific Fisheries Commission. https://meetings.wcpfc.int/node/10691

Condie, S., Ridgway, K., Griffiths, B., Rintoul, S., & Dunn, J. (2003). *National oceanographic description and*

information review for national bioregionalisation. Report for National Oceans Office. CSIRO Marine Research.

Crooks, J. A. (2002). Characterizing ecosystem-level consequences of biological invasions: The role of ecosystem engineers. *Oikos*, *97*(2), 153–166. https://doi.org/10.1034/j.1600-0706.2002.970201.x

CWTH. (2017). *Recovery Plan for Marine Turtles in Australia, Commonwealth of Australia 2017-2027.* 280 p. Australian Government Department of the Environment; Energy. https://www.dcceew.gov.au/sites/default/files/documents/recovery-plan-marine-turtles-2017.pdf

DAFF. (2018). *Department of agriculture and water resources 2018, commonwealth fisheries harvest strategy policy*. 28 p. Department of Agriculture; Water Resources. https://www.agriculture.gov.au/sites/default/files/sitecollectiondocuments/fisheries/domestic/hsp.pdf

Day, J., Magnusson, A., Teears, T., Hampton, J., Davies, N., Castillo-Jordán, C., Peatman, T., Scott, R., Scutt Phillips, J., McKechnie, S., Scott, F., Yao, N., Natadra, R., Pilling, G., Williams, P., & Hamer, P. (2023). *Stock assessment of bigeye tuna in the western and central pacific ocean: 2023.* SPC Fisheries, Aquaculture; marine Ecosystems division (FAME). https://meetings.wcpfc.int/node/19353

Department of Sustainability, Environment, Water, Population and Communities. (2011). *Three sharks listed as migratory species under the EPBC act.* Canberra, Commonwealth of Australia.

Domeier, M. L., & Speare, P. (2012). Dispersal of Adult Black Marlin (istiompax indica) from a Great Barrier Reef Spawning Aggregation. *PLOS ONE*, *7*, e31629.

Ducharme Barth, N., Castillo-Jordán, C., Hampton, J., Williams, P., Pilling, G., & Hamer, P. (2021). *Stock assessment of southwest pacific swordfish. Report to the western and central pacific fisheries commission.* SPC Fisheries, Aquaculture; marine Ecosystems division (FAME).

Ducharme Barth, N., Pilling, G., & Hampton, J. (2019). *Stock assessment of the SW pacific striped marlin in the WCPO. Report to the western and central pacific fisheries commission.* SPC Fisheries, Aquaculture; marine Ecosystems division (FAME).

Dunlop, R., McCauley, R. D., & Noad, M. J. (2020). Ships and air guns reduce social interactions in humpback whales at greater ranges than other behavioral impacts. *Marine Pollution Bulletin*, *154*, 8. https://doi.org/10.1016/j.marpolbul.2020.1110712

Emery, T. J., Noriega, R., Williams, A. J., & Larcombe, J. (2019). Changes in logbook reporting by commercial fishers following the implementation of electronic monitoring in Australian commonwealth fisheries. *Marine Policy*, *104*, 135–145. https://doi.org/10.1016/j.marpol.2019.01.018

EPDCFA. (2014). *Report of the expert panel on a declared Commercial Fishing activity: Final (Small Pelagic Fishery) Declaration 2012*. Department of Environment.

Fletcher, W. J., Chesson, J., Fisher, M., Sainsbury, K. J., Hundloe, T., Smith, A. D. M., & Whitworth, B. (2002). *National ESD reporting framework for australian fisheries: The how to guide for wild capture fisheries*. FRDC Report No. 2000/145.

Fu, D., Roux, M.-J., Clarke, S., Francis, M., Dunn, A., & Hoyle, S. (2016). *Pacific-wide sustainability risk assessment of Bigeye Thresher Shark (Alopias superciliosus). Prepared for western and central pacific fisheries commission september 2016.* 102 p. https://www.fao.org/fileadmin/user_upload/common_oceans/docs/Tuna/WCPFCStockStatusAssessmentReport.pdf

Garrison, L. P. (2016). *Abundance of marine mammals in waters of the u.s. Gulf of mexico during summer 2009. PRBD Contribution #PRBD-2016-09*. 18 p. NOAA Southeast Fisheries Science Center, Protected Resources; Biodiversity Division, 75 Virginia Beach Drive, Miami, FL 33140.

Gaughan, D. J. (2001). Disease-translocation across geographic boundaries must be recognized as a risk even in the absence of disease identification: The case with Australian sardinops. *Reviews in Fish Biology and Fisheries*, *11*(2), 113–123. https://doi.org/10.1023/A:1015255900836

Hayes, E., S. A.and Josephson, Maze-Foley, K., & Rosel, P. E. (eds). (2017). *US atlantic and gulf of mexico marine mammal stock assessments – 2016. National Oceanic and Atmospheric Administration Technical Memorandum NMFS-NE-241.* U.S. Department of Commerce, National Oceanic; Atmospheric Administration, National Marine Fisheries Service, Pacific Islands Fisheries Science Center.

Hillary, R. M., Preece, A. L., Takahashi, N., Davies, C. R., & T., I. (2023). *The Southern bluefin tuna stock assessment in 2023. CCSBT-ESC/2308/16, ESC agenda item 9*. 22 p.

Hobday, A. J., Bulman, C. M., Williams, A., & Fuller, M. (2011a). *Ecological Risk Assessment for Effects of Fishing on habitats and communities.* FRDC Report 2009/029. Fisheries Research and Development

Corporation and CSIRO Marine and Atmospheric Research.
Hobday, A. J., Smith, A. D. M., Stobutzki, I. C., Bulman, C., Daley, R., Dambacher, J. M., Deng, R. A., Dowdney, J., Fuller, M., Furlani, D., Griffiths, S. P., Johnson, D., Kenyon, R., Knuckey, I. A., Ling, S. D., Pitcher, R., Sainsbury, K. J., Sporcic, M., Smith, T., … Zhou, S. (2011b). Ecological risk assessment for the effects of fishing. *Fisheries Research*, *108*(2), 372–384. https://doi.org/10.1016/j.fishres.2011.01.013
Hobday, A. J., Smith, A., Webb, H., Daley, R., Wayte, S., Bulman, C., Dowdney, J., Williams, A., Sporcic, M., Dambacher, J., Fuller, M., & Walker, T. (2007). *Ecological risk assessment for the effects of fishing: methodology*. Report R04/1072 for the Australian Fisheries Management Authority.
Hutchinson, M., Siders, Z., Stahl, J., & Bigelow, K. (2021). *Quantitative estimates of post-release survival rates of sharks captured in Pacific tuna longline fisheries reveal handling and discard practices that improve survivorship.* https://doi.org/doi:10.25923/0M3C-2577
Interim Marine and Coastal Regionalisation for Australia Technical Group. (1998). *Interim marine and coastal regionalisation for australia: An ecosystem-based classification for marine and coastal environments. Version 3.3*. Environment Australia, Commonwealth Department of the Environment.
IOTC. (2020). *Report of the 23rd Session of the IOTC Scientific Commission, 7–11 December 2020. IOTC–2020–SC23–R[E]_Rev1. Appendix 13*. 211 p. Indian Ocean Tuna Commission.
ISC21. (2021). *Stock assessment report for Pacific Blue Marlin (makaira nigricans) Through 2019. Report to the International Scientific Committee for Tuna and Tuna-like Species in the North Pacific Ocean, 12–20 July 2021.* 115 p. International Scientific Committee for Tuna; Tuna-like Species in the North Pacific Ocean. https://isc.fra.go.jp/pdf/ISC21/ISC21_ANNEX10_Stock_Assessment_for_Pacific_Blue_Marlin.pdf
Jefferson, T. A., Webber, M. A., & Pitman, R. L. (2015). *Marine mammals of the world: A comprehensive guide to their identification*. Second edition. Academic Press, London.
Large, K., Brouwer, S., & Neubauer, P. (2022). *Stock assessment of Southwest Pacific Shortfin Mako Shark. WCPFC-SC18-2022/SA-WP-02-Rev1. Report to the WCPFC Scientific Committee. Eighteenth Regular Session, 10–18 August 2018.* 40 p. Western; Central Pacific Fisheries Commission. https://meetings.wcpfc.int/node/16243
Last, P., Lyne, V., Yearsley, G., Gledhill, D., Gomon, M., Rees, T., & White, W. (2005). *Validation of national demersal fish datasets for the regionalisation of the australian continental slope and outer shelf (>40m depth)*. National Oceans Office, Department of Environment and Heritage and CSIRO Marine Research.
Lyne, V., & Hayes, D. (2004). *Pelagic regionalisation. National marine bioregionalisation integration project*. 137 p. CSIRO Marine Research and NOO.
Magnusson, A., Day, J., Teears, T., Hampton, J., Davies, N., Castillo-Jordán, C., Peatman, T., Scott, R., Scutt Phillips, J., McKechnie, S., Scott, F., Yao, N., Natadra, R., Pilling, G., Williams, P., & Hamer, P. (2023). *Stock assessment of yellowfin tuna in the western and central pacific ocean: 2023. WCPFC-SC19-2023/SA-WP-04 Rev2.* SPC Fisheries, Aquaculture; marine Ecosystems division (FAME). https://meetings.wcpfc.int/node/19352
Marchant, J., & Higgins, P. J. (1990). *Handbook of Australian, New Zealand and Antarctic Birds*. RAOU.
Menkhorst, P., Rogers, D., Clarke, R., Davies, J., Marsack, P., & Franklin, K. (2017). *The Australian bird guide*. 566 p. Original print edition. CSIRO Publishing.
Miyashita, T. (1993). *Abundance of dolphin stocks in the western North Pacific taken by the Japanese drive fishery. Reports of the International Whaling Commission 43: 417-437.*
Moore, J. (2015). *Intrinsic growth (rmax) and generation time (T) estimates for odontocetes of the genus Sousa, Orcaella, and Neophocaena, in support of IUCN Red List Assessments. NOAA Technical Memorandum NMFS SWFSC*.
Mukai, G. N. M., Kobayashi, D. R., Hutchinson, M., Scott, M., Stahl, J., Giddens, J., & Nelson, M. (2022). *Pacific islands vulnerability assessment shark species narrative*. 26 p. https://doi.org/doi:10.25923/bjg8-ze76
Neubauer, P., Carvalho, F., Ducharme-Barth, N., K., L., Brouwer, S., Day, J., & Hamer, P. (2022). *Improved stock assessment and structural uncertainty grid for Southwest Pacific Blue Shark. Report to the WCPFC Scientific Committee 18th Regular Session. WCPFC-SC18-2022/SA-WP-03 (Rev.01)*. 74 p. Western; Central Pacific Fisheries Commission. https://meetings.wcpfc.int/node/16244
Neubauer, P., Large, K., & Brouwer, S. (2021). *Stock assessment of Southwest Pacific Blue Shark. Report to the WCPFC Scientific Committee 17th Regular Session. WCPFC-SC17-2021/SA-WP-03*. 71 p. Western; Central Pacific Fisheries Commission. https://meetings.wcpfc.int/node/12552

Oleson, E. M., Boggs, C. H., Forney, K. A., Hanson, M. B., Kobayashi, D. R., Taylor, B. L., Wade, P. R., & Ylitalo, G. M. (2010). *Status review of Hawaiian insular false killer whales (Pseudorca crassidens) under the Endangered Species act. NOAA Technical Memorandum NMFS-PIFSC-22.* U.S. Department of Commerce, National Oceanic; Atmospheric Administration, National Marine Fisheries Service, Pacific Islands Fisheries Science Center.

Parker, D., Winker, H., da-Silva, C., & Kerwath, S. (2018). *Bayesian state-space surplus production model JABBA assessment of indian ocean black marlin (makaira indica) stock. IOTC-2018-WPB16-XX*. 21 p. file:///C:/Users/spo024/Downloads/Parker_etal_2018-WPB16-15_BLM_JABBA_Final.pdf

Patterson, H., & Dylewski, M. (2023). Chapter 22. Southern Bluefin Tuna Fishery. In *Fishery status reports 2023, eds: Butler, I, Patterson, H, Bromhead, D, Galeano, D, Timmiss, T, Woodhams, J and Curtotti, R.* (pp. 344–351). Australian Bureau of Agricultural; Resource Economics; Sciences. https://daff.ent.sirsidynix.net.au/client/en_AU/search/asset/1035183/23

Pitcher, C. R., Ellis, N., Althaus, F., Williams, A., & McLeod, I. (2015). *Predicting benthic impacts & recovery to support biodiversity management in the south-east marine region*. Marine Biodiversity Hub, National Environmental Research Program, Final report 2011–2015. Report to Department of the Environment.

Pitcher, C. R., Rochester, W., Dunning, M., Courtney, T., Broadhurst, M., Noell, C., Tanner, J., Kangas, M., Newman, S., Semmens, J., Rigby, C., T., S., Martin, J., & Lussier, W. (2018). *Putting potential environmental risk of Australia's trawl fisheries in landscape perspective: Exposure of seabed assemblages to trawling, and inclusion in closures and reserves.* 71 p.

Pitcher, C. R., Williams, A., Ellis, N., Althaus, F., McLeod, I., Bustamante, R., Kenyon, R., & Fuller, M. (2016). *Implications of current spatial management measures for AFMA ERAs for habitats — FRDC project no 2014/204*. CSIRO Oceans and Atmosphere.

Preece, A. (2021). *Management Strategy Evaluation for Striped Marlin. Report for TTRAG32.* 31 p. CSIRO Environment. https://www.afma.gov.au/sites/default/files/2023-02/Management%20Strategy%20Evaluation%20for%20Striped%20Marlin.pdf

Punt, A. E., Su, N.-J., & Sun, C.-L. (2015). Assessing billfish stocks: A review of current methods and some future directions. *Fisheries Research*.

Reid, T. A., Hindell, M. A., Eades, D. W., & Newman, M. (2002). *Seabird atlas of south-eastern Australian waters*. Birds Australia Monograph 4.

Rice, J., Carvalho, F., Fitchett, M., Harley, S., & Ishizaki, A. (2021). *Future Stock Projections of Oceanic Whitetip Sharks in the Western and Central Pacific Ocean. Seventeenth Regular Session, 11–19 August 2020, WCPFC-SC17-2021/SA-IP-21*. 17 p. https://meetings.wcpfc.int/node/12853

Smith, A., Hobday, A., Webb, H., Daley, R., Wayte, S., Bulman, C., Dowdney, J., Williams, A., Sporcic, M., Dambacher, J., Fuller, M., Furlani, D., & Walker, T. (2007). *Ecological risk assessment for the effects of fishing: Final report*. Report R04/1072 for the Australian Fisheries Management Authority.

Smithers, S. G., & Dawson, J. L. (2023). Beach reprofiling to improve reproductive output at the world's largest remaining green turtle rookery: Raine Island, northern Great Barrier Reef. *Ocean and Coastal Zone Management*, *231*, 106385.

Sporcic, M., Hobday, A., Bulman, C., Hartog, J., & Fuller, M. (2019). *Ecological risk assessment for the effects of fishing report for the eastern tuna and billfish fishery: Longline sub-fishery, data to 2015 report for the australian fisheries management authority*. 234 p. CSIRO Oceans; Atmosphere. https://www.afma.gov.au/sites/default/files/2023-02/Ecological%20Risk%20Assessment%20for%20the%20Effects%20of%20Fishing%20for%20the%20Eastern%20Tuna%20and%20Billfish%20Fishery%202019.pdf

Thomson, R., Sporcic, M., Foster, S., Haddon, M., Potter, A., Carroll, A., Przeslawski, R., Knuckey, I., Koopman, M., & Hartog, J. (2014). *Examining fisheries catches and catch rates for potential effects of Bass Strait seismic surveys.* 84 p. CSIRO; Geoscience Australia.

Tremblay-Boyer, L., Carvalho, F., Neubauer, P., & Pilling, G. (2019). *Stock assessment for Oceanic Whitetip Shark in the Western and Central Pacific Ocean. Report to the WCPFC Scientific Committee. Fifteenth Regular Session, 12–20 August 2018, Pohnpei, Federated States of Micronesia. WCPFC-SC15-2019/SA-WP-06.* 100 p. Drafgonfly Data Science.

Wade, P. R., & Gerrodette, T. (1993). *Estimates of cetacean abundance and distribution in the eastern tropical pacific. Reports of the international whaling commission 43: 477-493.*

Waring, G. T., Josephson, E., Maze-Foley, K., & Rosel, P. E. (2013). *U.S. Atlantic and Gulf of Mexico Marine*

Mammal Stock Assessments–2012. NOAA Technical Memorandum NMFS-NE-223. U.S. Department of Commerce, National Oceanic; Atmospheric Administration, National Marine Fisheries Service, Northeast Fisheries Science Center.

Williams, A., Althaus, F., Dunstan, P. K., Poore, G. C. B., Bax, N. J., Kloser, R. J., & McEnnulty, F. R. (2010a). Scales of habitat heterogeneity and megabenthos biodiversity on an extensive Australian continental margin (100–1100 m depths). *Marine Ecology*, *31*(1), 222–236. https://doi.org/10.1111/j.1439-0485.2009.00355.x

Williams, A., Althaus, F., Schlacher, T. A., Kloser, R. J., Green, M. A., Barker, B. A., Bax, N. J., Brodie, P., & Schlacher-Hoenlinger, M. A. (2009). Impacts of bottom trawling on deep-coral ecosystems of seamounts are long-lasting. *Marine Ecology Progress Series*, *397*, 279–294. https://doi.org/10.3354/meps08248

Williams, A., Daley, R., Fuller, M., & Knuckey, I. (2010b). *Supporting sustainable fishery development in the GAB with interpreted multi-scale seabed maps based on fishing industry knowledge and scientific survey data*. Final Report to the Fisheries Research Development Corporation FRDC Project No 2006/036.

Williams, A., Dowdney, J., Smith, A. D. M., Hobday, A. J., & Fuller, M. (2011). Evaluating impacts of fishing on benthic habitats: A risk assessment framework applied to Australian fisheries. *Fisheries Research*, *112*(3), 154–167. https://doi.org/10.1016/j.fishres.2011.01.028

Williams, A., Dunstan, P. K., Althaus, F., Barker, B. A., McEnnulty, F., Gowlett-Holmes, K., & Keith, G. (2010c). *Characterising the seabed biodiversity and habitats of the deep continental shelf and upper slope off the Kimberley coast, NW Australia.* Final report to Woodside Energy Ltd. CSIRO Wealth from Oceans, Hobart, Australia.

Woinarski, J. C. Z. (2014). *The action plan for Australian mammals 2012*. CSIRO Publishing.

Zaeschmar, J. R. (2014). *False killer whales (pseudorca crassidens) in new zealand waters. M.sc. thesis*. Massey University, New Zealand.

Zhou, S., & Griffiths, S. P. (2008). Sustainability assessment for fishing effects (SAFE): A new quantitative ecological risk assessment method and its application to elasmobranch bycatch in an australian trawl fishery. *Fisheries Research*, *91*, 56–68.

Zhou, S., Hobday, A. J., Dichmont, C. M., & Smith, A. D. M. (2016). Ecological risk assessments for the effects of fishing: A comparison and validation of PSA and SAFE. *Fisheries Research*, *183*, 518–529.

Zhou, S., Smith, A. D. M., & Fuller, M. (2011). Quantitative ecological risk assessment for fishing effects on diverse data-poor non-target species in a multi-sector and multi-gear fishery. *Fisheries Research*, *112*(3), 168–178.

Zhou, S., Smith, T., & Fuller, M. (2007). *Rapid quantitative risk assessment for fish species in major Commonwealth fisheries*. Report to the Australian Fisheries Management Authority.

Glossary of Terms

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

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

Habitat The place where fauna or flora complete all or a portion of their life cycle.
Hazard identification The identification of activities (hazards) that may impact the components of interest.
Indicator Used to monitor the effect of an activity on a sub-component. An indicator is something that can be measured, such as biomass or abundance.
Likelihood The chance that a sub-component will be affected by an activity.
Operational objective A measurable objective for a component or sub-component (typically expressed as "the level of X does not fall outside acceptable bounds").
Precautionary approach The approach whereby, if there is uncertainty about the outcome of an action, the benefit of the doubt should be given to the biological entity (such as species, habitat or community).
PSA Productivity-Susceptibility Analysis. Used at Level 2 in the ERAEF methodology.
Scoping A general step in an ERA or the first step in the ERAEF involving the identification of the fishery history, management, methods, scope and activities.
SICA Scale, Impact, Consequence Analysis. Used at Level 1 in the ERAEF methodology.
Sub-component A more detailed aspect of a component. For example, within the target species component, the sub-components include the population size, geographic range, and the age/size/sex structure.
Sub-fishery A subdivision of the fishery on the basis of the gear or areal extent of the fishery. Ecological risk is assessed separately for each sub-fishery within a fishery.
Sustainability Ability to be maintained indefinitely.
Target species A species or group of species whose capture is the goal of a fishery, sub-fishery, or fishing operation.
Trophic position Location of an individual organism or species within a foodweb.
Unit of analysis The entities for which attributes are scored in the Level 2 analysis. For example, the units of

analysis for the Key Commercial Species component are individual “species”, while for Habitats, they are “biotypes”, and for Communities the units are “assemblages”.

A APPENDIX Examples of Fishing Activities

Table A.1: Examples of fishing activities (Modified from Fletcher et al., 2002).

Direct impact of Fishing	Fishing Activity	Examples of activities include
Capture		Activities that result in the capture or removal of organisms. This includes cryptic mortality due to organisms being caught but dropping out prior to the gear's retrieval (i.e., they are caught but not landed).
	Bait collection	Capture of organisms due to bait gear deployment, retrieval and bait fishing. This includes organisms caught but not landed.
	Fishing	Capture of organisms due to gear deployment, retrieval and actual fishing. This includes organisms caught but not landed.
	Incidental behaviour	Capture of organisms due to crew behaviour incidental to primary fishing activities, possible in the crew's down time; e.g., crew may line or spear fish while anchored, or perform other harvesting activities, including any land-based harvesting that occurs when crew are camping in their down time.
Direct impact without capture		This includes any activities that may result in direct impacts (damage or mortality) to organisms without actual capture.
	Bait collection	Direct impacts (damage or mortality) to organisms due to interactions (excluding capture) with bait gear during deployment, retrieval and bait fishing. This includes: damage/mortality to organisms through contact with the gear that doesn't result in capture, e.g., damage/mortality to benthic species by gear moving over them, organisms that hit nets but aren't caught.
	Fishing	Direct impacts (damage or mortality) to organisms due to interactions (excluding capture) with fishing gear during deployment, retrieval and fishing. This includes: damage/mortality to organisms through contact with the gear that doesn't result in capture, e.g., damage/mortality to benthic species by gear moving over them, organisms that hit nets but are not caught.
	Incidental behaviour	Direct impacts (damage or mortality) without capture, to organisms due to behaviour incidental to primary fishing activities, possibly in the crew's down time; e.g., the use of firearms on scavenging species, damage/mortality to organisms through contact with the gear that the crew use to fish during their down time. This does not include impacts on predator species of removing their prey through fishing.
	Gear loss	Direct impacts (damage or mortality), without capture on organisms due to gear that has been lost from the fishing boat. This includes damage/mortality to species when the lost gear contacts them or if species swallow the lost gear.

Table A.1: *(continued)*

Direct impact of Fishing	Fishing Activity	Examples of activities include
	Anchoring/ mooring	Direct impact (damage or mortality) that occurs and when anchoring or mooring. This includes damage/mortality due to physical contact of the anchor, chain or rope with organisms, e.g., an anchor damaging live coral.
	Navigation/ steaming	Direct impact (damage or mortality) without capture may occur while vessels are navigating or steaming. This includes collisions with marine organisms or birds.
Addition/ movement of biological material		Any activities that result in the addition or movement of biological material to the ecosystem of the fishery.
	Translocation of species	The translocation and introduction of species to the area of the fishery, through transportation of any life stage. This transport can occur through movement on boat hulls or in ballast water as boats move throughout the fishery or from outside areas into the fishery.
	On board processing	The discarding of unwanted sections of target after on board processing introduces or moves biological material, e.g., heading and gutting, retaining fins but discarding trunks.
	Discarding catch	The discarding of unwanted organisms from the catch can introduce or move biological material. This includes individuals of target and byproduct species due to damage (e.g., shark or marine mammal predation), size, high grading and catch limits. Also includes discarding of all non-retained bycatch species. This also includes discarding of catch resulting from incidental fishing by the crew. The discards could be alive or dead.
	Stock enhancement	The addition of larvae, juveniles or adults to the fishery or ecosystem to increase the stock or catches.
	Provisioning	The use of bait or berley in the fishery.
	Organic waste disposal	The disposal of organic wastes (e.g., food scraps, sewage) from the boats.
Addition of non-biological material		Any activities that result in non-biological material being added to the ecosystem of the fishery, this includes physical debris, chemicals (in the air and water), lost gear, noise and visual stimuli.
	Debris	Debris from non-fishing activities can also contribute to this e.g., crew rubbish – discarding or food scraps, plastics or other rubbish. Discarding at sea is regulated by MARPOL,which forbids the discarding of plastics.
	Chemical pollution	Chemicals can be introduced to water, sediment and atmosphere through: oil spills, detergents other cleaning agents, any chemicals used during processing or fishing activities.
	Exhaust	Exhaust can be introduced to the atmosphere and water through operation of fishing vessels.

Table A.1: *(continued)*

Direct impact of Fishing	Fishing Activity	Examples of activities include
	Gear loss	The loss of gear will result in the addition of non-biological material, this includes hooks, line, sinkers, nets, otter boards, light sticks, buoys etc.
	Navigation/ steaming	The navigation and steaming of vessels will introduce noise and visual stimuli into the environment. Boat collisions and/or sinking of vessels. Echo-sounding may introduce noise that may disrupt some species (e.g., whales, Orange Roughy).
	Activity/ presence on water	The activity or presence of fishing vessels on the water will noise and visual stimuli into the environment.
Disturb physical processes		Any activities that will disturb physical processes, particularly processes related to water movement or sediment and hard substrate (e.g., boulders, rocky reef) processes.
	Bait collection	Bait collection may disturb physical processes if the gear contacts seafloor-disturbing sediment, or if the gear disrupts water flow patterns.
	Fishing	Fishing activities may disturb physical processes if the gear contacts seafloor-disturbing sediment, or if the gear disrupts water flow patterns.
	Boat launching	Boat launching may disturb physical processes, particularly in the intertidal regions, if dredging is required, or the boats are dragged across substrate. This would also include foreshore impacts where fishers drive along beaches to reach fishing locations and launch boats.Impacts of boat launching that occurs within established marinas are outside the scope of this assessment.
	Anchoring/ mooring	Anchoring/mooring may affect the physical processes in the area that anchors and anchor chains contact the seafloor.
	Navigation/ steaming	Navigation /steaming may affect the physical processes on the benthos and the pelagic by turbulent action of propellers or wake formation.
External Hazards		Any outside activities that will result in an impact on the component in the same location and period that the fishery operates. The particular activity as well as the mechanism for external hazards should be specified.
	Other capture fishery methods	Take or habitat impact by other commercial, indigenous or recreational fisheries operating in the same region as the fishery under examination.
	Aquaculture	Capture of feed species for aquaculture. Impacts of cages on the benthos in the region.
	Coastal development	Sewage discharge, ocean dumping, agricultural runoff.

Table A.1: *(continued)*

Direct impact of Fishing	Fishing Activity	Examples of activities include
	Other extractive activities	Oil and gas pipelines, drilling, seismic activity.
	Other non-extractive activities	Defense, shipping lanes, dumping of munitions, submarine cables.
	Other anthropogenic activities	Recreational activities, such as scuba diving leading to coral damage, power boats colliding with whales, dugongs, turtles. Shipping, oil spills.

B APPENDIX Level 1 Description of Consequences for Each Component

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

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

Table B.1: *(continued)*

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

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

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

Table B.2: *(continued)*

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

Table B.2: *(continued)*

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

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

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

Table B.3: *(continued)*

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

Table B.3: *(continued)*

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

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

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

Table B.4: *(continued)*

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

Table B.4: ***(continued)***

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

Table B.4: *(continued)*

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

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

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

Table B.5: ***(continued)***

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

Table B.5: *(continued)*

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

C APPENDIX Reproducibility Details

C.1 Date and time of execution

2025-02-18 11:02:25.661097

C.2 Execution environment

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

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

pandoc Version: 3.1.1

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

C.3 Version Control

C.3.1 Bitbucket

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

Branch: ETBF_Longline

Commit Number: 87dcd3a03e3b8513960784e1c16a8f0a82572dc9

C.3.2 Data Sources

Table C.1: Version control for data sources.

Item No.	Aspect	Version No./Git ID	Comments
1.	Bioregionalization information	2023	
1.1	New species distribution information added manually	08/03/2024	Date of last added species
2	Update of species attributes from FishBase	Jan. 2024	
3	Manual updates to ERAEF species attributes	08/03/2024	Date of last added species
4	Database snapshots for fishery ERAEF extracts	10/03/2024	Fishery species table, species table and species attributes
5	Version front end tables snapshot	01/03/2022	Scoring tables - calculate productivity, susceptibility for each sub-fishery Intermediate information used for PSA and SAFE plots

Table C.1: *(continued)*

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

C.3.3 Excel templates

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

File	Version	Date
ManualInput/Appendix/Appendices.xlsx	1.2.1	2024-03-04
ManualInput/Level1/HazardsTemplateAFMA.xlsm	1.2	2024-06-05
ManualInput/Level1/SICA.xlsm	1.1	2023-09-04
ManualInput/Scoping/GeneralFisheryCharacteristics.xlsx	1.2	2024-02-09

C.4 Parameters

C.4.1 index.Rmd

```
## [1,1] ---
## [2,1]
## [3,1] params:
## [4,1]   subfishery_id: 3
## [5,1]   assessment_year: "`r format(Sys.Date(), '%Y')`"
## [6,1]   data_from: 2018
## [7,1]   data_to: 2022
## [8,1]   needs_client_review: false
## [9,1]   sql:
## [10,1]    value:
## [11,1]      run_sql: false
## [12,1]
## [13,1]      dsn: "aqua"
## [14,1]
## [15,1]  evaluation:
## [16,1]    value:
## [17,1]      scoping: true
## [18,1]
## [19,1]
## [20,1]
## [21,1]      level1: true
## [22,1]      level2: true
## [23,1]      level3: false
## [24,1]  recreateScopingRmdFile: true
## [25,1]
```

```
## [26,1]
## [27,1]
## [28,1]   recreateAppendixRmdFile: true
## [29,1]
## [30,1]
## [31,1]   show_warnings: false
## [32,1]
## [33,1]
## [34,1]
## [35,1]   show_messages: false
## [36,1]   dev_mode: false
## [37,1]
## [38,1]
## [39,1]
## [40,1]
## [41,1]
## [42,1]
## [43,1] draft: false
## [44,1] documentclass: CSIROerareport2021
## [45,1] hyperrefoptions: "linktoc = all"
## [46,1] mainfont: Calibri
## [47,1] sansfont: Calibri
## [48,1] urlcolor: blue
## [49,1] linkcolor: black
## [50,1] citecolor: black
## [51,1] link-citations: yes
## [52,1] bibliography: [ERAEF.bib, Fishery.bib]
## [53,1]
## [54,1] csl: apa_mod.csl
## [55,1] always_allow_html: true
## [56,1] csirocolour: blueberry
## [57,1] site: bookdown::bookdown_site
## [58,1]
## [59,1]
## [60,1] title: "Ecological Risk Assessment for the Effects of Fishing"
## [61,1] author: "M. Sporcic, J. Dell, M. Fuller, C. Gerber, M. Roos"
## [62,1] date: "`r paste(format(Sys.Date(), ifelse(rmarkdown::metadata$draft, '%d %B
## [62,2]  %Y', '%d %B %Y')), ifelse(rmarkdown::metadata$draft, ifelse(!knitr::is_lat
## [62,3] ex_output(),ifelse(knitr::is_html_output(),'<br>Commercial in Confidence',
## [62,4] '  \\n Commercial in Confidence'),'') ,''))`"
## [63,1]
## [64,1] subtitle: "Report for the Eastern Tuna and Billfish Fishery: Pelagic Longli
## [64,2] ne sub-fishery, 2018 - 2022"
## [65,1] citation: "Sporcic, M., Dell, J., Fuller, M., Gerber, C., Roos, M. (`r form
## [65,2] at(Sys.Date(), '%Y')`). `r rmarkdown::metadata$title`. `r rmarkdown::metada
## [65,3] ta$subtitle`. Report for the Australian Fisheries Management Authority."
## [66,1]
## [67,1] year: "`r format(Sys.Date(), '%Y')`"
## [68,1]
## [69,1] description: This is a technical report detailing an ecological risk assess
## [69,2] ment for the effects of fishing.
## [70,1] ---
## [71,1]
```

```
## [72,1]
## [73,1] NULL
```

C.4.2 _bookdown.yml

```
##  [1] "book_filename: \"ERAEF-AR\""     "delete_merged_file: false "
##  [3] "                           "     "language:"
##  [5] "  ui:"                           "    appendix_name: \"Chapter \""
##  [7] "    "                            ""
##  [9] ""                                ""
## [11] ""                                ""
## [13] ""                                ""
## [15] ""                                ""
## [17] ""                                ""
## [19] ""                                ""
## [21] ""                                ""
## [23] ""                                "rmd_files: "
## [25] "- index.Rmd"                     "- 01-frontmatters.Rmd"
## [27] "- 03-executivesummary.Rmd"       "- 04-overview.Rmd"
## [29] "- 05-scoping.Rmd"                "- 06-results-level1.Rmd"
## [31] "- 07-results-level2.Rmd"         "- 08-discussion.Rmd"
## [33] "- 09-references.Rmd"             "- 10-glossary.Rmd"
## [35] "- 11-appendix-automated.Rmd"     "- 12-appendix-manual.Rmd"
## [37] "- 13-backmatters.Rmd"
```

As Australia's national science agency and innovation catalyst, CSIRO is solving the greatest challenges through innovative science and technology.

CSIRO. Unlocking a better future for everyone.

Contact us

1300 363 400
+61 3 9545 2176
csiro.au/contact
csiro.au

For further information

CSIRO Environment
Miriana Sporcic
+61 3 6232 5222
Miriana.Sporcic@csiro.au
csiro.au/en/about/people/business-units/environment