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Australian Government
Australian Fisheries Management Authority

Ecological Risk Assessment for Effects of Fishing

REPORT FOR EASTERN TUNA & BILLFISH FISHERY: LONGLINE SUB-FISHERY

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Helping Communities Helping Australia
An Australian Government Initiative

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

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

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

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

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

Executive Summary

This assessment of the ecological impacts of the Eastern Tuna and Billfish Fishery: Longline Sub-fishery was undertaken using the ERAEF method version 9.2. ERAEF stands for "Ecological Risk Assessment for Effect of Fishing", and was developed jointly by CSIRO Marine and Atmospheric Research and the Australian Fisheries Management Authority. ERAEF provides a hierarchical framework for a comprehensive assessment of the ecological risks arising from fishing, with impacts assessed against five ecological components – target species; byproduct and bycatch species; threatened, endangered and protected (TEP) species; habitats; and (ecological) communities.

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

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

This assessment of the Eastern Tuna and Billfish Fishery: Longline Sub-fishery includes the following:

- Scoping
- Level 1 results for all components
- Level 2 results for the three species components

Fishery Description

Gear:	Pelagic longline
Area:	Cape York (Qld) to SA/Vic border
Depth range:	30 to 400m below the surface
Fleet size:	98 vessels fishing (2005)
Effort:	9.05 million hooks (2005)
Landings:	6,171 t of 5 main target species (2005)
Discard rate:	not reported
Main target species:	yellowfin tuna, bigeye tuna, broadbill swordfish, albacore tuna, striped marlin
Management:	Effort units
Observer program:	AFMA observer program operating since July 2003

Ecological Units Assessed

Target species:	5
Target species/Bait	3
Byproduct and bycatch species:	44 and 54 respectively
TEP species:	284
Habitats:	274 (264 benthic, 10 pelagic)
Communities:	64 (55 demersal, 9 pelagic)

Level 1 Results

Habitats were eliminated at Level 1 –no risk scores were greater than 2. There was at least one risk score of 3 (moderate) or above for each of the other components.

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

- Fishing (direct impacts on all ecological components except habitats,
- Fishing without capture (direct impact on TEP species),
- Translocation of species (impact on all components except habitats)
- On board processing (impact on TEP species), and
- Discarding catch (impact on TEP species).

Significant external hazards included impacts from other fisheries in the region.

Risks rated as major (risk score 4) included direct impacts from primary fishing operations on target species, and disease introduction through imported bait on target species and communities. Severe impacts (risk score 5) were confined to direct and indirect impacts on TEP species.

Impacts from fishing on all species components were assessed in more detail at Level 2.

Level 2 Results

Species

A total of 390 species were assessed at Level 2 using the PSA analysis. Of these, 34 were assessed to be at high risk, including 1 target species (broad billed swordfish), 3 byproduct species, 0 bycatch species, and 30 TEP species. By taxa, the high risk species comprised 1 teleost, 4 chondrichthyans, 23 marine birds, 5 marine mammals, and 1 marine reptile (turtles). Of the 390 species assessed, over rides were used on 145 species. Of the 34 species assessed to be at high risk, four species had more than 3 missing attributes.

The five target species are managed through a system of effort limits (number of hook deployments) modified by spatial "usage rates" that allows some direction of effort away from depleted areas. Current management developments include the intended introduction of formal harvest strategies for this group of species that should ensure sustainability of catches into the future. An interim quota for the high risk species, Broadbill swordfish, was set in 2006.

Of the 44 byproduct species, three chondrichthyan species (longfin mako, porbeagle and dusky shark) were identified at high risk. None of these three high risk species are currently subject to explicit management controls. Logbooks show that dusky shark are caught in considerable numbers, and it is likely that many bronze whalers in the logbooks are in fact mis-identified dusky sharks. Of the 56 bycatch species, none were assessed to be at high risk.

The main ecological sustainability issue for species appears to be catches of TEP species, in particular seabirds, leathery turtles, and perhaps to a lesser extent, marine mammals. The issue with seabirds has already been well documented and discussed in the fishery, and a threat abatement plan was developed in 1998 to reduce capture rates to less than 0.05 birds per 1000 hooks. A variety of mitigation measures have been implemented and trialed. Although capture rates of seabirds have declined sine 1999, they are still quite high for some species (including albatross) and only fell below the threshold rate in one year (2005). Capture rates are also variable in space (with higher encounter and capture rates further south in the fishery). While one of the main mitigation measures (setting at night) has reduced capture rates of albatross, problems remain with flesh-footed shearwaters, which are the subject of a current research project which is effectively undertaking a Level 3 analysis for this species. The PSA analysis has identified that two groups of seabirds (albatross, and shearwaters), may be at high risk from fishing. Detailed analyses being undertaken through development of the new Threat Abatement Plan (2006) may be lend additional information about priorities across species and groups. A fundamental limitation on any assessment of true risk is obtaining information on trends in abundance for individual species. In the absence of such information, declining trends in catch rates may indicate success of mitigation measures, but may also reflect declining abundance of species.

Capture of marine mammals is less of an issue than seabirds, but some smaller species are occasionally caught, though many survive capture. Improved species identification for sightings and gear interactions by observers would help reduce uncertainty for this

group. Concerns remain for risk to turtle species, many of which are caught in longline operations, though many appear to survive capture. Risk to turtles is likely to be higher from trawling, but the data summaries show that some leatherback turtles are caught and killed each year. The species of most conservation concern (loggerhead turtles) is also captured routinely, but no deaths have been recorded by observers to date.

Habitats
The habitat component did not require assessment at Level 2 for the ETBF longline sub-fishery.

Communities
The community component was not assessed at Level 2 for the ETBF longline sub fishery, but should be considered in future assessments when the methods to do this are fully developed.

Summary

Sustainability of both target and non-target catch is an important issue for the ETBF longline sector. The high risk target species, swordfish, is now under an interim quota. The non-target group at highest risk is undoubtedly seabirds, and this issue is being addressed through the Threat Abatement Plan process (currently in its second planning period). Some species of turtles may also be at risk from capture, and interactions with marine mammals should continue to be monitored. While four species of chondrichthyans (longfin mako, porbeagle, white shark and dusky shark) were a high risk, this is a taxa group that will require increased focus and monitoring. The Level 1 analysis also identified disease risk from imported bait as a potential issue.

Managing identified risks

Using the results of the ecological risk assessment, the next steps for each fishery will be to consider and implement appropriate management responses to address these risks. To ensure a consistent process for responding to the ERA outcomes, AFMA has developed an Ecological Risk Management (ERM) framework.

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1. Overview

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

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**). This approach is efficient because many potential risks are screened out at Level 1, so that the more intensive and quantitative analyses at Level 2 (and ultimately at Level 3) are limited to a subset of the higher risk activities associated with fishing. It also leads to rapid identification of high-risk activities, which in turn can lead to immediate remedial action (risk management response). The ERAEF approach is also precautionary, in the sense that risks will be scored high in the absence of information, evidence or logical argument to the contrary.

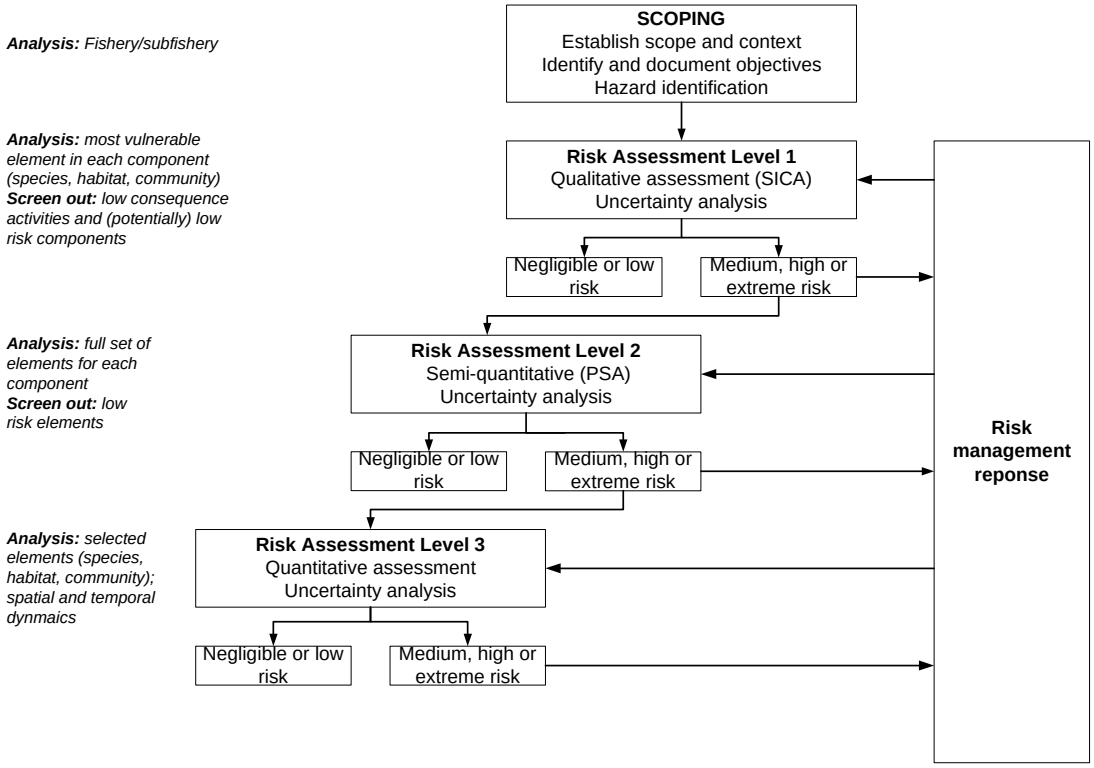


Figure 1. Overview of ERAEF showing focus of analysis for each level at the left in italics.

Conceptual Model

The approach makes use of a general conceptual model of how fishing impacts on ecological systems, which is used as the basis for the risk assessment evaluations at each level of analysis (Levels 1-3). For the ERAEF approach, five general ecological

component are evaluated, corresponding to five areas of focus in evaluating impacts of fishing for strategic assessment under EPBC legislation. The five *components* are:

- Target species
- Byproduct and bycatch species
- Threatened, endangered and protected species (TEP species)
- Habitats
- Ecological communities

This conceptual model (**Figure 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, TEP species, habitats, and communities); → *effects of fishing and external activities* which are the direct impacts of fishing and external activities; → *natural processes and resources* that are affected by the impacts of fishing and external activities; → *sub-components* which are affected by impacts to natural processes and resources; → *components*, which are affected by impacts to the sub-components. Impacts to the sub-components and components in turn affect achievement of management objectives.

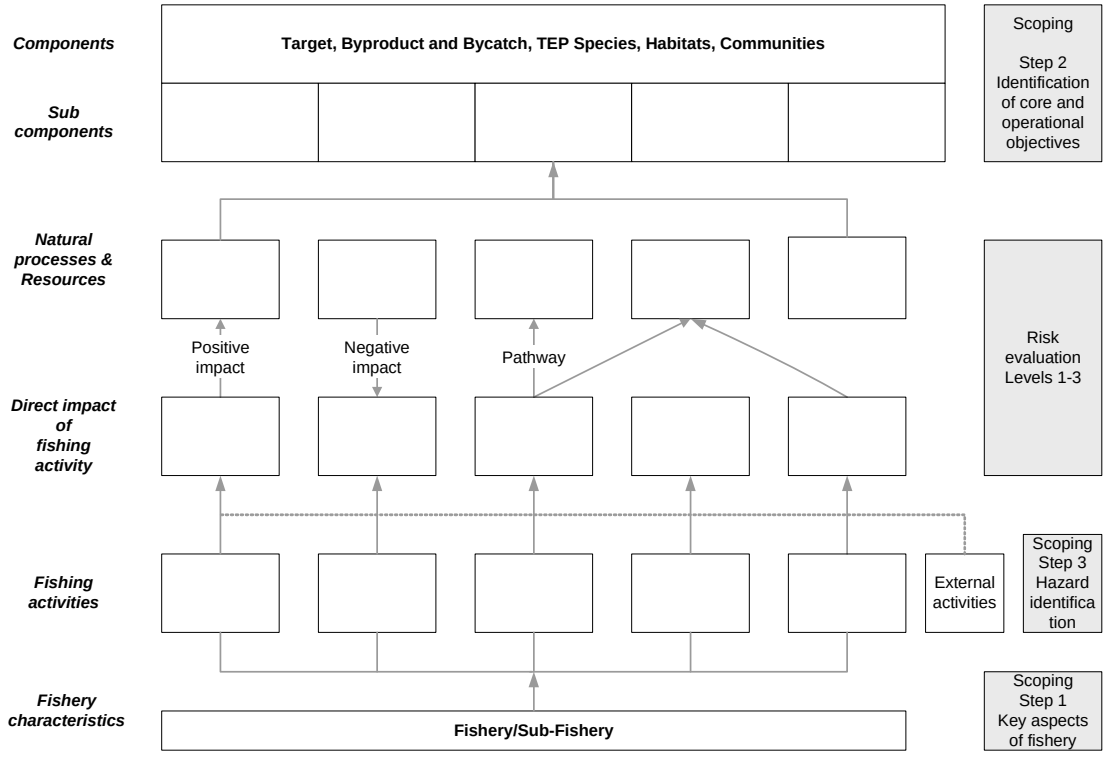


Figure 2. Generic conceptual model used in ERAEF.

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

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

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

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.

Scoping

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

1. Identification of units of analysis (species, habitats and communities) potentially impacted by fishery activities (Section 2.2.2; Scoping Documents S2A, S2B and S2C).
2. Selection of objectives (Section 2.2.3; Scoping Document S3) is a challenging part of the assessment, because these are often poorly defined, particularly with regard to the habitat and communities components. Stakeholder involvement is necessary to agree on the set of objectives that the risks will be evaluated against. A set of preliminary objectives relevant to the sub-components is selected by the drafting authors, and then presented to the stakeholders for modification. An agreed set of objectives is then used in the Level 1 SICA analysis. The agreement of the fishery management advisory body (e.g. the MAC, which contains representatives from industry, management, science, policy and conservation) is considered to represent agreement by the stakeholders at large.
3. Selection of activities (hazards) (Section 2.2.4; Scoping Document S4) that occur in the sub-fishery is made using a checklist of potential activities provided. The checklist was developed following extensive review, and allows repeatability between fisheries. Additional activities raised by the stakeholders can be included in this checklist (and would feed back into the original checklist). The background information and consultation with the stakeholders is used to finalize the set of activities. Many activities will be self-evident (e.g. fishing, which obviously occurs), but for others, expert or anecdotal evidence may be required.

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

The SICA analysis evaluates the risk to ecological components resulting from the stakeholder-agreed set of activities. Evaluation of the temporal and spatial scale, intensity, sub-component, unit of analysis, and credible scenario (consequence for a sub-component) can be undertaken in a workshop situation, or prepared ahead by the draft fishery ERA Report author and debated at the stakeholder meeting. Because of the number of activities (up to 24) in each of five components (resulting in up to 120 SICA elements), preparation before involving the full set of stakeholders may allow time and attention to be focused on the uncertain or controversial or high risk elements. The rationale for each SICA element must be documented and this may represent a challenge in the workshop situation. Documenting the rationale 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). Level 1 analysis potentially result in the elimination of activities (hazards) and in some cases whole components. Any SICA element that scores 2 or less is documented, but not considered further for analysis or management response.

Level 2. PSA (Productivity Susceptibility Analysis)

The semi-quantitative nature of this analysis tier should reduce but not eliminate the need for stakeholder involvement. In particular, transparency about the assessment will lead to greater confidence in the results. The components that were identified to be at moderate or greater risk (SICA score > 2) at Level 1 are examined at Level 2. The units of analysis at Level 2 are the agreed set of species, habitat types or communities in each component identified during the scoping stage. A comprehensive set of attributes that are proxies for productivity and susceptibility have been identified during the ERAEF project. Where information is missing, the default assumption is that risk will be set high. Details of the PSA method are described in the accompanying ERAEF Methods Document. Stakeholders can provide input and suggestions on appropriate attributes, including novel ones, for evaluating risk in the specific fishery. The 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 full stakeholder involvement. This is a consultation of the published scientific literature. Further stakeholder input is required when the preliminary gathering of attribute values is completed. In particular, where information is missing, expert opinion can be used to derive the most reasonable conservative estimate. For example, if the species attribute values for annual fecundity have been categorized as low, medium and high on the set [<5, 5-500, >500], estimates for species with no data can still be made. Estimated fecundity of a species such as a broadcast-spawning fish with unknown fecundity, is still likely greater than the cutoff for the high fecundity categorization (>500). Susceptibility attribute estimates, such as "fraction alive when landed", can also be made based on input from experts such as scientific observers. The final PSA is completed by scientists because access to computing resources, databases, and programming skills is required. Feedback to stakeholders regarding comments received during the preliminary PSA consultations is considered crucial. The final results are

then presented to the stakeholder group before decisions regarding Level 3 are made. The stakeholder group may also decide on priorities for analysis at Level 3.

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 PSA. It will be both time and data-intensive. Individual stakeholders are engaged as required in a more intensive and directed fashion. Results are presented to the stakeholder group and feedback incorporated, but live modification is not considered likely.

Conclusion and final risk assessment report

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

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 reevaluated, 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.

Each fishery ERA Report will be revised at least every four years or as required by Strategic Assessment. However, to ensure that actions in the intervening period do not unduly increase ecological risk, each year certain criteria will be considered. At the end of each year, the following trigger questions should be considered by the MAC for each sub-fishery.

- Has there been a change in the spatial distribution of effort of more than 50% compared to the average distribution over the previous four years?
- Has there been a change in effort in the fishery of more than 50% compared to the four year average (e.g. number of boats in the fishery)?
- Has there been an expansion of a new gear type or configuration such that a new sub-fishery might be defined?

Responses to these questions should be tabled at the relevant fishery MAC each year and appear on the MAC calendar and work program. If the answer to any of these trigger questions is yes, then the sub-fishery should be reevaluated.

2. Results

The focus of analysis is the fishery as identified by the responsible management authority. The assessment area is defined by the fishery management jurisdiction within the Australian Fisheries Zone (AFZ). The fishery may also be divided into sub-fisheries on the basis of fishing method and/or spatial coverage. These sub-fisheries should be clearly identified and described during the scoping stage. Portions of the scoping and analysis at Level 1 and beyond 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 pelagic longline sub-fishery of the Eastern Tuna and Billfish Fishery (ETBF).

A full description of the ERAEF method is provided in the methodology document (Hobday et al 2007). This fishery report contains figures and tables with numbers that correspond to this methodology document. Thus, table and figure numbers within this fishery ERAEF report are not sequential, as not all figures and tables are relevant to the fishery risk assessment results.

2.1 Stakeholder Engagement

2.1 Summary Document SD1. Summary of stakeholder involvement for sub-fishery: Eastern Tuna and Billfish Fishery: Longline sub-fishery

Fishery ERA Report stage	Type of stakeholder interaction	Date of stakeholder interaction	Composition of stakeholder group (names or roles)	Summary of outcome
Scoping	Phone calls and email	Jan-2002	AFMA contacts	Various information supplied and reports sent to ERA Team
Scoping	Review by fishers	Canberra; April 17-18, 2002	ERA Team and FAG	Project discussed, methods, and Level 1 and 2 examples worked with the group. Hazards agreed on.
Level 1 (SICA)	Workshop	Hobart, July 10-11, 2002	Alistair Hobday, FAG meeting	Draft Level 1 presented. (Note this has now changed, update to be presented Nov, 2003)
Level 2 (PSA)	Workshop	Canberra, December 11-12, 2002	Jock Young, FAG meeting	Presented the draft Level 2. Feedback on attributes and the species lists. Issues included how uncertainty was indicated for Level 2. Lots of species at high risk, but based on high uncertainty and missing data
	Workshop	Hobart; Nov 21, 2003 (3 hour meeting)	Alistair Hobday and FAG	Reviewed the project history to date, scoping, SICA results, and the

Fishery ERA Report stage	Type of stakeholder interaction	Date of stakeholder interaction	Composition of stakeholder group (names or roles)	Summary of outcome
				preliminary PSA for species. One issues was still where particular species fall relative to each other.
Stage 1 Draft final report	Sent to AFMA	31 July 2004		
Level 2 PSA		Canberra 30 March 2005	RAG meeting Tony Smith and Helen Webb	Review Level 1 and present updated Level 2 (as at March 05). Identify high risks and why. Discuss possible management options to mitigate high risks
Draft final report	Sent to AFMA	May 2006	AFMA managers	Minor comments received and corrected where possible in the report.
Draft Final Report	Expert review	Sept 2006	Robert Campbell	Updates and corrections to report suggested and included.

2.2 Scoping

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

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

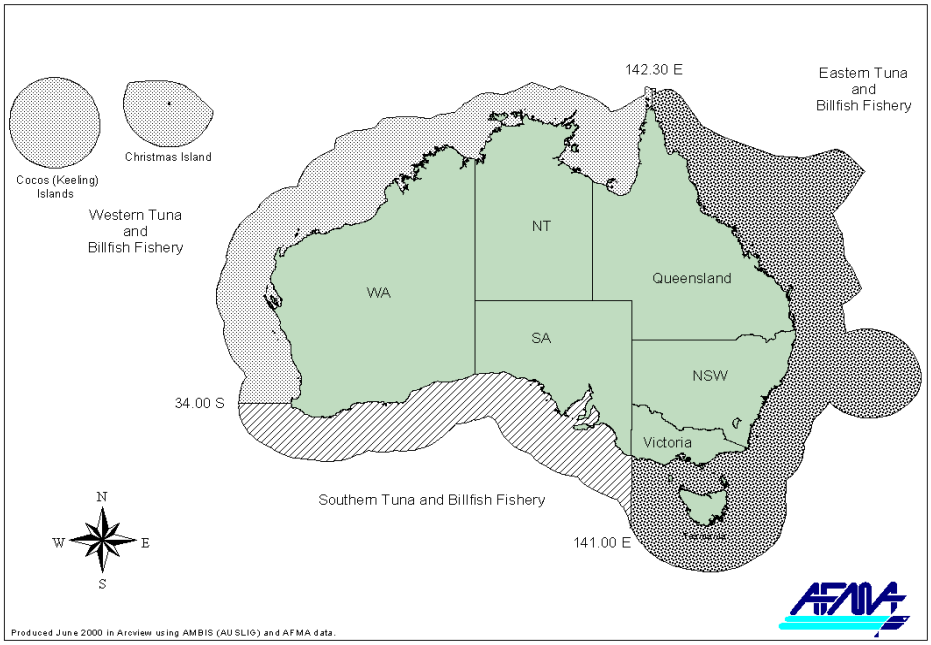
2.2.1 General Fishery Characteristics (Step 1).

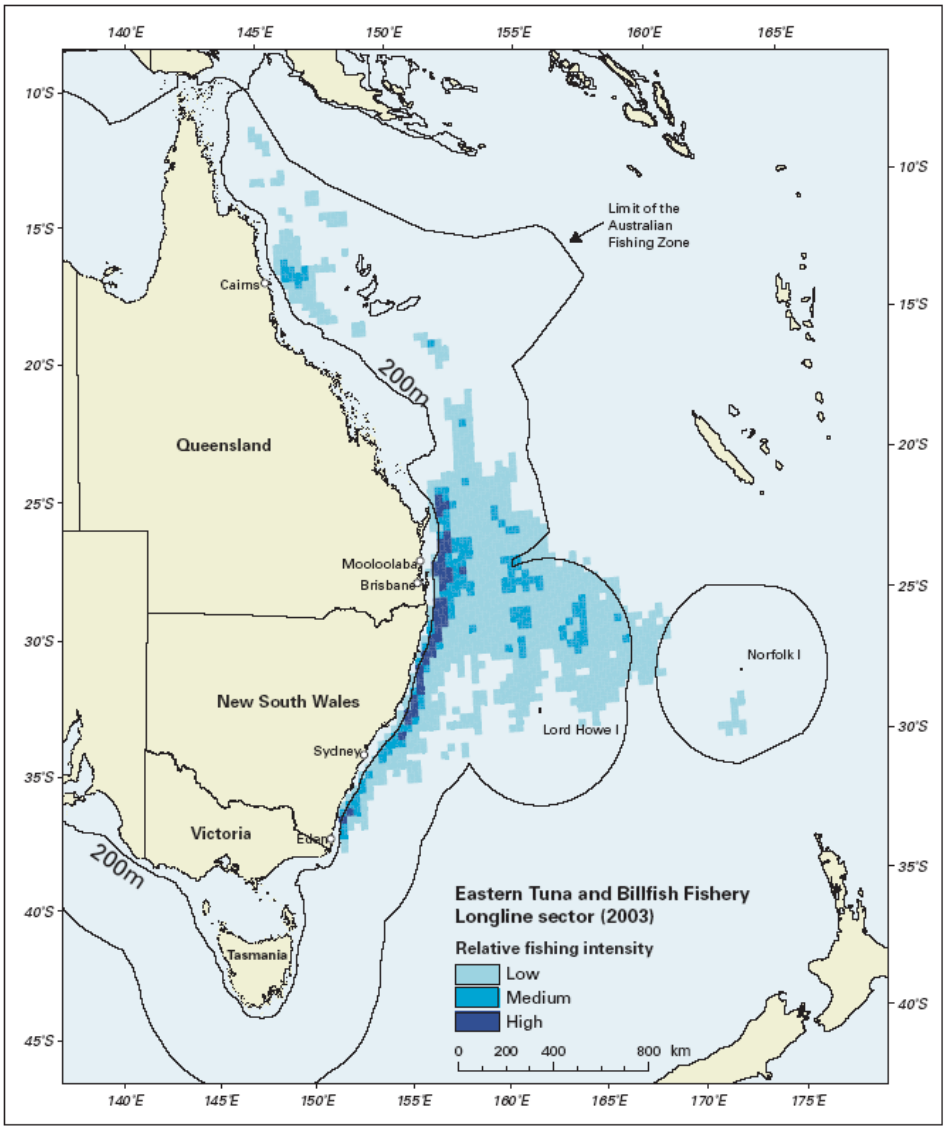
The information used to complete this step may come from a range of documents such as the Fishery's Management Plan, Assessment Reports, Bycatch Action Plans, and any other relevant background documents. The level and range of information available will vary. Some fisheries/sub-fisheries will have a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

Scoping Document S1 General Fishery Characteristics

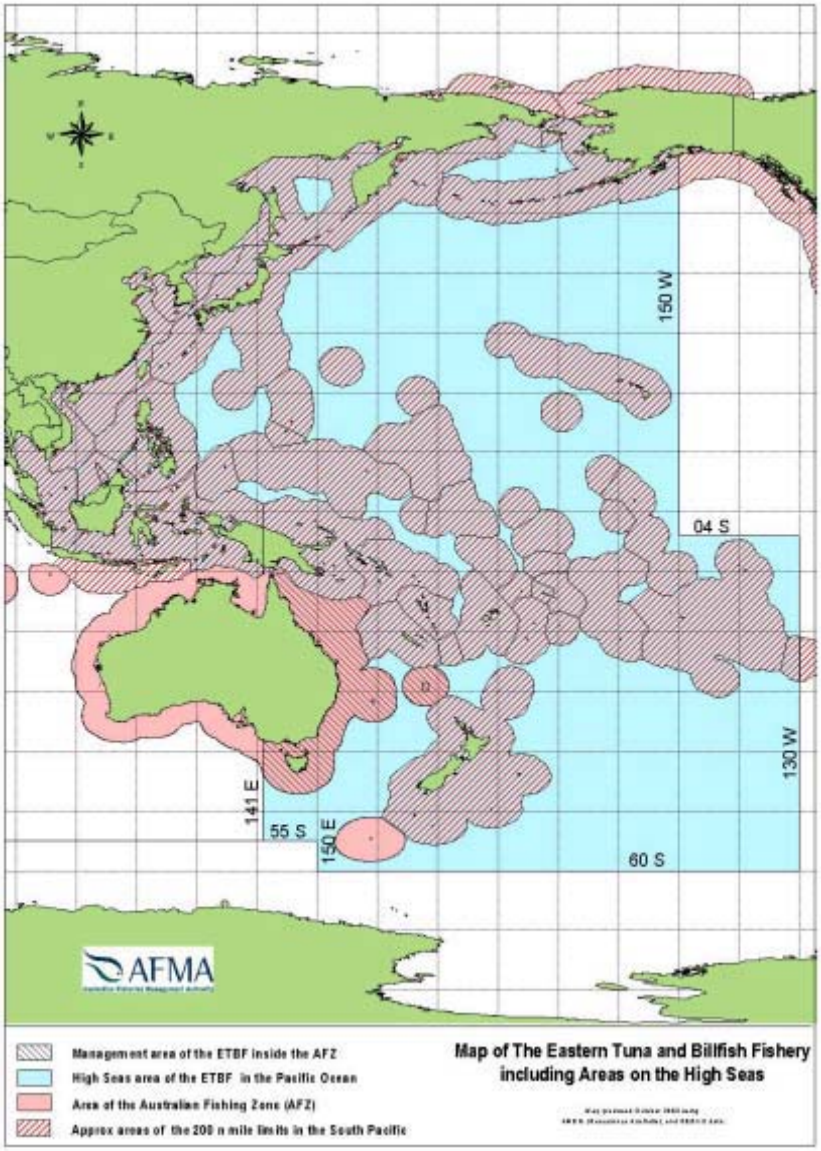
Fishery Name: Eastern Tuna and Billfish fishery
Date of ERAEF assessment: October 24, 2003 (initiated July 2002).
Updated August 2, 2005,
Updated 30 April 2006
Assessor: Helen Webb: Update 30 April 2006

General Fishery Characteristics	
Fishery Name	Eastern Tuna And Billfish Fishery
Sub-fisheries	*Identify sub-fisheries on the basis of fishing method/area.* The ETBF consists of three principle methods (longlining, poling and minor line); the predominant method is pelagic longlining. Pelagic longlining, Pole and line, Minor line, and Bait fishing (inshore purse seining) for other fishery methods.
Sub-fisheries assessed	*The sub-fisheries to be assessed on the basis of fishing method/area in this report.* The Pelagic longline fishery is the focus of this risk assessment. Bait collection is considered as part of the longline fishery.
Start date/ history	*Provide an indication of the length of time the fishery has been operating.* 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 geographic extent of the managed area of the fishery. Maps of the managed area and distribution of fishing effort should be included in the detailed description below, or appended to the end of this table.* The eastern part of the Australian Fishing Zone (AFZ) from the tip of Cape York (142º31'49"E) to the South Australian/Victorian border (141ºE). It includes Commonwealth waters off Queensland, New South Wales, Victoria and Tasmania out to the 200 nautical miles limit of the AFZ and includes waters around Norfolk Island. **Existing tuna and billfish fishery boundaries within the Australian Fishing Zone** 



Source: BRS ETBF Fishery Status Report 2004



Eastern Tuna and Billfish Fishery Management Area. (AFMA ETBF Data summary 2004/05)

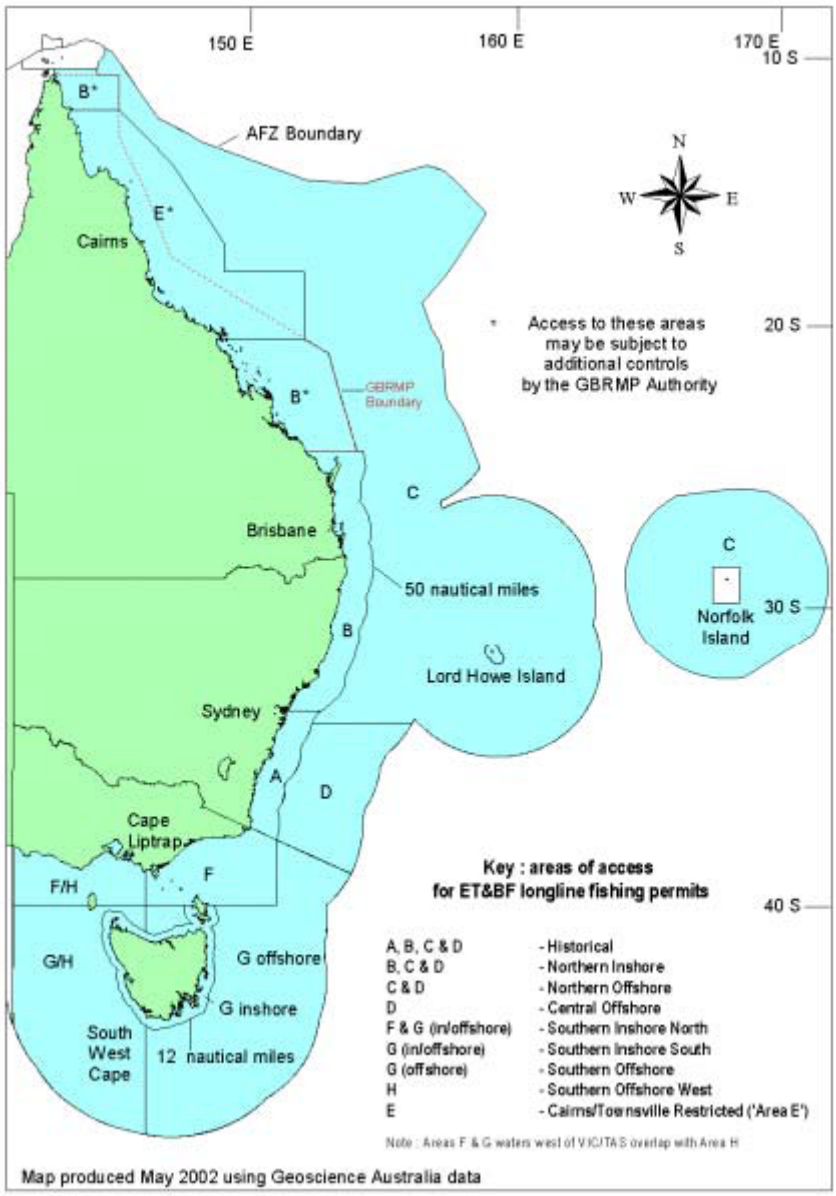


Figure 2: Pelagic Longline Fishery Management Area within the Australian Fishing Zone. Note: AFMA currently prohibits commercial fishing within 12nm of Lord Howe Island. (AFMA ETBF Data summary 2004/05)

Regions or Zones within the fishery

Any regions or zones used within the fishery for management purposes and the reason for these zones if known.

The management zones of the longline and minor line sectors are shown below. Since 1 July 2003 purse seining has been managed as a separate skipjack fishery.

As per ETBF Management Plan 12 October 2005
Area of the fishery
Part 1 AFZ area (other than the Coral Sea zone)
(section 3)

The parts of the AFZ that are:

(a) 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

(b) 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
- 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
(section 3)

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 (section 3) 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. AFMA currently prohibits commercial fishing within 12nm of Lord Howe Island. No tuna fishing is permitted within the Great Barrier Reef Marine Park (GBRMP) without a permit issued by the GBRMP Authority.
Fishing season	*What time of year does fishing in each sub-fishery occur?* Fishing occurs year round in the ETBF long-line fishery, although the target species change seasonally.
Target species and stock status	*Species targeted and where known, stock status.* Albacore tuna, Bigeye tuna, Broadbill Swordfish, Yellowfin tuna, Striped Marlin Both yellowfin and bigeye tuna are considered to be single stocks which extend across the western and central Pacific Ocean. The most recent stock assessments for these species (presented at the 2nd meeting of the Scientific Committee for the Western Central Pacific Fisheries Commission in August 2006) suggest that both species are presently being overfished ($F_{current}>F_{MSY}$) but that neither is yet in an overfished state ($B_{current}>B_{MSY}$). The most recent stock assessment for albacore tuna, which is considered to be a single stock in the South Pacific, indicates that present catch levels are sustainable and that increases in fishing mortality and yields are possible. However, given the age specific mortality of the longline fleets, any significant increase in effort would reduce CPUE to low levels with only moderate increases in yields. CPUE reductions may be more severe in areas of locally concentrated fishing effort. Both broadbill swordfish and striped marlin are considered to be single stocks within the southwest Pacific and the stocks status of both species remains uncertain. For swordfish the estimates of stock status relative to standard biological reference points (e.g. B_{MSY}) cannot identify whether the stock is presently overfished or not, though the assessment has indicated consistent declines in stock abundance in recent years, and most model projections predict further declines at current levels of fishing mortality. For striped marlin several of the plausible model scenarios investigated indicate that current levels of fishing mortality may approximate or exceed the reference level F_{MSY} and current spawning biomass

	levels may approximate or be below the biomass based reference point B_{MSY} According to BRS Fishery Status Reports 2004, within the Eastern Tuna and Billfish Fishery albacore and yellowfin tuna are deemed 'not overfished'. Albacore tuna has potential for increased harvesting, whereas for yellowfin tuna increasing effort increases concern about possible growth overfishing in AFZ. Uncertainty exists about the status of regional striped marlin and broadbill swordfish stocks. For striped marlin catch increased with the expansion of effort further offshore; and for broadbill swordfish caution is requires as no reliable assessment; strong indications of localised depletion in inshore areas – catch rate has declined to less than 50% of peak rate, with increasing effort outside the AFZ to compensate. From 2004 in both regional and Internationally Managed fisheries, bigeye tuna is considered 'subject to overfishing', with catch in the broader Pacific – especially of juveniles – needs to be reduced. Reliability of assessment: reasonable for bigeye, yellowfin and albacore in WCPO; otherwise unknown. Unreliable for AFZ because interactions of stock components in the WCPO and AFZ uncertain.
Bait Collection and usage	*Identify bait species and source of bait used in the sub-fishery. Describe methods of setting bait and trends in bait usage.* Bait used in the ETBF comes from a number of sources: • fresh self caught yellowtail scad and blue (slimy) mackerel • frozen local (WA) pilchards (small quantities), 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. Lynch (2004) noted 1.3% higher CPUE in 2003-04 on self caught bait. Overall, the difference in 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 have a preference for self caught (live bait) while swordfish tend to prefer bought bait (squid). Overall the trend is toward increasing use of live bait, however in 2003/04 72% and in 2004/05 76% of hooks were set with frozen (thawed) purchased bait, compared to 28% and 24% self caught bait in these respective years. (ETBF AFMA data summaries for 2003/04 and 2004/05 years. Bought bait is generally frozen squid or pilchards, while self-caught bait is almost entirely comprised of yellowtail scad and blue (slimy) mackerel. Self-caught baits are almost always fished live. Some shots contained a mixture of bought and self-caught bait. 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. Assessment for the purposes of ERA will not include this aspect of the fishery as bait collection occurs inshore.
Current entitlements	*The number of current entitlements in the fishery. Note latent entitlements. Licences/ permits/ boats and number active* 311 concessions as at 27 October 2002 Source: http://www.afma.gov.au/fisheries/etbf/default.php Total packages 311 Pelagic longline 232 Purse seine 19 Pole and line 101 minor line 297

Note: 'Total packages' represents the total number of Permit packages for each access regime, ie an individual Permit package may have various gear entitlements including pelagic longline, purse seine, minor line and pole and line.

Current and recent TACs, quota trends by method

The most recent catch quota levels in the fishery by fishing method (sub-fishery).
Summary of the most recent catch quota levels in the fishery by fishing method (sub-fishery) in table form.

At present the ETBF is a limited entry fishery with vessel size restrictions in some areas. At present there are no catch quotas for individual species, though an interim quota of 1400t was set for broadbill swordfish in 2006. The Management Plan outlines revised management arrangements involving input controls in the form of branchline clip usage (therefore hook usage). These will be allocated as fully transferable SFRs. Operators will be able to use these anywhere in the fishery excluding Area E off Northern Queensland (see **Figure 2** in the scoping table above) which will remain a limited access area.

On 14 December 2005 the then Minister for Fisheries, Forestry and Conservation, directed AFMA in accordance with Section 91 of the *Fisheries Administration Act 1991*, to take immediate action in all Commonwealth fisheries to:
a) Cease overfishing and recover overfished stocks to levels that will ensure longterm and productivity;
b) Avoid further species from becoming overfished in the short and long term; and
c) Manage the broader environmental impacts of fishing, including on threatened species or those otherwise protected under the *Environment Protection and Biodiversity Conservation Act 1999*.
The Minister also directed that AFMA take a more "strategic, science-based approach" to setting catch and/or effort levels in all Commonwealth fisheries through the development and implementation of a Commonwealth Harvest Strategy Policy.
Other key aspects of the Direction relevant to the ETBF are:
a) Implement output controls in the form of ITQs by 2010 unless a strong case is made to the Minister that this would not be cost-effective or would be otherwise detrimental;
b) Evaluate whether boat statutory fishing rights and boat permits are an impediment to autonomous adjustment and if so, phase these out in all fisheries by 2010 (AFMAs Response to the Ministerial direction February 2006)

Current and recent fishery effort trends by method

The most recent estimate of effort levels in the fishery by fishing method (sub-fishery).
Summary of the most recent effort levels in the fishery by fishing method (sub-fishery) in table form.

Effort based on the total number of hooks set decreased by 16% in 2004/05 The average number of hooks set per vessel by the longline fleet in 2004/05 was 82,943,a decrease of 1,892 from last year. The average number of hooks per set in 2004/05 was 950. There has been a consistent trend toward more hooks being deployed on each set over the last 5 years.

Total longline sets and hooks deployed by year for all vessels is as follows (Campbell 2006)

		Effort	
year	vessels	sets	hooks
1986/87	59	755	284,556
198788	66	1,610	1,070,947
1988/89	95	2,091	1,087,618
1989/90	97	2,300	793,703
1990/91	99	2,842	1,547,067
1991/92	108	3,252	1,759,567
1992/93	89	2,975	1,859,491
1993/94	91	3,664	2,381,087
1994/95	95	4,509	3,366,380
1995/96	110	5,552	3,979,041
1996/97	131	7,473	5,287,572

1997/98	144	10,012	7,694,322	
1998/99	161	11,447	9,995,953	
1999/00	154	11,408	9,986,913	
2000/01	139	11,527	10,090,522	
2001/02	144	12,882	11,804,128	
2002/03	141	13,551	12,706,501	
2003/04	133	11,811	11,151,511	
2004/05	116	9,910	9,414,458	
2005/06*	92	7,572	7,613,599	

* Preliminary

Total longline sets and hooks deployed by year for all vessels.(ETBF Data Summary 2004/05)

Year	Hooks (millions)	Shots	Active vessels
1986/87	0.29	760	62
1987/88	1.07	1,618	68
1988/89	1.09	2,099	94
1989/90	0.79	2,300	98
1990/91	1.56	2,864	101
1991/92	1.76	3,252	109
1992/93	1.86	2,975	91
1993/94	2.38	3,664	79
1994/95	3.37	4,509	98
1995/96	3.98	5,552	112
1996/97	5.33	7,645	123
1997/98	7.53	9270	150
1998/99	9.91	10,762	156
1999/00	9.86	11,070	147
2000/01	10.09	11,529	136
2001/02	11.8	12,874	143
2002/03	12.69	13,535	140
2003/04	11.11	11,766	131
2004/05	9.37	9,869	113

Current and recent fishery catch trends by method

The most recent estimate of catch levels in the fishery by fishing method (sub-fishery) (total and/or by target species). Summary of the most recent estimate of catch levels in the fishery by fishing method (sub-fishery). In table form

Total longline catch by year of the main target and bycatch species for all vessels is as follows (Campbell 2006):

	Retained Catch (Whole Weight)						TOTAL
Year	YFT	BET	SWO	STM	ALB	OTH*	Catch
1986/87	136	29	14	4	37	2	222
1987/88	954	33	14	75	170	5	1,252
1988/89	1,010	29	25	65	174	10	1,312
1989/90	684	20	22	8	90	5	830
1990/91	913	28	67	140	293	58	1,499
1991/92	900	34	64	49	319	218	1,583
1992/93	1,077	33	63	47	207	163	1,589
1993/94	1,003	68	57	88	457	377	2,049
1994/95	1,212	168	65	130	617	350	2,543
1995/96	1,826	276	214	154	802	345	3,617
1996/97	2,319	743	1,668	317	511	619	6,176
1997/98	1,574	1,237	2,510	349	658	469	6,796

	1998/99	2,701	1,100	2,382	732	655	836	8,405
	1999/00	1,725	832	3,174	814	532	337	7,413
	2000/01	2,246	1,164	2,236	828	586	490	7,550
	2001/02	2,859	1,102	2,462	819	897	654	8,793
	2002/03	4,011	1,004	2,293	719	683	480	9,190
	2003/04	2,715	807	1,788	595	781	589	7,274
	2004/05	2,342	911	1,720	423	872	603	6,872
	2005/06 #	1,600	506	1,594	449	1,039	327	5,515
	* OTH = SBT, Rudderfish, Dolphinfish, Pomfrets, # Preliminary							
Current and recent value of fishery ($)	*Note current and recent value trends by sub-fishery.* 2002/03 estimated Longline and minor line: catch - 8,522 tonnes : value - $67,913,000 (http://www.afma.gov.au/fisheries/tuna/etbf/at_a_glance.htm)							
Relationship with other fisheries	*Commercial and recreational, state, national and international fisheries. List other fisheries operating in the same region any interactions* 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 Southern Shark Fishery and the South East Non-Trawl Fishery. Tuna operators occasionally take dusky, gummy and bronze whaler sharks, which are the target of state-managed fisheries in coastal waters of southern and south-western Australia. 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 byproduct species in Australia's tuna and billfish fisheries, such as Ray's bream and dolphin fish. <u>International Fisheries</u> Many of the species targeted in the ETBF are also captured by fisheries in the western Pacific Ocean. The connectivity of the stocks is unclear. The level of exploitation for the Pacific Ocean stocks varies from over exploited to underexploited. The link between fish caught in the ETBF and the large stocks of the central and western Pacific is poorly understood, and is the subject of ongoing research in Australia and the South Pacific. Over 2.1 million tonnes of tuna, worth in excess of US$1 billion, are taken annually in this region. Australia's catch represents less than 1% of tuna caught in the central and western Pacific ocean. The Scientific Committee for the Western Central Pacific Fishery Commission have produced preliminary estimates for the total catches in the western and central Pacific Ocean in 2005: skipjack tuna 1,443,127 tonnes (highest on record); bigeye tuna 163,419 tonnes (highest on record), yellowfin tuna 423,468 tonnes (about 10% less thatn the record catch in 1998), and albacore (115,353 tonnes (the lowest for 5 fives) (Lawson, 2006). <u>Japanese fishing activity with the Australian fishing zone</u> 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. This 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

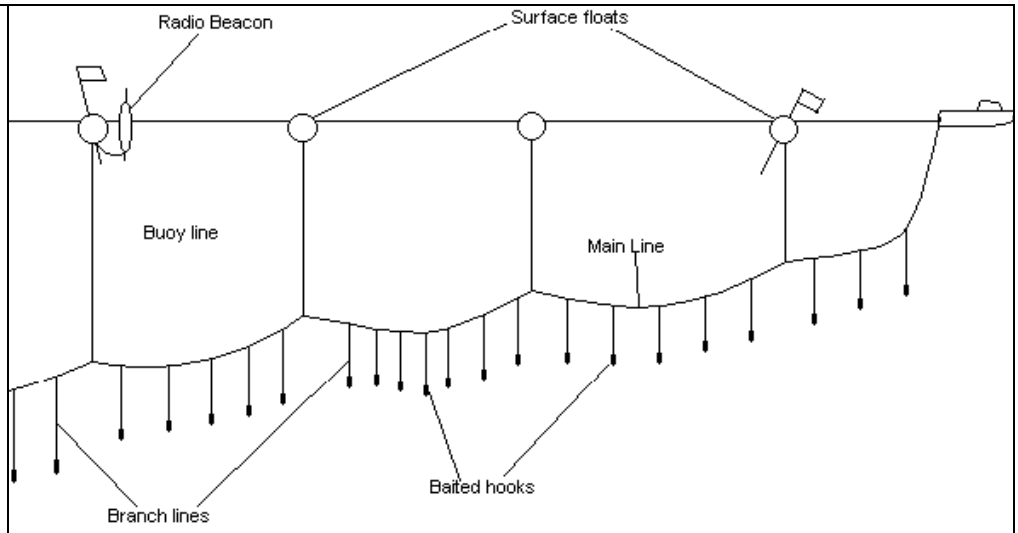
Commonwealth fisheries that operate in the same region as the ETBF include the Southern Bluefin Tuna Fishery, Small Pelagics Fishery, South East Non-Trawl Fishery, South East Trawl Fishery, Southern Shark Fishery and the Coral Sea Fishery. The Southern and Western Tuna and Billfish Fishery operates in waters adjacent to the ETBF. Many state finfish fisheries operate adjacent to the waters of the ETBF, however direct interactions are limited given that most pelagic species caught in the ETBF do not venture into near shore waters and only a few species of inshore fish are susceptible to capture on pelagic longlines. There many other fisheries that overlap the operational area of the ETBF, however those mentioned are principally related to the fishery because species caught are common or species targeted in one fishery are caught for bait in another. Table below identifies the relationship between the ETBF and other fisheries.

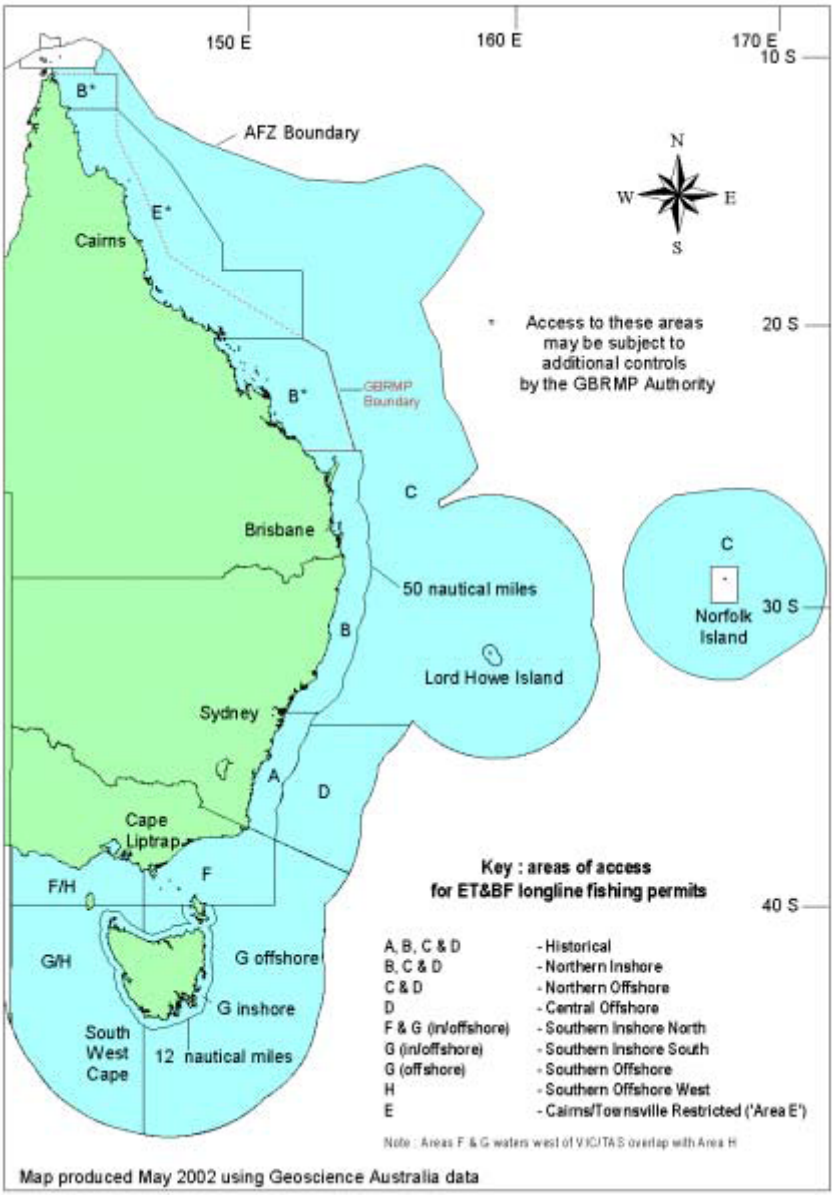
Characteristics of Commonwealth fisheries related to the ETBF

Fishery	Target species	Interactions with ETBF	Gear
Southern Bluefin Tuna Fishery	Southern bluefin tuna	Southern bluefin tuna- bycatch on pelagic longlines in the ETBF. Very small catches of bigeye and albacore in purse seining and poling operations	Purse seine, Pelagic longline
Southern & Western Tuna & Billfish Fishery	Broadbill swordfish, Yellowfin tuna, Bigeye tuna, Albacore tuna	Broadbill swordfish are commonly caught across southern Australia. A number of studies have found no genetic differences between broadbill caught on the east and west coasts of Australia. There is a likelihood of some interchange between stocks of the Pacific and Indian oceans, however it is not known how much mixing occurs. Scientific evidence indicates that stocks of yellowfin, bigeye, albacore and striped marlin are separate in the pacific and Indian oceans, The level of mixing between them is likely to be very low but with current levels if knowledge this remains unclear (Dr R. Campbell, CSIRO, Pers Comm.).	Pelagic longline, Purse seine, minor line
Small Pelagics Fishery	Peruvian jack mackerel, Greenback jack mackerel, Blue mackerel, Yellowtail scad, Redbait	Small pelagic species caught for own use and/or as bait in the ETBF	Purse seine
Skipjack Fishery	Skipjack tuna	Purse seine fishery for skipjack tuna can interact with species taken in the ETBF (yellowfin tuna and bigeye tuna)	

Recreational and charter fisheries:

	Recreational anglers fish in the same areas as ETBF longliners but generally closer to shore. Recreational anglers use trolling lures or baits from the shore and drifting boats. Baits include small skipjack tuna, pilchards, mackerel, nannygai and redfish. All Australian states now have some controls on recreational and charter fishing for tuna and billfish species. Attachment 6 contains a summary of the legal length and bag/boat limit restrictions for recreational and charter fishing in each state. More information on the management of state recreational fisheries can be found at the individual states websites. Queensland - www.dpi.qld.gov.au NSW - www.fisheries.nsw.gov.au Victoria - www.nre.vic.gov.au/fishing Tasmania - www.dpif.tas.gov.au FRDC has funded research into recreational and Indigenous fishing. The project is entitled *National and recreational Indigenous fishing survey* and is described in more detail in Part III. of the Draft Assessment report 2003 (AFMA Draft Assessment report 2003)
Gear	
Fishing methods and gear	*Description of the methods and gear in the fishery, average number days at sea per trip.* Pelagic longlining (live, fresh & frozen bait, light sticks) Operators in the ETBF utilise a variety of boats, ranging from small, general purpose inshore boats to large, 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 a relatively large fleet has been established to fish for broadbill swordfish and bigeye tuna on a year-round basis. The Australian tuna and billfish fisheries are based on pelagic resources, and therefore use methods designed to capture species that are associated with the surface and midwater. With the exception of purse seine, all fishing methods used in the Australian tuna and billfish fisheries are passive and rely on fish attacking the bait. Longlining is the primary fishing method in the ETBF. Pelagic longlines are set near the surface of the water. Longlines can be many kilometres long and carry thousands of hooks (though the average number of hooks deployed per set in the ETBF during 2005 was around 1050). Baited hooks are attached to the longline by short lines called snoods that hang off the mainline. Pelagic longlines are not anchored and are set to drift near the surface of the ocean with a radio beacon attached so that the vessel can track them to haul in the catch. Pelagic longlines are usually used to catch large tuna and billfish species. Pelagic longline fishing involves use of a mainline to which are attached branch line, each fitted with one or more, baited hooks pr artificial lures. The longline is set in the sea in such a manner that the mainline, branch lines, and hooks are suspended above the sea bed by floats at the sea surface. Longlines are deployed from the vessels and radio beacons are used to locate the gear after a period of time.

	 Trips are generally at least three to seven days, although since the late 1990s, trips of seven to 20 days have become common for longliners targeting bigeye and swordfish in offshore grounds with the advent of larger capacity vessels.
Fishing gear restrictions	*Any restrictions on gear* According to BRS (2004) in the ETBF marine birds such as albatross and shearwaters maybe attracted to long line baits when vessels are setting their gear, and some birds are hooked and drown. The 1998 Threat Abatement Plan to reduce incidental bycatch of marine birds, which requires longline operators to carry approved bird scaring tori line, to use it and set at night only when operating south of 30° S, and to not discharge offal during line setting and hauling. Trials are underway re mitigation measures such as chutes and line weighting(BRS 2004.) The requirement on fishers is to not discard lightsticks (BRS 2004)
Selectivity of fishing methods	*Description of the selectivity of the sub-fishery methods* Pelagic longline In comparison to many other fishing methods, pelagic longlining is considered to be 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 a number of 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 • 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. In particular, these include environmentally protected seabirds and turtles, and commercially protected blue and black marlins and various shark species of concern.
Spatial gear	*Description where gear set ie continental shelf, shelf break, continental slope (range nautical*

zone set	*miles from shore)* Inshore and offshore as below and in the high seas 
Depth range gear set	*Depth range gear set at in metres* The gear is set from between 30-400metres below the surface
How gear set	*Description how set, pelagic in water column, benthic set (weighted) on seabed* A pelagic longline consists of a mainline with attached branch lines. Each branchline 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 (see Figure 3 below). Longlines are deployed from the vessel and radio beacons are used to locate the gear after a period of time. Because the gear is set in the water column, pelagic longlining has no direct impact with the benthos.
Area of gear impact per set or shot	*Description of area impacted by gear per set (square metres)* Gear is set in the water column, therefore pelagic longlining has no direct impact with the benthos.

Capacity of gear	*Description number hooks per set, net size weight per trawl shot* Most Australian pelagic longline vessels are between 15 and 30 m long and set between 200 and 1200 hooks per fishing operation. Some longliners now routinely set more that 1200 hooks per day. Some longliners fish around seamounts while others range up to 500 nautical miles from port in search of target species. Australian longliners store their catch on ice, in ice slurry, brine or use brine spray systems.
Effort per annum all boats	*Description effort per annum of all boats in fishery by shots or sets and hooks, for all boats* See current and recent fishery trends by method above
Lost gear and ghost fishing	*Description of how gear is lost, whether lost gear is retrieved, and what happens to gear that is not retrieved, and impacts of ghost fishing* Radio beacons are used to locate the gear for hauling. However, some gear or parts of line may break free. If gear lost then it may drift for a while before balling up, baits usually fall off.
Issues	
Target Species issues and Interactions	*List any issues, including biological information such as spawning season and spawning location, major uncertainties about biology or management, interactions etc* Albacore tuna, Bigeye tuna, Broadbill Swordfish, Yellowfin tuna, Striped Marlin The variety of tuna and billfish species 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 specieis 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 jurisdictional issue, however, complementary management is essential. There are three distinct tuna and billfish fisheries managed under Commonwealth jurisdiction and some conflicts arise where catches in one fishery impact on the stocks of another. This usually results in some level of discarding and needs to be addressed. The link between fish caught in the ETBF and the large stocks of the central and western Pacific is poorly understood, and is the subject of ongoing research in Australia and the South Pacific. Over 2 million tonnes of tuna, worth in excess of US$1 billion, are taken annually in this region. Australia's catch represents less than 1% of tuna caught in the central and western Pacific ocean. (AFAM Draft Strategic Assessment 2003).
Byproduct and bycatch issues and interactions	*List any issues, as for the target species above* As defined, byproduct species include any part of the catch which is kept or sold, but which is not the target species. The predominant byproduct species are Short-finned mako Blue whaler shark Rudderfish Dolphinfish Moonfish Bronze whaler shark Ray's bream Around 100 species of fish have been recorded as taken 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 byproducts, 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. Perhaps the most critical issue with respect to 'other fish' species taken in Australia's tuna and billfish fisheries is that of sustainability. The mortality of these animals when caught is likely to vary 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 1998* 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). According to the AFMA Draft Strategic Assessment 2003 some information is available on composition and abundance of bycatch species taken in the fishery, however the level of validated data for the fishery is limited. According to the Tuna and billfish longline BAP 2004 the longline fisheries have recorded over 60 marine species in catches. Some are caught in significant numbers, particularly oceanic shark species, and these catches may represent a high risk to the sustainability of these species. <u>Sharks</u> Sharks, other than those protected species discussed elsewhere, taken mainly during longline and minor line fishing operations in Australia's tuna and billfish fisheries are predominantly oceanic species. A number of species of sharks are taken, however, logbook data indicates that blue shark is the major species caught by longline fishers while mako sharks are the major species caught by minor line operators. Logbooks provide for recording the numbers and species that are captured and released, as well as the species and quantity retained. However, species identification for some shark species can be difficult. Logbooks are not validated with respect to bycatch information. In response to concerns over the practice of shark finning and the results of a technical review of shark finning in Australia, a new Government policy to ban the practice at sea in all Commonwealth tuna and billfish fisheries was announced in October 2000. The ban was introduced as an interim measure, pending the development of medium and long term arrangements. There is currently a 20 shark carcass per trip byproduct limit in all Commonwealth longline tuna and billfish fisheries in recognition that sharks occur as a non-targeted catch. Any shark caught after this 20 shark limit cannot be landed. <u>Billfish</u> It is recognised that billfish are an important recreational fishing species. The Bycatch Action Plan aims to minimise capture of commercially protected billfish species, but also to fill the gaps in knowledge about the problem. Scientific information indicates that billfish are highly migratory fish with a wide geographic distribution, which includes areas outside the Australian Fishing Zone. They are believed to be highly fecund and grow quickly in their early years. While there is no scientifically based evidence that the current levels of commercial fishing for tuna and billfish in Australia threaten the sustainability of the billfish, the status of these stocks remains uncertain due to a lack of information and assessment. Legislation was introduced in 1998 banning the take of blue and black marlin by commercial fishers. This ban has resulted in the discarding of these species that are caught during normal fishing activity. Besides the resultant discarding due to these bans, the collection of data for catch and stock monitoring has also ceased. Code of Practice: Black and blue marlin are non-commercial species. Every effort should be made to return these species to the sea, alive and undamaged. Black and blue marlin are protected through a voluntary industry agreement and must be returned to the sea even if dead <u>Other fish species</u> The knowledge on species composition, catch rates and basic biological parameters of the range of 'other fish' species presents concern about sustainability. Work needs to be done in

	all key areas to enhance the management of bycatch of 'other fish' species and provide some level of certainty about the sustainability of these animals. Tuna fishers are permitted to catch tuna and tuna-like species as part of their Fishing Permit. Some other species have bycatch limits as stated in the bycatch regulations that have been negotiated as part of the Offshore Constitutional Settlement arrangements or imposed by the Commonwealth. These arrangements require review as part of this Bycatch Action Plan to ensure that such limits reflect to the best extent possible the management needs of these species. Regulations The targeting of bycatch species is limited through implementing limits on each species landed per trip. Limits are made binding under Regulations. Determining effective limits and achieving complementary jurisdictional arrangements is a management issue. Bycatch data The majority of the bycatch data for the domestic fisheries has been collected through the logbook program that began in the 1960s. Logbooks have traditionally focused on target species and therefore are not reliable indicators of the extent of bycatch in fisheries. In addition, inaccurate identification of species that are recorded infects the data and reduces its use in scientific analyses. This data has not been validated but validation of logbook data and improvements in logbook records are focuses of the Bycatch Action Plan (2001). Validated data is, however, available from observers on Japanese longliners fishing in the Australian Fishing Zone since 1979. Although observer coverage on these vessels was about eight per cent, the data provides an accurate indication of the bycatch caught on the Japanese vessels at the time (Table 3). It is important to note that although this information is the best indication of bycatch likely to occur in Australia's tuna and billfish fisheries, the fishing methods used by the Japanese fleet were not identical to those used by Australian operators today.
TEP issues and interactions	*List any issues. This section should consider all TEP species groups: marine mammals, chondrichthyans (sharks, rays etc.), marine reptiles, seabirds, teleosts (bony fishes), include any key spawning/breeding/aggregation locations that might overlap with the fishery/sub-fishery.* Longline sector operators are required to complete the Australian Pelagic Longline Daily Fishing Log (Al05) on a shot by shot basis. Reporting of any interactions with any Protected species is a mandatory requirement of the EPBC Act 1999. Both the great white and grey nurse sharks are listed as vulnerable species under the EPBC Act, meaning that it is illegal to knowingly or recklessly take, trade or move either of these species while fishing under State or Commonwealth jurisdiction. 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 to avoid all interactions with these species. Interactions include knowingly or recklessly taking, trading or moving these species. Where an interaction does occur, operators are legally required to report to Environment Australia. *Chondrichthyans* Species list: DEH: Protected Matters Search Tool, CAAB distribution, Last & Stevens (1994). Chondrichthyans do not appear on the s248 EPBC Act: Listed Marine Species as of the date of this publication, but are listed under the EPBC Act List of Threatened Fauna. [http://www.deh.gov.au/cgi-bin/sprat/public/publicthreatenedlist] The Grey Nurse Shark (*Carcharias taurus*: east coast population) is considered Critically endangered. Lynch (2004) noted 5 alive following interactions with this fishery in 2000-01.

No interactions since.

There has been only one interaction resulting in the mortality of a Great White (*Carcharodon carcharias*) noted in 1999-2000. None since (Lynch 2004).

Whale Sharks have been positively identified in the deeper waters of the sub-fishery as far south as eastern Victoria, however as plankton feeders are higher unlikely to interact directly with the gear. (CAAB distribution, Last & Stevens 1994).

Whale sharks, great white sharks and grey nurse sharks are protected species. Logbook and anecdotal information collected to date indicates that Australia's tuna and billfish fisheries have very low rates of known interactions with these species. Given that the grey nurse shark is classified as an inshore species, the species is not considered to be at risk of interacting with Australia's tuna and billfish fisheries. These species have low productivity.

Marine birds

The incidental catch of seabirds during oceanic longline fishing operations has been identified as a key threatening process to the conservation of their populations. This listing obliged the Commonwealth to prepare a Threat Abatement Plan for this threatening process within three years of the listing. This process was completed in August 1998, when the Commonwealth Minister for the Environment approved the Threat Abatement Plan. The EPBC Act, which came into force in July 2000, replaced several pieces of Commonwealth environment legislation and now administers the Threat Abatement Plan.

The Threat Abatement Plan was prepared in consultation with the oceanic longline fishing industry, non-government conservation groups, scientists, and government authorities responsible for conservation and fisheries management. The Threat Abatement Plan is binding on all Commonwealth agencies.

The objective of the Threat Abatement Plan is to reduce seabird bycatch in all fishing areas, seasons or fisheries to below 0.05 seabirds per thousand hooks, based on current fishing levels. The Bycatch Action Plan acknowledges the Threat Abatement Plan as the primary mechanism to address seabird bycatch, and supports full and timely implementation of all actions specified in the Threat Abatement Plan. The 1998 TAP is being updated in 2006. Prior to the development of the Threat Abatement Plan, AFMA regulated the compulsory use of tori poles in Australia's tuna and billfish fisheries south of 30°S to address the high risk of seabird interaction and, in particular, reduce the likelihood of catching species of concern like albatross. The poles extend off the rear of the vessel and trail a line with streamers that deter birds from taking the bait entering the water. These poles have also been considered in the Threat Abatement Plan. Trials are underway re mitigation measures such as chutes and line weighting(BRS 2004.) According to BRS (2004) longliners targeting swordfish often use several hundred chemical lightsticks per set. The active ingredients are not considered to pose an environmental threat, but the plastic cases may harm seabird chicks. Flying fish eggs which are a food source for several marine birds species attach to floating debris such as light sticks, marine birds may then accidentally ingest light sticks, and regurgitate plastic fragments when feeding chicks, which could potentially choke them.

AFMA Data summaries for 1999/00 – 2004/05 observed undifferentiated albatross, petrels and prions, and shearwaters as caught dead and alive during this period. Data summaries for 1999/00 – 2004/05 observed undifferentiated seabirds as caught dead and alive. Detailed wildlife data was also collected through the eight percent coverage of the foreign observer programs. The data indicates that seabird interactions were the most common wildlife interaction with longline gear, with mostly dead birds released from the gear (Table 4). It should be noted that this data ranges from before to after the Threat Abatement Plan was established to reduce seabird capture. Seabird interactions have since decreased dramatically.

Observed Seabirds Interactions	
Species	Interaction Source AFMA Data Summary

		(Lynch 2004)		
	Cape Petrel (Daption capense)	Observed around vessel during setting and hauling of baits in ETBF in 2003-04. Noted to be chasing and diving on baits and to make "light" contact with vessel or gear.		
	Silver Gull (Larus novaehollandiae)	Observed around vessel during setting and hauling of baits in ETBF in 2003-04, and to make light contact with the gear or vessel.		
	Australasian Gannet (Morus serrator)	Observed around vessel during setting and hauling of baits in ETBF in 2003-04. Noted to be chasing and diving for non target species and to make "heavy" contact with vessel or gear.		
	Wilson's storm petrel (subantarctic) (Oceanites oceanicus)	Noncapture interaction: Observed around vessel during setting and hauling of baits in ETBF in 2003-04.		
	Fairy Prion (Pachyptila turtur)	Noncapture interaction: Observed around vessel during setting and hauling of baits in ETBF in 2003-04, chasing and diving on baits and or target species.		
	White-faced Storm-Petrel (Pelagodroma marina)	Noncapture interaction: Observed around vessel during setting and hauling of baits in ETBF in 2003-04.		
	White-chinned Petrel (Procellaria aequinoctialis)	Noncapture interaction: Observed around vessel during setting and hauling of baits in ETBF in 2003-04.		
	Grey petrel (Procellaria cinerea)	Noncapture interaction: Observed around vessel during setting and hauling of baits in ETBF in 2003-04.		
	Westland Petrel (Procellaria westlandica)	Observed around vessel during setting and hauling of baits in ETBF in 2003-04, chasing or diving for baits or target species. Mitigation trials findings (2001-2003): 38 gm swivel in combination with double tori lines - I dead >seabird captures during daytime deployment.		
	Tahiti Petrel (Pseudobulweria rostrata)	Observed around vessel during setting and hauling of baits in ETBF in 2003-04. Noted to make "light" contact with vessel or gear.		
	Gould's Petrel (Pterodroma leucoptera)	Noncapture interaction: Observed around vessel during setting and hauling of baits in ETBF in 2003-04.		
	Great-winged Petrel (Pterodroma macroptera)	Observed around vessel during setting and hauling of baits in ETBF in 2003-04, chasing or diving for baits or target species, ~ 25% sustaining "light contact with gear or vessel". Mitigation trials findings (2001-2003), second most captured species after fleshy footed shearwaters: (1) underwater line setting chute - 2 dead: 1 released alive, >seabird captures during daytime deployment, (2) 38 gm swivel in combination with double tori lines - 2 dead whilst tori lines set vs 0 with no lines deployed, (3) 60 gm swivel in combination with double tori lines- 1 dead.		
	Soft-plumaged Petrel (Pterodroma mollis)	Noncapture interaction: Observed around vessel during setting and hauling of baits in ETBF in 2003-04.		
	Black-winged Petrel (Pterodroma nigripennis)	Noncapture interaction: Observed around vessel during setting and hauling of baits in ETBF in 2003-04.		
	Providence Petrel (Pterodroma solandri)	Observed around vessel during setting and hauling of baits in ETBF in 2003-04, diving and chasing baits or target species and to make "heavy" contact with the gear or vessel.		
	Flesh-footed Shearwater (Puffinus carneipes)	Major seabird bycatch species in this fishery, deepest divers to baits ~ 70m. Mitigation trials findings (2001-2003): (1) underwater line setting chute - 233 ffsw's @ 98% mortality. > no.s caught during daytime		

		deployment, (2) 38 gm swivel in combination with double tori lines - 3 dead whilst tori lines set vs 0 with no lines deployed, (3) 60 gm swivel in combination with double tori lines - 9 @ 100% mortality; all daytime captures.		
	Sooty Shearwater (Puffinus griseus)	Shearwaters constitute the major seabird bycatch in this fishery. Observed around vessel during setting and hauling of baits in ETBF in 2003-04. Mitigation trials findings (2001-2003): (1) underwater line setting chute - 1 dead > no.s caught during daytime deployment.		
	Hutton's Shearwater (Puffinus huttoni)	Noncapture interaction: Observed around vessel during setting and hauling of baits in ETBF in 2003-04.		
	Wedge-tailed Shearwater (Puffinus pacificus)	Shearwaters constitute the major seabird bycatch in this fishery. Most common species observed around vessel during setting and hauling of baits in ETBF in 2003-04, chasing or diving for baits or target species, frequent contact with gear and vessel. Mitigation trials findings (2001-2003): (1) underwater line setting chute - 1 dead >seabird captures during daytime deployment, (2) 38 gm swivel in combination with double tori lines -nil captures of this species, (3) 60 gm swivel in combination with double tori lines- nil captures of this species.		
	Short-tailed Shearwater (Puffinus tenuirostris)	Shearwaters constitute the major seabird bycatch in this fishery. Observed around vessel during setting and more when hauling of baits in ETBF in 2003-04, chasing or diving for baits or target species, ~ 75% sustaining "light contact with gear or vessel", some getting hooked. Mitigation trials findings (2001-2003): (1) underwater line setting chute - 1 dead >seabird captures during daytime deployment, (2) 38 gm swivel in combination with double tori lines - 2 dead whilst tori lines set vs 0 with no lines deployed, (3) 60 gm swivel in combination with double tori lines- nil captures of this species.		
	Crested Tern (Sterna bergii)	Observed around vessel during setting and more when hauling of baits in ETBF in 2003-04, all observed birds sustaining "light contact with gear or vessel".		
	Sooty tern (Sterna fuscata)	Noncapture interaction: Observed around vessel during setting and hauling of baits in ETBF in 2003-04.		
	Great Skua (Catharacta skua)	Capture		
	Southern Royal Albatross (Diomedea epomophora)	Noncapture interaction: Observed around vessel during setting and hauling of baits in ETBF in 2003-04.		
	Wandering Albatross (Diomedea exulans)	Observed around vessel during setting and hauling of baits in ETBF in 2003-04. Noted to be chasing and diving on baits and to make "light" contact with vessel or gear.		
	Gibson's Albatross (Diomedea gibsoni)	Observed around vessel during setting and hauling of baits in ETBF in 2003-04. Mitigation trials findings (2001-2003): (1) underwater line setting chute - 1 released alive, >seabird captures during daytime deployment, (2) 38 gm swivel in combination with double tori lines - 1 undifferentiated dead whilst tori lines set vs 0 with no lines deployed.		
	Southern Giant-Petrel (Macronectes giganteus)	Noncapture interaction: Observed around vessel during setting and hauling of baits in ETBF in 2003-04.		
	Northern Giant-Petrel (Macronectes halli)	Noncapture interaction: Observed around vessel during setting and hauling of baits in ETBF in 2003-04.		

	Sooty Albatross (Phoebetria fusca)	Noncapture interaction: Observed around vessel during setting of baits in ETBF in 2003-04.		
	Buller's Albatross (Thalassarche bulleri)	Noncapture interaction: Observed around vessel during setting and hauling of baits in ETBF in 2003-04.		
	Indian Yellow-nosed Albatross (Thalassarche carteri)	Observed around vessel during setting and hauling of baits in ETBF in 2003-04, chasing or diving for baits or target species, and to make "light" contact with gear or the vessel.		
	Shy Albatross (Thalassarche cauta)	Observed around vessel during setting and more when hauling of baits in ETBF in 2003-04, chasing baits or target/ non target species, some observed birds sustaining "light contact with gear or vessel". Mitigation trials findings (2001-2003): (1) underwater line setting chute - 1 dead, >seabird captures during daytime deployment, (2) 38 gm swivel in combination with double tori lines - 1 undifferentiated dead whilst tori lines set vs 0 with no lines deployed.		
	Yellow-nosed Albatross, Atlantic Yellow- nosed Albatross (Thalassarche chlororhynchos)	Observed around vessel during setting and hauling of baits in ETBF in 2003-04. May be more common during setting. Mitigation trials findings (2001-2003):38 gm swivel in combination with double tori lines and (3) 30 gm swivel in combination with double tori lines - I dead; I dead undifferentiated albatross. >seabird captures during daytime deployment.		
	Grey-headed Albatross (Thalassarche chrysostoma)	Noncapture interaction: Observed around vessel during hauling of baits in ETBF in 2003-04.		
	Campbell Albatross (Thalassarche impavida)	Noncapture interaction: Observed around vessel during setting and hauling of baits in ETBF in 2003-04.		
	Black-browed Albatross (Thalassarche melanophrys)	Observed around vessel during setting and hauling of baits in ETBF in 2003-04, chasing and diving for baits and or target species, large no.s making contact with gear or vessel. Mitigation trials findings (2001-2003): (1) underwater line setting chute - 1 dead >seabird captures during daytime deployment, (2) 38 gm swivel in combination with double tori lines and (3) 60 gm swivel in combination with double tori lines - I dead undifferentiated albatross		

Marine mammals

All Australian marine mammals (eg whales, dolphins, seals and the dugong) are protected under the EPBC Act. The interaction between marine mammals and tuna fishing activities based on logbook data is low, however, there is very little verified data to confirm this assessment. There is some anecdotal evidence that the primary source of interactions with longline fishing activities arises from killer whales, dolphins and seals preying on fish caught on longlines. In relation to the. International data suggests that the close association between tuna schools and dolphins found in tropical waters of the eastern Pacific is not predominant in the western and central Pacific.

Bob Stanley provided a paper and applicable to the ETBF by Bell et al (2006) Marine mammals and Japanese longline fishing vessels in Australia waters: operational interactions and sightings *Pacific Cons Biology* 12:31-39. The paper analysed Observer data of Japanese fleets 1980 -1997 provided information on whales and dolphins. Killer and false whales one of each were hooked and cut free alive, and one of each were caught drowned. One undifferentiated whale was caught dead. Killer and false whales were observed taking, damaging, scaring away target species. Two killer whales were observed taking bycatch or bait fish and took a prolonged interest in the vessel, possibly feeding. A small pod of pilot whales was observed taking a prolonged interest in the vessel, possibly feeding. According to R Daley small whales and dolphins can be caught. According to BRS (2004) marine

	mammals sometimes create problems for fishers by removing or damaging hooked fish before the longline is hauled. The paper by Bell et al (2006) provided information on leopard seals; 2 were observed hooked one alive but other does not provide status alive or dead. According to R. Daley, Elephant seals have been in longline fisheries in Australia. Bell et al (2006) observed 4 unidentified seals caught; 2 were cut free alive, while the status of the other 2 was not specified as alive or dead. Marine reptiles *Turtles* Available information on turtle bycatch in tuna longline fisheries has recently been assessed by AFMA. Although available information suggests that bycatch is at a low level, it may pose an ongoing risk to the status of some species. In particular the status of loggerhead turtles and leatherback turtles is such that very low levels of take and subsequent mortality may pose a risk to populations in waters off eastern Australia. There is insufficient information currently available to determine the species composition of turtle catch and to verify catch levels. The likelihood of survival of released turtles is also unknown although anecdotal information suggests that turtles, handled correctly, may have high levels of post-release survival. Turtles are rarely caught but are released alive in almost all cases and seal and cetacean interactions are also infrequent. According to BRS (2004) the ETBF expansion of shallow line sets targeting swordfish has increased the likelihood of catching sea turtles. A BRS project has examined the the extent of ETBF turtle by catch and possible mitigation measures that the fishery might adopt. The results of the project suggest that turtle interaction rates in the ETBF are low compared to other longline fisheries and that almost all turtles are released alive. Despite this finding the project also highlights the need for improved data collection on turtle interaction rates. *Seasnakes* Not considered an issue in this fishery (RAG Meeting 31/03/05). Teleosts *Sygnathids: Seahorses and Seadragons, Pipehorses and Pipefish* At the stakeholder meeting 30/3/05 pipehorses not considered an issue for this fishery.
Habitat issues and interactions	*List any issues for any of the habitat units identified in **Scoping Document S1.2.** This should include reference to any protected, threatened or listed habitats* No benthic habitat interactions have been identified, however over 50 seamounts are identified within the management area and are utilised as pelagic fish aggregating devices (FADs).
Community issues and interactions	*List any issues for any of the community units identified in **Scoping Document S1.2.*** Possibility that the diversity of species, i.e., the bycatch/byproduct species in addition to the target species, captured in the fishery may be unsustainable and have some community effects. There is no information on the effects of fishing on the lower trophic levels, or on the competitors (e.g. sharks) of some of the main target species in this region, either in the offshore oceanic communities or in the seamount communities. Fishing has the potential to influence the survival rate of some species through altering the rates of predation on their juveniles of predators which might be impacted by the fishery. The seamount communities may potentially be at risk from high levels of fishing.
Discarding	*Summary of discarding practices by sub-fishery, including bycatch, juveniles of target species, high-grading, processing at sea.* Generally occurs because the species is of no value, or where the return in the catch would not be adequate to cover the costs of further handling. Discards may include juvenile or damaged target and non-target species, which are often discarded back into the sea during

	fishing operations.
Management: planned and those implemented	
Management Objectives	*The management objectives from the most recent management plan* The Eastern Tuna and Billfish Fishery is managed by a range of input and output controls (see entries). The Eastern Tuna and Billfish Fishery Management Advisory Committee (Eastern Tuna MAC) provides the principal forum in which matters relating to the management of the Fishery are considered. Eastern Tuna MAC has advisory responsibility for tuna and broadbill species other than southern bluefin tuna within the area of waters outside the Southern and Western Tuna and Billfish Fisheries, including Australian Fishing Zone waters adjacent to Norfolk Island. Eastern Tuna MAC has commenced a process to develop a Management Plan designed to provide an appropriate mechanism to control the expanding level of effective fishing effort throughout the entire area of the Fishery. The management objectives for Eastern Tuna MAC are consistent with the 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. The Commonwealth 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), except off New South Wales, where Offshore Constitutional Settlement arrangements are under review. AFMA manages the Australian tuna and billfish fisheries under the provisions of the *Fisheries Management Act 1991*, in partnership with all 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 Convention for the Conservation of Southern Bluefin Tuna. 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. The Convention on the Conservation and Management of Highly Migratory Fish Stocks in the 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. The western limits of the Eastern Tuna and Billfish Fishery stocks and eastern limits of the Southern and Western Tuna and Billfish Fisheries stocks are generally consistent with the current northern boundary at 142º30'E and the southern boundary at 141ºE between the fisheries. These boundaries are consistent with what are thought to be the boundaries between Pacific and Indian Ocean tuna and billfish stocks.
Fishery management plan	*Is there a fisheries management plan is it in the planning stage or implemented what are the key features* The ETBF Management Plan 2005 was accepted on the 12 October 2005 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: (a) to manage the fishery efficiently and cost-effectively for the Commonwealth; (b) to ensure that the exploitation of the resources of the fishery and the carrying on of any related activities are conducted in a manner consistent with the principles of ecologically sustainable development and the exercise of the precautionary principle, and, in particular, the need to have regard to the impact of fishing activities on bycatch species and the long-term sustainability of the marine environment;

	(c) to maximise economic efficiency in the exploitation of the resources of the fishery; (d) to ensure AFMA's accountability to the fishing industry and to the Australian community in managing the resources of the fishery; (e) to reach Government targets for the recovery of the costs of AFMA in relation to the fishery; (f) to ensure that conservation and management measures taken in relation to the fishery implement Australia's obligations under relevant international agreements. Part 2 Specific ecosystem requirements Bycatch (Act s 17 (6D)) (1) AFMA must prepare and implement a bycatch action plan, or bycatch action plans, for the fishery. (2) AFMA must review each bycatch action plan at least once every second year, while it is in force. (3) A bycatch action plan must require action to ensure that: (a) information is gathered about the impact of the fishery on bycatch species; and (b) all reasonable steps are taken to minimise interactions with seabirds, marine reptiles, marine mammals and fish of a kind mentioned in sections 15 and 15A of the Act; and (c) the ecological impacts of fishing operations on habitats in the area of the fishery are minimised and kept at an acceptable level; and (d) bycatch is reduced to, or kept at, a minimum and below a level that might threaten bycatch species. (4) In developing a bycatch action plan, AFMA must take into account: (a) the protection given to whales and other cetaceans under Division 3 of Part 13 of the EPBC Act; and (b) the requirements under the EPBC Act for the protection of: (i) listed threatened species; and (ii) listed threatened ecological communities; and (iii) listed migratory species; and (iv) listed marine species; within the meanings given in that Act. (5) If information gathered under a bycatch action plan shows it is necessary to do so, AFMA must consider making appropriate amendments of this Management Plan or changes to the conditions imposed on the holders of fishing concessions. Reference points (1) This section sets out provisional reference points for primary and secondary species. (2) Within 12 months after the commencement day, AFMA must: (a) collate all available information about the stocks of bigeye tuna, broadbill swordfish, striped marlin and yellowfin tuna in the fishery; and

	(b) assess the risks to the ecological sustainability of those stocks; and (c) unless it sets reference points at the end of that 12 months — not increase the amount of each of the species mentioned in paragraph (a) expected to be taken under the longline TAE and minor line TAE. (3) Within 24 months after the commencement day, AFMA must: (a) carry out an assessment of the risk to the ecological sustainability of each primary species and secondary species posed by fishing in the fishery; and (b) establish reference points for each of those species. (4) If no reference points are set, AFMA must set precautionary limits on the catch of the species. *Note 1* Subsection 17 (5C) of the Act provides that a plan of management for a fishery affecting straddling fish stocks, highly migratory fish stocks or ecologically related fish stocks (within the meaning of the Fish Stocks Agreement) must set out stock-specific reference points (within the meaning of that Agreement) for the stocks. Information to determine reference points is currently poor and, until reliable information is available, provisional reference points are being used. When improved monitoring yields more accurate information, the provisional reference points will be revised. *Note 2* Other ecosystem requirements in this Management Plan are included in Part 4 (Statutory fishing rights and fishing permits) and section 50 (Obligations relating to interactions with certain species and communities). *Note 3* Obligations have been placed on the holders of fishing concessions under section 49 (Obligations of holders of SFRs) to ensure that bycatch is kept to a minimum.
Input controls	*Summary of any input controls in the fishery, e.g. limited entry, area restrictions (zoning), vessel size restrictions and gear restrictions. Primarily focused on target species as other species are addressed below.* The main management control for the fishery is a cap on total number of hooks which can vary from year to year. A recent modification is to differentiate the value of hook deployments by area such that hooks deployed in areas where stocks are depleted will be counted more heavily than those deployed in other areas.
Output controls	*Summary of any output controls in the fishery, e.g. quotas. Effort days at sea. Primarily focused on target species as other species are addressed below.* Trip limits for some species (e.g. sharks, mahi mahi) and limited catch (e.g. SBT, see technical measures), bycatch provisions. For 2006 an interim total catch quota of 1400 t for broadbill swordfish was implemented.
Technical measures	*Summary of any technical measures in the fishery, e.g. size limits, bans on females, closed areas or seasons. Gear mesh size, mitigation measures such as TEDs. Primarily focused on target species as other species are addressed below.* There is a management framework to restrict long-line access to waters containing SBT. Typically two restricted access zones, one in which fishers may set gear if they hold <500 kg of SBT quota, and a more southern zone where fishers must hold more than 4 t on quota. This zone is managed in an interactive fashion during the season.
Regulations	*Regulations regarding species (bycatch and byproduct, TEP), habitat, and communities; MARPOL and pollution; rules regarding activities at sea such as discarding offal and/ or processing at sea.* The Management Plan, is made under the *Fisheries Management Act 1991*, manages only commercial fishing for tuna and billfish species in the area of the fishery. The bycatch provisions set out in the *Fisheries Management Regulations 1998* apply to all

	Fishing Permits in the Eastern Tuna and Billfish Fishery. The 1998 Threat Abatement Plan to reduce incidental bycatch of marine birds
Initiatives, strategies and incentives	*BAPs;TEDs;Industry codes of conduct* The Long line and minor line Bycatch Action Plan was finalised in late 2004. The 1998 Threat Abatement Plan to reduce incidental bycatch of marine birds, which requires longline operators to carry approved bird scaring tori line, to use it and set at night only when operating south of 30° S, and to not discharge offal during line setting and hauling. Trials are underway re mitigation measures such as chutes and line weighting(BRS 2004.) *Chondrichthyans* **Logbook and observer data collection:** monitor bycatch species and rates. **Bycatch action plans**: Australia's Tuna and Billfish Longline and Minor Line Fisheries Bycatch Action Plan. (AFMA 2004). Includes a Code of Practice when dealing with chondrichthyans **National Plan of Action (NPOA):** has been established to address priorities in conservation and management measures, including research and data collection and monitoring programs. **Recovery Plans:** exist for the Grey Nurse Shark (Carcharias taurus), and the Great White (Carcharodon carcharias) in Australia (Environment Australia, 2002). *Marine Mammals* All cetaceans are protected under the EPBC Act 1999, and within the boundaries of the Australian Whale Sanctuary http://www.deh.gov.au/coasts/species/cetaceans/protection.html **Bycatch Action Plan:** Australia's Tuna and Billfish Longline and Minor Line Fisheries Bycatch Action Plan (AFMA 2004) outlines AFMA's intended monitoring strategies, and management responses to address at risk species. The BAP Includes a Code of Practice when dealing with Seals: if a seal is caught on a tuna longline hook, fishers should attempt to remove the hook or, if this is not practical, cut the line as close to the hook as is practical. **Action Plans** exist for all mammal taxa: Cetaceans (Bannister *et al*., 1996), Dugong **(**Marsh et al., 2002), Seals and Sea lions (Shaughnessy 1999). **Recovery Plan:** Sub-antarctic fur seal, and southern elephant seal (Department of the Environment and Heritage, 2004) *Seabirds* The **Threat Abatement Plan** (1998) outlines the compulsory and voluntary mitigation measures that currently exist for vessels operating in the AFZ. Mandatory measures include: (1) Fisheries Management Regulation 19A of the *Fisheries Management Act 1991* specifies mandatory use of tori poles (constructed in accordance with the regulation) by all vessels setting beneath 30° S. (2) Night setting by operators south of 30° S. (3) All day setting vessels must also demonstrate an ability to thaw baits prior to setting, and use thawed baits on hooks. Use weighted lines as determined by experimental trials. (4) Retention of offal during line setting and hauling, to be discharged when not line setting. (5) Code of Practice specific to pelagic longline vessels. It should be noted that boats under 20m may apply for variation to the prescribed measures. Agreements by AFMA board May 2005: (i) operators allowed day setting south of 25° S, providing line weighting regime achieves recommended sink rate (ETMAC July 2005), and mandatory use of a standardized tori line system. A further proposal by ETMAC: (ii) all hooks set south of 25° S, be weighted with either (a) 60gram swivels no

	more than 1m from the hook, or, (b) 98 gram swivels no more than 3.5m from the hook. These arrangements are 'provisional' pending revision of TAP and further R&D work. The **Code of Practice** suggests avoidance of midday and early afternoon sets when analysis suggests mortalities are highest, and requires additional voluntary adoption of mitigation measures which include; puncturing the swim bladders of bait fish, use of bait casting machines on suitable boats, promoting the removal of hooks from fish discards, and the release of live birds caught on gear. **Mitigation trials** to assess the effectiveness of mitigation measures, and the development of others for the ETBF are underway. Current testing is focused on bait sink rate, tori line design, chutes, and line weighting. (AFMA Observer Program, 2003) **Observer program**: currently a very small percentage (3.5-7%) of line sets are observed for TEP interactions, and rate of bycatch. Data collected may include life status, however species identification remains an issue. **Bycatch Action Plan:** Australia's Tuna and Billfish Longline and Minor Line Fisheries Bycatch Action Plan (AFMA 2004) outlines AFMA's intended monitoring strategies and management responses to address at risk species. **Recovery Plans:** exist for a number of species and can be viewed via the DEH website (Recovery Plans) **<u>Marine reptiles</u>** *Turtles* Turtles booklet "Catch fish not turtles using long lines" outlines information on turtles, issues and possible solutions ie use large circle hooks, research directions, how to release captured turtles; and DVD "Crossing the Line: sea turtle handling guidelines for the longline fishing industry" both distributed in March 2005. **Bycatch Action Plan:** Australia's Tuna and Billfish Longline and Minor Line Fisheries Bycatch Action Plan (AFMA 2004) requires further validation of turtle catch rates. **Recovery Plan:** for marine turtles in Australia. (Environment Australia, 2003) *Seasnakes* Seasnakes are not covered by BAP specifically or any Action Plan.
Enabling processes	*Monitoring, logbooks, observer data, scientific surveys); assessment stock assessments); performance indicators (decision rules, processes, compliance; education; consultation process.* See above re Fishery Management Plan
Other initatives or agreements	*State, national or international conventions or agreements that impact on the management of the fishery/sub-fishery being evaluated.* *MPAs* There are four Commonwealth marine protected areas in the area of the ETBF: Barrier Reef marine park, Solitary Islands marine park, Lord Howe Island marine park, Tasmanian Seamounts marine Parks and two reserves Coringa-Herald and the Lithou Reef National Nature Reserves. There are also State reserves within the range of the fishery. International Obligations Australia has signed (but not ratified) the Convention for the Conservation and Management of Highly Migratory Fish Stocks in the Western and Central Pacific Ocean. Once ratified,

	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. Bilateral agreements between Japan and Australia Agreement between Japan and Australia under the Bilateral agreement, regarding the shark bycatch code of practice 4 June 1997 Agreement between Japan and Australia under the Bilateral agreement, regarding the seabird mitigation measures 4 June 1997
Data	
Logbook data	*Verified logbook data; data summaries describe programme* AFMA logbook data exists since the mid-1980's. AFMA Logbooks Longline sector operators, and those operators who are using both pelagic longline and minor line methods, are required to complete the 'Australian Pelagic Longline Daily Fishing Log' AL05) on a shot-byshot basis. The AL05 was introduced into the fishery in September 2000, replacing the AL04.Operators fill in catch and effort logbooks while fishing. They are required to send them to AFMA 14 days after the end of each month. The data is entered into AFMA's GENLOG database. Data collected prior to 25/11/99 is stored in AFMA's TUNALOG database. AFMA observers collect data to verify logbook information.
Observer data	*Objective observer programme; describe parameters, how many years run; coverage – random or full coverage; comments on interactions with species; observer training, species identification, and length of service; data summaries* AFMA observer program was initiated in 2002. Earlier observers worked as part of scientific studies and the data is often classified. A more comprehensive AFMA observer programme commenced in July 2003 and aims to achieve 5% coverage. It is a requirement under the Threat and Abatement Plan (TAP) 1998
Other data	*Studies, surveys* The ETBF has a five year research plan 2003-2008

2.2.2 Unit of Analysis Lists (Step 2)

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

- Species Components (target, byproduct/discards and TEP components). [Scoping document S2A Species]
- Habitat Component: habitat types. [Scoping document S2B Habitats]
- Community Component: community types. [Scoping document S2C Communities]

Ecological Units Assessed

Target species:	5
Byproduct and bycatch species:	44 and 56 respectively
TEP species:	284
Habitats:	274 (264 benthic, 10 pelagic)
Communities:	64 (55 demersal, 9 pelagic)

Scoping Document S2A Species

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

Target species *Eastern Tuna and Billfish Longline Fishery*

List the target species of the sub- fishery. This list is obtained by reviewing all available fishery literature, including logbooks, observer reports and discussions with stakeholders. Target species are as agreed by the fishery.

ERA species ID	Taxa name	Scientific name	CAAB code	Family name	Common name	Source
212	Teleost	*Thunnus albacares*	37441002	Scombridae	Yellowfin Tuna	ERA Stage 1
62	Teleost	*Thunnus obesus*	37441011	Scombridae	Bigeye Tuna	ERA Stage 1
895	Teleost	*Thunnus alalunga*	37441005	Scombridae	Albacore	ERA Stage 1
213	Teleost	*Xiphias gladius*	37442001	Xiphiidae	Broad Billed Swordfish	ERA Stage 1
884	Teleost	*Tetrapturus audax*	37444002	Istiophoridae	Striped marlin	ERA Stage 1
1088	Teleost	*Trachurus declivis*	37337002	Carangidae	Jack Mackerel	ERA Stage 1

ERA species ID	Taxa name	Scientific name	CAAB code	Family name	Common name	Source
540	Teleost	*Trachurus novaezelandiae*	37337003	Carangidae	Yellow tail scad	Species added Alistair Hobday, 20070620
210	Teleost	*Scomber australasicus*	37441001	Scombridae	Blue Mackerel	ERA Stage 1

Byproduct species *Eastern Tuna and Billfish Longline Fishery*

List the byproduct species of the sub- fishery. Byproduct refers to any part of the catch which is kept or sold by the fisher but which is not a target species. This list is obtained by reviewing all available fishery literature, including logbooks, observer reports and discussions with stakeholders.

ERA species ID	Taxa name	Scientific name	CAAB code	Family name	Common name	Source
862	Chondrichthyan	*Pseudocarcharias kamoharai*	37009003	Pseudocarchariidae	Crocodile Shark	ERA Stage 1
964	Chondrichthyan	*Isurus oxyrinchus*	37010001	Lamnidae	Shortfinned Mako or Blue Pointer	ERA Stage 1
370	Chondrichthyan	*Isurus paucus*	37010002	Lamnidae	Longfin Mako	ERA Stage 1
972	Chondrichthyan	*Lamna nasus*	37010004	Lamnidae	Porbeagle shark	ERA Stage 1
179	Chondrichthyan	*Alopias vulpinus*	37012001	Alopiidae	Thintail Thresher Shark, thresher shark	ERA Stage 1
375	Chondrichthyan	*Alopias pelagicus*	37012003	Alopiidae	Pelagic Thresher	ERA Stage 1
535	Chondrichthyan	*Carcharhinus brachyurus*	37018001	Carcharhinidae	Bronze Whaler	ERA Stage 1
808	Chondrichthyan	*Carcharhinus obscurus*	37018003	Carcharhinidae	Dusky Shark	ERA Stage 1
1039	Chondrichthyan	*Prionace glauca*	37018004	Carcharhinidae	Blue Shark	ERA Stage 1
621	Chondrichthyan	*Carcharhinus falciformis*	37018008	Carcharhinidae	Silky Shark	ERA Stage 1
630	Chondrichthyan	*Carcharhinus sorrah*	37018013	Carcharhinidae	Sorrah shark	ERA Stage 1
647	Chondrichthyan	*Carcharhinus tilstoni*	37018014	Carcharhinidae	Australian blacktip	ERA Stage 1
469	Chondrichthyan	*Carcharhinus leucas*	37018021	Carcharhinidae	Bull Shark	ERA Stage 1

ERA species ID	Taxa name	Scientific name	CAAB code	Family name	Common name	Source
551	Chondrichthyan	*Galeocerdo cuvier*	37018022	Carcharhinidae	Tiger Shark	ERA Stage 1
625	Chondrichthyan	*Carcharhinus longimanus*	37018032	Carcharhinidae	Oceanic Whitetip Shark	ERA Stage 1
880	Chondrichthyan	*Sphyrna lewini*	37019001	Sphyrnidae	Scalloped Hammerhead	ERA Stage 1
552	Chondrichthyan	*Sphyrna zygaena*	37019004	Sphyrnidae	smooth hammerhead	Species added from GENLOG species list 2001-2004
489	Chondrichthyan	*Centroscymnus crepidater*	37020012	Squalidae	deepwater dogfish	Commercial Species Grouping expanded for available CAAB synonyms
633	Chondrichthyan	*Centroscymnus plunketi*	37020013	Dalatiidae	plunket's shark	Commercial Species Grouping expanded for available CAAB synonyms
491	Chondrichthyan	*Centroscymnus owstoni*	37020019	Dalatiidae	owston's dogfish	Commercial Species Grouping expanded for available CAAB synonyms
809	Chondrichthyan	*Centroscymnus coelolepis*	37020025	Dalatiidae	Portuguese dogfish	Commercial Species Grouping expanded for available CAAB synonyms
1361	Chondrichthyan	*Centroscymnus spp.*	37020906	Squalidae	Black Shark - (roughskin)	ERA Stage 1
842	Teleost	*Lampris guttatus*	37268001	Lampridae	Spotted moonfish	ERA Stage 1
123	Teleost	*Lepidoperca pulchella*	37311001	Serranidae	Orange Perch	Species added from GENLOG species list 2001-2004
148	Teleost	*Seriola lalandi*	37337006	Carangidae	Yellowtail Kingfish	ERA Stage 1
593	Teleost	*Elagatis bipinnulata*	37337029	Carangidae	rainbow runner	ERA Stage 1
1121	Teleost	*Parastromateus niger*	37337072	Carangidae	Black pomfret	Species added from GENLOG species list 2001-2004
814	Teleost	*Coryphaena hippurus*	37338001	Coryphaenidae	Dolphin Fish (mahi mahi)	ERA Stage 1
152	Teleost	*Brama brama*	37342001	Bramidae	Ray's Bream	ERA Stage 1
682	Teleost	*Pristipomoides filamentosus*	37346032	Lutjanidae	Rosy Jobfish / King Snapper	Species added from GENLOG species list 2001-2004

ERA species ID	Taxa name	Scientific name	CAAB code	Family name	Common name	Source
162	Teleost	*Argyrosomus hololepidotus*	37354001	Sciaenidae	Jewfish	Species added from GENLOG species list 2001-2004
169	Teleost	*Paristiopterus gallipavo*	37367001	Pentacerotidae	Yellow-Spotted Boarfish	Species added from GENLOG species list 2001-2004
204	Teleost	*Ruvettus pretiosus*	37439003	Gempylidae	Oilfish	ERA Stage 1
845	Teleost	*Lepidocybium flavobrunneum*	37439008	Gempylidae	Escolar or Black Oil fish	ERA Stage 1
64	Teleost	*Katsuwonus pelamis*	37441003	Scombridae	Skipjack Tuna	Species added from GENLOG species list 2001-2004
908	Teleost	*Auxis thazard*	37441009	Scombridae	Frigate mackerel	Species added from GENLOG species list 2001-2004
899	Teleost	*Thunnus tonggol*	37441013	Scombridae	Long-tail tuna	ERA Stage 1
255	Teleost	*Thunnus maccoyii*	37441004	Scombridae	Southern Bluefin Tuna	ERA Stage 1
897	Teleost	*Thunnus orientalis*	37441026	Scombridae	Northern Bluefin Tuna	ERA Stage 1
211	Teleost	*Sarda australis*	37441020	Scombridae	Australian bonito	ERA Stage 1
259	Teleost	*Acanthocybium solandri*	37441024	Scombridae	Wahoo	ERA Stage 1
215	Teleost	*Centrolophus niger*	37445004	Centrolophidae	Rudderfish	ERA Stage 1
1069	Teleost	*Seriolella punctata*	37445006	Centrolophidae	Spotted Warehou	ERA Stage 1
1533	Teleost	*Mola ramsayi*	37470001	Molidae	[an ocean sunfish]	Species added from GENLOG species list 2001-2004

Bycatch (discard) species *Eastern Tuna and Billfish Longline Fishery*

List the bycatch species (excluding TEP species) of the sub-fishery. Bycatch as defined in the Commonwealth Policy on Fisheries Bycatch 2000 refers to:

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

However, in the ERAEF method, the part of the target or byproduct catch that is discarded is included in the assessment of the target or byproduct species. The list of bycatch species is obtained by reviewing all available fishery literature, including logbooks, observer reports and discussions with stakeholders.

ERA species ID	Taxa name	Scientific name	CAAB code	Family name	Common name	Source
60	Chondrichthyan	*Notorynchus cepedianus*	37005002	Hexanchidae	Broadnose sevengill shark	ERA Stage 1
936	Chondrichthyan	*Galeorhinus galeus*	37017008	Triakidae	School Shark, Tope shark	ERA Stage 1
629	Chondrichthyan	*Carcharhinus plumbeus*	37018007	Carcharhinidae	Sandbar shark	ERA Stage 1
590	Chondrichthyan	*Dalatias licha*	37020002	Squalidae	Black Shark	ERA Stage 1
604	Chondrichthyan	*Deania calcea*	37020003	Centrophoridae	Brier Shark	ERA Stage 1
1077	Chondrichthyan	*Squalus acanthias*	37020008	Squalidae	White-spotted dogfish	ERA Stage 1
963	Chondrichthyan	*Isistius brasiliensis*	37020014	Squalidae	Cookie-cutter shark (cigar shark)	ERA Stage 1
905	Chondrichthyan	*Zameus squamulosus*	37020042	Squalidae	Velvet dogfish	ERA Stage 1
660	Chondrichthyan	*Squatina australis*	37024001	Squatinidae	Australian Angel Shark	ERA Stage 1
801	Teleost	*Muraenesox bagio*	37063003	Muraenesocidae	COMMON PIKE EEL	ERA Stage 1
373	Teleost	*Alepisaurus ferox*	37128001	Alepisauridae	Long-nosed lancet fish	ERA Stage 1
372	Teleost	*Alepisaurus brevirostris*	37128002	Alepisauridae	Short-nosed Lancet Fish	ERA Stage 1
982	Teleost	*Macruronus novaezelandiae*	37227001	Merlucciidae	Blue Grenadier	ERA Stage 1
550	Teleost	*Exocoetus volitans*	37233013	Exocoetidae	Flying Fish	ERA Stage 1
644	Teleost	*Lampris immaculatus*	37268002	Lampridae	Southern moonfish	Commercial Species Grouping expanded for available CAAB synonyms
810	Teleost	*Lampris guttatus & Lampris immaculatus*	37268900	Lampridae	Moonfish	ERA Stage 1
718	Teleost	*Lophotus lacepede*	37270001	Lophotidae	Crest Fish (J RTMP Obs)	ERA Stage 1
86	Teleost	*Trachipterus arawatae*	37271001	Trachipteridae	Ribbon or Dealfish	ERA Stage 1
562	Teleost	*Regalecus glesne*	37272002	Regalecidae	Oarfish ("king of herrings")	ERA Stage 1
1038	Teleost	*Polyprion oxygeneios*	37311006	Percichthyidae	Hapuku	ERA Stage 1

ERA species ID	Taxa name	Scientific name	CAAB code	Family name	Common name	Source
147	Teleost	*Rachycentron canadum*	37335001	Rachycentridae	Cobia	ERA Stage 1
149	Teleost	*Seriola hippos*	37337007	Carangidae	Samsonfish	ERA Stage 1
882	Teleost	*Taractichthys longipinnis*	37342003	Bramidae	Long finned Bream (pomfret)	ERA Stage 1
594	Teleost	*Brama australis*	37342010	Bramidae	Southern Rays Bream	ERA Stage 1
597	Teleost	*Aphareus rutilans*	37346001	Lutjanidae	Rusty jobfish	ERA Stage 1
600	Teleost	*Etelis carbunculus*	37346014	Lutjanidae	Ruby snapper; Northwest Ruby Fish	ERA Stage 1
158	Teleost	*Pagrus auratus*	37353001	Sparidae	Snapper/Squirefish	ERA Stage 1
159	Teleost	*Acanthopagrus butcheri*	37353003	Sparidae	Black Bream	ERA Stage 1
165	Teleost	*Upeneichthys lineatus*	37355001	Mullidae	Red Mullet/Blue- lined Goatfish	ERA Stage 1
605	Teleost	*Tilodon sexfasciatus*	37361003	Kyphosidae	Moonlighter	ERA Stage 1
607	Teleost	*Scorpis lineolata*	37361009	Kyphosidae	Sweep	ERA Stage 1
1012	Teleost	*Nemadactylus macropterus*	37377003	Cheilodactylidae	Jackass Morwong	ERA Stage 1
178	Teleost	*Nemadactylus valenciennesi*	37377004	Cheilodactylidae	Queen snapper	ERA Stage 1
181	Teleost	*Latridopsis forsteri*	37378002	Latridae	Bastard Trumpeter	ERA Stage 1
879	Teleost	*Sphyraena jello*	37382004	Sphyraenidae	Slender Barracuda	ERA Stage 1
614	Teleost	*Sphyraena barracuda*	37382008	Sphyraenidae	Great Barracuda	ERA Stage 1
1087	Teleost	*Thyrsites atun*	37439001	Gempylidae	Barracouta	ERA Stage 1
1066	Teleost	*Rexea solandri*	37439002	Gempylidae	Gemfish	ERA Stage 1
618	Teleost	*Gempylus serpens*	37439010	Gempylidae	Snake mackerel	ERA Stage 1
208	Teleost	*Lepidopus caudatus*	37440002	Trichiuridae	Southern Frostfish	ERA Stage 1
620	Teleost	*Scomberomorus commerson*	37441007	Scombridae	Spanish Mackerel	ERA Stage 1
63	Teleost	*Euthynnus affinis*	37441010	Scombridae	Eastern Little Tuna/Mackerel tuna	ERA Stage 1
622	Teleost	*Scomberomorus munroi*	37441015	Scombridae	Australian Spotted Mackerel-DoggySchol	ERA Stage 1
623	Teleost	*Scomberomorus semifasciatus*	37441018	Scombridae	Broad-barred Mackerel - Grey Mackerel	ERA Stage 1
830	Teleost	*Gasterochisma melampus*	37441019	Scombridae	Butterfly Mackerel	ERA Stage 1
377	Teleost	*Allothunnus fallai*	37441021	Scombridae	Slender Tuna	ERA Stage 1

ERA species ID	Taxa name	Scientific name	CAAB code	Family name	Common name	Source
835	Teleost	*Gymnosarda unicolor*	37441029	Scombridae	Dogtooth tuna	ERA Stage 1
873	Teleost	*Scomber scombrus*	37441790	Scombridae	Atlantic mackerel	ERA Stage 1
852	Teleost	*Makaira mazara*	37444003	Istiophoridae	Blue Marlin	ERA Stage 1
836	Teleost	*Istiophorus platypterus*	37444005	Istiophoridae	Sailfish	ERA Stage 1
851	Teleost	*Makaira indica*	37444006	Istiophoridae	Black Marlin	ERA Stage 1
883	Teleost	*Tetrapturus angustirostris*	37444007	Istiophoridae	Short Bill Spearfish	ERA Stage 1
958	Teleost	*Hyperoglyphe antarctica*	37445001	Centrolophidae	Blue Eye Trevalla	ERA Stage 1
252	Teleost	*Mola mola*	37470002	Molidae	Ocean sunfish	ERA Stage 1

TEP species *Eastern Tuna and Billfish Longline Fishery*

List the TEP species that occur in the area of the sub-fishery. Highlight species that are known to interact directly with the fishery. TEP species are those species listed as Threatened, Endangered or Protected under the EPBC Act.

TEP 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 TEP species has been generated for each fishery and is included in the PSA workbook species list. This list has been generated using the DEH Search Tool from DEH home page http://www.deh.gov.au/

For each fishery, the list of TEP species is compiled by reviewing all available fishery literature. Species considered to have potential to interact with fishery (based on geographic range & proven/perceived susceptibility to the fishing gear/methods and examples from other similar fisheries across the globe) should also be included.

ERA species ID	Taxa	Family name	Scientific name	Common Name	CAAB code	Reference
315	Chondrichthyan	Lamnidae	*Carcharodon carcharias*	White shark	37010003	144,154
313	Chondrichthyan	Odontaspididae	*Carcharias taurus*	Grey nurse shark	37008001	144,154
1067	Chondrichthyan	Rhincodontidae	*Rhincodon typus*	Whale shark	37014001	144,154
1032	Marine bird	Diomedeidae	*Thalassarche bulleri*	Buller's Albatross	40040001	144,145, 158

ERA species ID	Taxa	Family name	Scientific name	Common Name	CAAB code	Reference
1033	Marine bird	Diomedeidae	*Thalassarche cauta*	Shy Albatross	40040002	144,145, 158
1034	Marine bird	Diomedeidae	*Thalassarche chlororhynchos*	Yellow-nosed Albatross, Atlantic Yellow-	40040003	144,145, 158
1035	Marine bird	Diomedeidae	*Thalassarche chrysostoma*	Grey-headed Albatross	40040004	144,145, 158
1673	Marine bird	Diomedeidae	*Thalassarche nov. sp.*	Pacific Albatross	no CAAB	144,145, 158
753	Marine bird	Diomedeidae	*Diomedea epomophora*	Southern Royal Albatross	40040005	144, 145, 120
451	Marine bird	Diomedeidae	*Diomedea exulans*	Wandering Albatross	40040006	144, 145
1085	Marine bird	Diomedeidae	*Thalassarche melanophrys*	Black-browed Albatross	40040007	144,145, 158
1008	Marine bird	Diomedeidae	*Phoebetria fusca*	Sooty Albatross	40040008	144, 145, 119
1009	Marine bird	Diomedeidae	*Phoebetria palpebrata*	Light-mantled Albatross	40040009	145, 120, 119
755	Marine bird	Diomedeidae	*Diomedea gibsoni*	Gibson's Albatross	40040010	144, 145, 120
628	Marine bird	Diomedeidae	*Diomedea antipodensis*	Antipodean Albatross	40040011	144, 145, 120
799	Marine bird	Diomedeidae	*Diomedea sanfordi*	Northern Royal Albatross	40040012	144, 145, 120
1084	Marine bird	Diomedeidae	*Thalassarche impavida*	Campbell Albatross	40040013	144,145, 158
1031	Marine bird	Diomedeidae	*Thalassarche carteri*	Indian Yellow-nosed Albatross	40040014	144,145, 158
894	Marine bird	Diomedeidae	*Thalassarche salvini*	Salvin's albatross	40040016	144,145, 158
889	Marine bird	Diomedeidae	*Thalassarche eremita*	Chatham albatross	40040017	144,145, 158
1428	Marine bird	Diomedeidae	*Diomedea amsterdamensis*	Amsterdam Albatross	40040018	144, 145
1429	Marine bird	Diomedeidae	*Diomedea dabbenena*	Tristan Albatross	40040019	144, 145, 120, 87
1086	Marine bird	Diomedeidae	*Thalassarche steadi*	White-capped Albatross	no CAAB	144,145, 158
829	Marine bird	Fregatidae	*Fregata ariel*	Lesser frigatebird	40050002	144, 151
1435	Marine bird	Fregatidae	*Fregata minor*	Great Frigatebird, Greater Frigatebird	40050003	144, 151
918	Marine bird	Hydrobatidae	*Fregetta grallaria*	White-bellied Storm-Petrel (Tasman Sea),	40042001	144,145, 148
917	Marine bird	Hydrobatidae	*Fregetta tropica*	Black-bellied Storm-Petrel	40042002	119
555	Marine bird	Hydrobatidae	*Garrodia nereis*	Grey-backed storm petrel	40042003	145, 119

ERA species ID	Taxa	Family name	Scientific name	Common Name	CAAB code	Reference
556	Marine bird	Hydrobatidae	*Oceanites oceanicus*	Wilson's storm petrel (subantarctic)	40042004	109
1004	Marine bird	Hydrobatidae	*Pelagodroma marina*	White-faced Storm-Petrel	40042007	144, 119
2766	Marine bird	Laridae	*Catharacta maccormicki*	South Polar skua	40128004	AFMA Data Sum
2764	Marine bird	Laridae	*Stercorius longicaudus*	Long-tailed jaeger	40128019	Bob Stanley
1438	Marine bird	Laridae	*Anous minutus*	Black Noddy	40128001	144, 151, 82
203	Marine bird	Laridae	*Anous stolidus*	Common noddy	40128002	144, 151, 119
325	Marine bird	Laridae	*Catharacta skua*	Great Skua	40128005	144, 119
973	Marine bird	Laridae	*Larus dominicanus*	Kelp Gull	40128012	144, 151,119
974	Marine bird	Laridae	*Larus novaehollandiae*	Silver Gull	40128013	144, 151,119
975	Marine bird	Laridae	*Larus pacificus*	Pacific Gull	40128014	144, 145,151,119
1582	Marine bird	Laridae	*Procelsterna cerulea*	Grey ternlet	40128018	144, 119
1014	Marine bird	Laridae	*Sterna albifrons*	Little tern	40128022	145, 151
1015	Marine bird	Laridae	*Sterna anaethetus*	Bridled Tern	40128023	144, 82
1016	Marine bird	Laridae	*Sterna bengalensis*	Lesser crested tern	40128024	144, 82
1017	Marine bird	Laridae	*Sterna bergii*	Crested Tern	40128025	144, 82
1018	Marine bird	Laridae	*Sterna caspia*	Caspian Tern	40128026	144, 82
1019	Marine bird	Laridae	*Sterna dougallii*	Roseate tern	40128027	144, 82
1020	Marine bird	Laridae	*Sterna fuscata*	Sooty tern	40128028	144, 82
1021	Marine bird	Laridae	*Sterna hirundo*	Common tern	40128029	144, 82
1023	Marine bird	Laridae	*Sterna paradisaea*	Arctic tern	40128032	82
1024	Marine bird	Laridae	*Sterna striata*	White-fronted Tern	40128033	144, 82
1025	Marine bird	Laridae	*Sterna sumatrana*	Black-naped tern	40128034	144, 82
1432	Marine bird	Phaethontidae	*Phaethon rubricauda*	Red-tailed Tropicbird	40045002	145
912	Marine bird	Phalacrocoracidae	*Phalacrocorax fuscescens*	Black faced cormorant	40048003	144, 119
1580	Marine bird	Procellariidae	*Calonectris leucomelas*	Streaked shearwater	40041002	144, 119
595	Marine bird	Procellariidae	*Daption capense*	Cape Petrel	40041003	145, 119

ERA species ID	Taxa	Family name	Scientific name	Common Name	CAAB code	Reference
314	Marine bird	Procellariidae	*Fulmarus glacialoides*	Southern fulmar	40041004	119
939	Marine bird	Procellariidae	*Halobaena caerulea*	Blue Petrel	40041005	145, 151,119
1052	Marine bird	Procellariidae	*Lugensa brevirostris*	Kerguelen Petrel	40041006	119
73	Marine bird	Procellariidae	*Macronectes giganteus*	Southern Giant-Petrel	40041007	144,145, 120
981	Marine bird	Procellariidae	*Macronectes halli*	Northern Giant-Petrel	40041008	144,145, 120
1003	Marine bird	Procellariidae	*Pachyptila turtur*	Fairy Prion	40041013	144,149,119
1006	Marine bird	Procellariidae	*Pelecanoides urinatrix*	Common Diving-Petrel	40041017	144, 151,119
1041	Marine bird	Procellariidae	*Procellaria aequinoctialis*	White-chinned Petrel	40041018	145, 119
494	Marine bird	Procellariidae	*Procellaria cinerea*	Grey petrel	40041019	145, 119
1042	Marine bird	Procellariidae	*Procellaria parkinsoni*	Black Petrel	40041020	109, 119
1043	Marine bird	Procellariidae	*Procellaria westlandica*	Westland Petrel	40041021	109, 119
1691	Marine bird	Procellariidae	*Pseudobulweria rostrata*	Tahiti Petrel	40041022	155
1045	Marine bird	Procellariidae	*Pterodroma cervicalis*	White-necked Petrel	40041025	145,109,119
504	Marine bird	Procellariidae	*Pterodroma lessoni*	White-headed petrel	40041029	145,119
1046	Marine bird	Procellariidae	*Pterodroma leucoptera*	Gould's Petrel	40041030	145, 119
1047	Marine bird	Procellariidae	*Pterodroma macroptera*	Great-winged Petrel	40041031	119
1048	Marine bird	Procellariidae	*Pterodroma mollis*	Soft-plumaged Petrel	40041032	144,145, 119
1049	Marine bird	Procellariidae	*Pterodroma neglecta*	Kermadec Petrel (western)	40041033	144,145, 119
1050	Marine bird	Procellariidae	*Pterodroma nigripennis*	Black-winged Petrel	40041034	144,145, 119
1051	Marine bird	Procellariidae	*Pterodroma solandri*	Providence Petrel	40041035	144,145, 119
1053	Marine bird	Procellariidae	*Puffinus assimilis*	Little Shearwater (Tasman Sea)	40041036	144, 145, 119
1054	Marine bird	Procellariidae	*Puffinus bulleri*	Buller's Shearwater	40041037	109, 119
1055	Marine bird	Procellariidae	*Puffinus carneipes*	Flesh-footed Shearwater	40041038	144,109, 119
1694	Marine bird	Procellariidae	*Puffinus creatopus*	Pink-footed Shearwater	40041039	155
1056	Marine bird	Procellariidae	*Puffinus gavia*	Fluttering Shearwater	40041040	109, 119
1057	Marine bird	Procellariidae	*Puffinus griseus*	Sooty Shearwater	40041042	109, 119

ERA species ID	Taxa	Family name	Scientific name	Common Name	CAAB code	Reference
1058	Marine bird	Procellariidae	*Puffinus huttoni*	Hutton's Shearwater	40041043	109, 119
1059	Marine bird	Procellariidae	*Puffinus pacificus*	Wedge-tailed Shearwater	40041045	144,109, 119
1060	Marine bird	Procellariidae	*Puffinus tenuirostris*	Short-tailed Shearwater	40041047	144, 119
1610	Marine bird	Procellariidae	*Pterodroma heraldica*	Herald Petrel	no CAAB	144,109, 119
898	Marine bird	Spheniscidae	*Eudyptula minor*	Little Penguin	40001008	144, 119
1549	Marine bird	Sulidae	*Morus capensis*	Cape gannet	40047001	144, 145,87
998	Marine bird	Sulidae	*Morus serrator*	Australasian Gannet	40047002	144, 145,119
1433	Marine bird	Sulidae	*Sula dactylatra*	Masked Booby	40047004	1, 2,109, 12
881	Marine bird	Sulidae	*Sula leucogaster*	Brown boobies	40047005	144, 109, 151
1434	Marine bird	Sulidae	*Sula sula*	Red-footed Booby	40047006	144, 109, 151
896	Marine mammal	Balaenidae	*Eubalaena australis*	Southern Right Whale	41110001	144,50
289	Marine mammal	Balaenidae	*Caperea marginata*	Pygmy Right Whale	41110002	144,50
1439	Marine mammal	Balaenidae	*Balaenoptera bonaerensis*	Antarctic Minke Whale	41112007	144,50, 8
256	Marine mammal	Balaenopteridae	*Balaenoptera acutorostrata*	Minke Whale	41112001	144,50, 8
261	Marine mammal	Balaenopteridae	*Balaenoptera borealis*	Sei Whale	41112002	144,50, 8
262	Marine mammal	Balaenopteridae	*Balaenoptera edeni*	Bryde's Whale	41112003	144,50, 8
265	Marine mammal	Balaenopteridae	*Balaenoptera musculus*	Blue Whale	41112004	144,50
268	Marine mammal	Balaenopteridae	*Balaenoptera physalus*	Fin Whale	41112005	144,50
984	Marine mammal	Balaenopteridae	*Megaptera novaeangliae*	Humpback Whale	41112006	144,50
612	Marine mammal	Delphinidae	*Delphinus delphis*	Common Dolphin	41116001	144,50
902	Marine mammal	Delphinidae	*Feresa attenuata*	Pygmy Killer Whale	41116002	144,50
934	Marine mammal	Delphinidae	*Globicephala macrorhynchus*	Short-finned Pilot Whale	41116003	144,50
935	Marine mammal	Delphinidae	*Globicephala melas*	Long-finned Pilot Whale	41116004	144,50
937	Marine mammal	Delphinidae	*Grampus griseus*	Risso's Dolphin	41116005	144, 8
970	Marine mammal	Delphinidae	*Lagenodelphis hosei*	Fraser's Dolphin	41116006	144, 8
832	Marine mammal	Delphinidae	*Lagenorhynchus cruciger*	Hourglass dolphin	41116007	144,8, 110

ERA species ID	Taxa	Family name	Scientific name	Common Name	CAAB code	Reference
971	Marine mammal	Delphinidae	*Lagenorhynchus obscurus*	Dusky Dolphin	41116008	144, 8
61	Marine mammal	Delphinidae	*Lissodelphis peronii*	Southern Right Whale Dolphin	41116009	144,8, 110
860	Marine mammal	Delphinidae	*Orcaella brevirostris*	Irrawaddy dolphin	41116010	144
1002	Marine mammal	Delphinidae	*Orcinus orca*	Killer Whale	41116011	144
1007	Marine mammal	Delphinidae	*Peponocephala electra*	Melon-headed Whale	41116012	144, 8
1044	Marine mammal	Delphinidae	*Pseudorca crassidens*	False Killer Whale	41116013	144
1076	Marine mammal	Delphinidae	*Sousa chinensis*	Indo-Pacific Humpback Dolphin	41116014	144
1080	Marine mammal	Delphinidae	*Stenella attenuata*	Spotted Dolphin	41116015	144
1081	Marine mammal	Delphinidae	*Stenella coeruleoalba*	Striped Dolphin	41116016	144
1082	Marine mammal	Delphinidae	*Stenella longirostris*	Long-snouted Spinner Dolphin	41116017	144, 8
1083	Marine mammal	Delphinidae	*Steno bredanensis*	Rough-toothed Dolphin	41116018	144, 8
1091	Marine mammal	Delphinidae	*Tursiops truncatus*	Bottlenose Dolphin	41116019	144,50, 8,110
1494	Marine mammal	Delphinidae	*Tursiops aduncus*	Indian Ocean bottlenose dolphin	41116020	144, 8
864	Marine mammal	Delphinidae	*Delphinus capensis*	Common dolphin, long-beaked	no CAAB	50, 110
813	Marine mammal	Dugongidae	*Dugong dugon*	Dugong	41206001	144, 113
216	Marine mammal	Otariidae	*Arctocephalus forsteri*	New Zealand Fur-seal	41131001	144,127
253	Marine mammal	Otariidae	*Arctocephalus pusillus doriferus*	Australian Fur Seal	41131003	144,127
263	Marine mammal	Otariidae	*Arctocephalus tropicalis*	Subantarctic fur seal	41131004	127, 154
1000	Marine mammal	Otariidae	*Neophoca cinerea*	Australian Sea-lion	41131005	144, 8
295	Marine mammal	Phocidae	*Hydrurga leptonyx*	Leopard seal	41136001	127
993	Marine mammal	Phocidae	*Mirounga leonina*	Elephant seal	41136004	127
968	Marine mammal	Physeteridae	*Kogia breviceps*	Pygmy Sperm Whale	41119001	144,50
969	Marine mammal	Physeteridae	*Kogia simus*	Dwarf Sperm Whale	41119002	144, 110
1036	Marine mammal	Physeteridae	*Physeter catodon*	Sperm Whale	41119003	144
269	Marine mammal	Ziphiidae	*Berardius arnuxii*	Arnoux's Beaked Whale	41120001	144,50
959	Marine mammal	Ziphiidae	*Hyperoodon planifrons*	Southern Bottlenose Whale	41120002	144,50

ERA species ID	Taxa	Family name	Scientific name	Common Name	CAAB code	Reference
1440	Marine mammal	Ziphiidae	*Indopacetus pacificus*	Longman's Beaked Whale	41120003	144, 8
985	Marine mammal	Ziphiidae	*Mesoplodon bowdoini*	Andrew's Beaked Whale	41120004	144, 50, 8
986	Marine mammal	Ziphiidae	*Mesoplodon densirostris*	Blainville's Beaked Whale	41120005	144, 50, 8
987	Marine mammal	Ziphiidae	*Mesoplodon gingkodens*	Gingko Beaked Whale	41120006	144,50, 8
988	Marine mammal	Ziphiidae	*Mesoplodon grayi*	Gray's Beaked Whale	41120007	144,50, 8
989	Marine mammal	Ziphiidae	*Mesoplodon hectori*	Hector's Beaked Whale	41120008	144,50, 8
990	Marine mammal	Ziphiidae	*Mesoplodon layardii*	Strap-toothed Beaked Whale	41120009	144,50, 8
991	Marine mammal	Ziphiidae	*Mesoplodon mirus*	True's Beaked Whale	41120010	144, 50, 110
1030	Marine mammal	Ziphiidae	*Tasmacetus shepherdi*	Tasman Beaked Whale	41120011	144, 8
1098	Marine mammal	Ziphiidae	*Ziphius cavirostris*	Cuvier's Beaked Whale	41120012	144,8, 110
324	Marine reptile	Cheloniidae	*Caretta caretta*	Loggerhead	39020001	144, 170
541	Marine reptile	Cheloniidae	*Chelonia mydas*	Green turtle	39020002	144, 170
822	Marine reptile	Cheloniidae	*Eretmochelys imbricata*	Hawksbill turtle	39020003	144, 171
844	Marine reptile	Cheloniidae	*Lepidochelys olivacea*	Olive Ridley turtle	39020004	144, 171
857	Marine reptile	Cheloniidae	*Natator depressus*	Flatback turtle	39020005	155,144, 170
613	Marine reptile	Dermochelyidae	*Dermochelys coriacea*	Leathery turtle	39021001	144, 171
1408	Marine reptile	Hydrophiidae	*Acalyptophis peronii*	Horned Seasnake	39125001	172, 173,144
1409	Marine reptile	Hydrophiidae	*Aipysurus apraefrontalis*	Short-nosed Seasnake	39125002	155,172, 173
1410	Marine reptile	Hydrophiidae	*Aipysurus duboisii*	Dubois' Seasnake	39125003	155,144, 172, 173
1411	Marine reptile	Hydrophiidae	*Aipysurus eydouxii*	Spine-tailed Seasnake	39125004	155,144, 172, 173
1412	Marine reptile	Hydrophiidae	*Aipysurus foliosquama*	Leaf-scaled Seasnake	39125005	155,172
1413	Marine reptile	Hydrophiidae	*Aipysurus fuscus*	Dusky Seasnake	39125006	155,144, 172, 173

ERA species ID	Taxa	Family name	Scientific name	Common Name	CAAB code	Reference
1414	Marine reptile	Hydrophiidae	*Aipysurus laevis*	Olive Seasnake, Golden Seasnake	39125007	155,144, 172, 173
1415	Marine reptile	Hydrophiidae	*Aipysurus tenuis*	Brown-lined Seasnake	39125008	155,144, 172, 173
254	Marine reptile	Hydrophiidae	*Astrotia stokesii*	Stokes' seasnake	39125009	155,144, 172, 173
1530	Marine reptile	Hydrophiidae	*Disteira kingii*	spectacled seasnake	39125010	155,144, 172, 173
1416	Marine reptile	Hydrophiidae	*Disteira major*	Olive-headed Seasnake	39125011	155,144, 172, 173
1417	Marine reptile	Hydrophiidae	*Emydocephalus annulatus*	Turtle-headed Seasnake	39125012	155,144, 172, 173
1418	Marine reptile	Hydrophiidae	*Enhydrina schistosa*	Beaked Seasnake	39125013	155,144, 172, 173
1419	Marine reptile	Hydrophiidae	*Ephalophis greyi*	North-western Mangrove Seasnake	39125014	155,172, 173
1420	Marine reptile	Hydrophiidae	*Hydrelaps darwiniensis*	Black-ringed Seasnake	39125015	155,172, 173
1681	Marine reptile	Hydrophiidae	*Hydrophis atriceps*	Black-headed seasnake	39125016	155,172, 173
1682	Marine reptile	Hydrophiidae	*Hydrophis belcheri*	a seasnake	39125017	155,172
1683	Marine reptile	Hydrophiidae	*Hydrophis caerulescens*	Dwarf seasnake	39125018	155,172, 173
1421	Marine reptile	Hydrophiidae	*Hydrophis coggeri*	Slender-necked Seasnake	39125019	155,172
1531	Marine reptile	Hydrophiidae	*Hydrophis czeblukovi*	fine-spined seasnake	39125020	155,172, 173
957	Marine reptile	Hydrophiidae	*Hydrophis elegans*	Elegant seasnake	39125021	155,172, 173
1684	Marine reptile	Hydrophiidae	*Hydrophis gracilis*	Slender seasnake	39125023	155,172
1685	Marine reptile	Hydrophiidae	*Hydrophis inornatus*	Plain seasnake	39125024	155,172, 173
1422	Marine reptile	Hydrophiidae	*Hydrophis mcdowelli*	seasnake	39125025	155,172, 173
1686	Marine reptile	Hydrophiidae	*Hydrophis melanosoma*	Black-banded robust seasnake	39125027	155,172, 173
1423	Marine reptile	Hydrophiidae	*Hydrophis ornatus*	seasnake	39125028	155,172, 173

ERA species ID	Taxa	Family name	Scientific name	Common Name	CAAB code	Reference
1687	Marine reptile	Hydrophiidae	*Hydrophis pacificus*	Large-headed Seasnake	39125029	155,172
1688	Marine reptile	Hydrophiidae	*Hydrophis vorisi*	A seasnake	39125030	155,172
1424	Marine reptile	Hydrophiidae	*Lapemis hardwickii*	Spine-bellied Seasnake	39125031	155,172
1689	Marine reptile	Hydrophiidae	*Parahydrophis mertoni*	Northern mangrove seasnake	39125032	155,172
1005	Marine reptile	Hydrophiidae	*Pelamis platurus*	yellow-bellied seasnake	39125033	155,172, 173
1679	Marine reptile	Laticaudidae	*Laticauda colubrina*	Banded wide faced Sea krait	39124001	155,172
1680	Marine reptile	Laticaudidae	*Laticauda laticaudata*	Large scaled sea krait	39124002	155,172
308	Teleost	Clinidae	*Heteroclinus perspicillatus*	Common weedfish	37416013	53,144
1074	Teleost	Solenostomidae	*Solenostomus cyanopterus*	Blue-finned Ghost Pipefish, Robust Ghost	37281001	144
1075	Teleost	Solenostomidae	*Solenostomus paradoxus*	Harlequin Ghost Pipefish, Ornate Ghost Pipefish	37281002	144
1010	Teleost	Syngnathidae	*Phycodurus eques*	Leafy Seadragon	37282001	144,108
1011	Teleost	Syngnathidae	*Phyllopteryx taeniolatus*	Weedy Seadragon, Common Seadragon	37282002	144,108
1072	Teleost	Syngnathidae	*Solegnathus robustus*	Robust Spiny Pipehorse, Robust Pipehorse	37282004	144
549	Teleost	Syngnathidae	*Hippocampus angustus*	Western Spiny Seahorse	37282005	144
1089	Teleost	Syngnathidae	*Trachyrhamphus bicoarctatus*	Bend Stick Pipefish, Short-tailed Pipefish	37282006	144
360	Teleost	Syngnathidae	*Haliichthys taeniophorus*	Ribboned Seadragon, Ribboned Pipefish	37282007	144,168
1092	Teleost	Syngnathidae	*Urocampus carinirostris*	Hairy Pipefish	37282008	144,168
980	Teleost	Syngnathidae	*Lissocampus runa*	Javelin Pipefish	37282009	144
946	Teleost	Syngnathidae	*Hippocampus bleekeri*	pot bellied seahorse	37282010	108
953	Teleost	Syngnathidae	*Histiogamphelus briggsii*	Briggs' Crested Pipefish, Briggs' Pipefish	37282011	144, 168
961	Teleost	Syngnathidae	*Hypselognathus rostratus*	Knife-snouted Pipefish	37282012	144, 168
978	Teleost	Syngnathidae	*Leptoichthys fistularius*	Brushtail Pipefish	37282013	144, 168

ERA species ID	Taxa	Family name	Scientific name	Common Name	CAAB code	Reference
966	Teleost	Syngnathidae	*Kaupus costatus*	Deep-bodied Pipefish	37282014	144,168
995	Teleost	Syngnathidae	*Mitotichthys semistriatus*	Half-banded Pipefish	37282015	144,108
979	Teleost	Syngnathidae	*Lissocampus caudalis*	Australian Smooth Pipefish, Smooth Pipefish	37282016	144
1026	Teleost	Syngnathidae	*Stigmatopora argus*	Spotted Pipefish	37282017	144,168
1027	Teleost	Syngnathidae	*Stigmatopora nigra*	Wide-bodied Pipefish, Black Pipefish	37282018	144
1028	Teleost	Syngnathidae	*Stipecampus cristatus*	Ring-backed Pipefish	37282019	144,168
1061	Teleost	Syngnathidae	*Pugnaso curtirostris*	Pug-nosed Pipefish	37282021	144,168
994	Teleost	Syngnathidae	*Mitotichthys mollisoni*	Mollison's Pipefish	37282022	144,108
1094	Teleost	Syngnathidae	*Vanacampus phillipi*	Port Phillip Pipefish	37282023	144,168
1095	Teleost	Syngnathidae	*Vanacampus poecilolaemus*	Australian Long-snout Pipefish, Long-snouted Pipefish	37282024	144,168
996	Teleost	Syngnathidae	*Mitotichthys tuckeri*	Tucker's Pipefish	37282025	144
947	Teleost	Syngnathidae	*Hippocampus breviceps*	Short-head Seahorse, Short-snouted Seaho	37282026	144,108
952	Teleost	Syngnathidae	*Hippocampus whitei*	white's seahorse	37282027	144,168
1073	Teleost	Syngnathidae	*Solegnathus spinosissimus*	spiny pipehorse	37282029	144
938	Teleost	Syngnathidae	*Halicampus grayi*	Mud Pipefish, Gray's Pipefish	37282030	144,168
566	Teleost	Syngnathidae	*Corythoichthys conspicillatus*	Yellow-banded Pipefish, Network Pipefish	37282032	144,168
949	Teleost	Syngnathidae	*Hippocampus taeniopterus*	Spotted Seahorse, Yellow Seahorse	37282033	108,108
114	Teleost	Syngnathidae	*Acentronura breviperula*	Hairy Pygmy Pipehorse	37282035	144,168
1583	Teleost	Syngnathidae	*Bulbonaricus davaoensis*	[a pipefish]	37282038	144,168
546	Teleost	Syngnathidae	*Campichthys tricarinatus*	Three-keel Pipefish	37282040	144, 168
288	Teleost	Syngnathidae	*Campichthys tryoni*	Tryon's Pipefish	37282041	144, 168
388	Teleost	Syngnathidae	*Choeroichthys brachysoma*	Pacific Short-bodied Pipefish, Short-bodied pipefish	37282042	144, 168

ERA species ID	Taxa	Family name	Scientific name	Common Name	CAAB code	Reference
1584	Teleost	Syngnathidae	*Choeroichthys cinctus*	[a pipefish]	37282043	144, 168
1585	Teleost	Syngnathidae	*Choeroichthys sculptus*	[a pipefish]	37282045	168
389	Teleost	Syngnathidae	*Choeroichthys suillus*	Pig-snouted Pipefish	37282046	168,144
563	Teleost	Syngnathidae	*Corythoichthys amplexus*	Fijian Banded Pipefish, Brown-banded Pipefish	37282047	144,168
1586	Teleost	Syngnathidae	*Corythoichthys haematopterus*	[a pipefish]	37282048	144,168
52	Teleost	Syngnathidae	*Corythoichthys intestinalis*	Australian Messmate Pipefish, Banded Pipefish	37282049	144,168
578	Teleost	Syngnathidae	*Corythoichthys ocellatus*	Orange-spotted Pipefish, Ocellated Pipefish	37282050	144, 168
1587	Teleost	Syngnathidae	*Corythoichthys paxtoni*	[a pipefish]	37282051	144, 168
452	Teleost	Syngnathidae	*Corythoichthys schultzi*	Schultz's Pipefish	37282052	144, 168
1588	Teleost	Syngnathidae	*Cosmocampus darrosanus*	[a pipefish]	37282054	144,168
580	Teleost	Syngnathidae	*Cosmocampus howensis*	Lord Howe Pipefish	37282055	144, 168
1589	Teleost	Syngnathidae	*Cosmocampus maxweberi*	[a pipefish]	37282056	144, 168
361	Teleost	Syngnathidae	*Dunckerocampus dactyliophorus*	Ringed Pipefish	37282057	144,168
569	Teleost	Syngnathidae	*Doryrhamphus melanopleura*	Bluestripe Pipefish	37282058	144,168
55	Teleost	Syngnathidae	*Doryrhamphus janssi*	Cleaner Pipefish, Janss' Pipefish	37282059	144, 168
568	Teleost	Syngnathidae	*Doryrhamphus malus*	Flagtail Pipefish, Negros Pipefish	37282060	144,168
904	Teleost	Syngnathidae	*Festucalex cinctus*	Girdled Pipefish	37282061	144,168
1590	Teleost	Syngnathidae	*Festucalex gibbsi*	[a pipefish]	37282062	144, 168
914	Teleost	Syngnathidae	*Filicampus tigris*	Tiger Pipefish	37282064	144, 168
54	Teleost	Syngnathidae	*Halicampus brocki*	Brock's Pipefish	37282065	144, 168
359	Teleost	Syngnathidae	*Halicampus dunckeri*	Red-hair Pipefish, Duncker's Pipefish	37282066	144,168
1592	Teleost	Syngnathidae	*Halicampus macrorhynchus*	[a pipefish]	37282067	144,168
1593	Teleost	Syngnathidae	*Halicampus mataafae*	[a pipefish]	37282068	144,168
57	Teleost	Syngnathidae	*Halicampus nitidus*	Glittering Pipefish	37282069	144,168

ERA species ID	Taxa	Family name	Scientific name	Common Name	CAAB code	Reference
454	Teleost	Syngnathidae	*Halicampus spinirostris*	Spiny-snout Pipefish	37282070	144,168
942	Teleost	Syngnathidae	*Heraldia nocturna*	Upside-down Pipefish	37282071	144, 168
943	Teleost	Syngnathidae	*Hippichthys cyanospilos*	Blue-speckled Pipefish, Blue-spotted Pipefish	37282072	144,168
944	Teleost	Syngnathidae	*Hippichthys heptagonus*	Madura Pipefish	37282073	144,168
945	Teleost	Syngnathidae	*Hippichthys penicillus*	Beady Pipefish, Steep-nosed Pipefish	37282075	144,168
1595	Teleost	Syngnathidae	*Hippichthys spicifer*	[a pipefish]	37282076	144,168
951	Teleost	Syngnathidae	*Hippocampus planifrons*	Flat-face Seahorse	37282078	144,108
1603	Teleost	Syngnathidae	*Hippocampus zebra*	[a pipefish]	37282080	144, 168
954	Teleost	Syngnathidae	*Histiogamphelus cristatus*	Rhino Pipefish, Macleay's Crested Pipefish	37282081	144, 168
967	Teleost	Syngnathidae	*Kimblaeus bassensis*	Trawl Pipefish, Kimbla Pipefish	37282083	144, 168
983	Teleost	Syngnathidae	*Maroubra perserrata*	Sawtooth Pipefish	37282085	144
992	Teleost	Syngnathidae	*Micrognathus andersonii*	Anderson's Pipefish, Shortnose Pipefish	37282086	144,168
1604	Teleost	Syngnathidae	*Micrognathus pygmaeus*	[a pipefish]	37282087	144,168
547	Teleost	Syngnathidae	*Micrognathus micronotopterus*	Tidepool Pipefish	37282088	155
1605	Teleost	Syngnathidae	*Micrognathus natans*	[a pipefish]	37282089	144
1606	Teleost	Syngnathidae	*Microphis brachyurus*	[a pipefish]	37282090	144
798	Teleost	Syngnathidae	*Microphis manadensis*	Manado River Pipefish, Manado Pipefish	37282091	144,168
1607	Teleost	Syngnathidae	*Nannocampus lindemanensis*	[a pipefish]	37282093	144,168
1001	Teleost	Syngnathidae	*Notiocampus ruber*	Red Pipefish	37282095	144,168
1608	Teleost	Syngnathidae	*Phoxocampus diacanthus*	[a pipefish]	37282096	144,168
1609	Teleost	Syngnathidae	*Siokunichthys breviceps*	[a pipefish]	37282097	144,168
1070	Teleost	Syngnathidae	*Solegnathus dunckeri*	Duncker's Pipehorse	37282098	144
1071	Teleost	Syngnathidae	*Solegnathus sp. 1 [in Kuiter, 2000]*	Pipehorse	37282099	144

ERA species ID	Taxa	Family name	Scientific name	Common Name	CAAB code	Reference
1029	Teleost	Syngnathidae	*Syngnathoides biaculeatus*	Double-ended Pipehorse, Alligator Pipefish	37282100	144,168
322	Teleost	Syngnathidae	*Trachyrhamphus longirostris*	Long-nosed Pipefish, Straight Stick Pipefish	37282101	144,168
1093	Teleost	Syngnathidae	*Vanacampus margaritifer*	Mother-of-pearl Pipefish	37282102	144,168
950	Teleost	Syngnathidae	*Hippocampus minotaur*	Bullneck Seahorse	37282105	144, 168
1597	Teleost	Syngnathidae	*Hippocampus bargibanti*	pygmy seahorse	37282106	108,144, 168
1591	Teleost	Syngnathidae	*Halicampus boothae*	[a pipefish]	37282107	144, 168
948	Teleost	Syngnathidae	*Hippocampus queenslandicus*	Kellogg's Seahorse	37282110	108
1598	Teleost	Syngnathidae	*Hippocampus dahli*	[a pipefish]	37282114	108
1602	Teleost	Syngnathidae	*Hippocampus tristis*	[a pipefish]	37282117	108
1596	Teleost	Syngnathidae	*Hippocampus alatus*	[a pipefish]	37282118	108
1664	Teleost	Syngnathidae	*Hippocampus abdominalis*	Big-bellied / southern potbellied seahorse	37282120	144, 108
1601	Teleost	Syngnathidae	*Hippocampus procerus*	[a pipefish]	37282122	108,59
1600	Teleost	Syngnathidae	*Hippocampus multispinus*	[a pipefish]	37282124	108
1599	Teleost	Syngnathidae	*Hippocampus hendriki*	[a pipefish]	37282125	108
1548	Teleost	Syngnathidae	*Heraldia sp. 1 [in Kuiter, 2000]*	Western upsidedown pipefish	37282130	168
318	Teleost	Syngnathidae	*Hippocampus spinosissimus*	Hedgehog Seahorse	no CAAB	144,168
1665	Teleost	Syngnathidae	*Hippocampus histrix*	Spiny Seahorse	no CAAB	108,144,168
1666	Teleost	Syngnathidae	*Hippocampus kelloggi*	Kellogg's Seahorse	no CAAB	144,168
1667	Teleost	Syngnathidae	*Hippocampus kuda*	Spotted Seahorse, Yellow Seahorse	no CAAB	144,108

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8	Bannister, J. L., Kemper, C. M. and Warneke, R. M. (1996) The Action Plan for Australian Cetaceans. Australian Nature Conservation Agency. Canberra, ACT. Pp. 272.
173	EMBL Reptile database in CAAB: Additional online resources.

110	Encyclopedia of Marine Mammals (2002) Eds Perrin, W., Wursig, B., and Thewissen, J. Academic Press a Division of Harcourt Inc. San Diego, California.
155	EPBC Act List of Marine Species: http://www.deh.gov.au/epbc/biodiversityconservation/marine.html
154	EPBC Act List of Threatened Fauna: http://www.deh.gov.au/cgi-bin/sprat/public/publicthreatenedlist.pl?wanted=fauna
154	EPBC Act List of Threatened Fauna: http://www.deh.gov.au/cgi-bin/sprat/public/publicthreatenedlist.pl?wanted=fauna
158	Gales R. 1998. Albatross populations: status and threats. Pp20- 45 in The Albatross: Biology and Conservation. G. Robertson and R. Gales (eds). Surrey Beatty and Sons
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172	Greer, A.E. 2004. Encyclopedia of Australian Reptiles. Australian Museum Online http://www.amonline.net.au/herpetology/research/encyclopedia.pdf Version date: 9 November 2004.
82	Higgins, P.J.and Davies S.J.J.F. (eds) Handbook of Australian, New Zealand and Antarctic Birds Vol 3
2	http://www.antdiv.gov.au/default.asp?casid=1551
87	http://www.bsc-eoc.org/avibase/
171	http://www.deh.gov.au/coasts/species/turtles/recovery/map.html
50	Jefferson, T., Leatherwood, S. and Webber, M (1994) Marine Mammals of the World FAO speocies identification guide FAO, rome
109	Marchant, S. and Higgins, P.J.(co-ords) hadnbook of Australian, New Zealand and Antarctic Birds
113	Marsh, H., Penrose, H., Eros, C., Hugues, J. Dugong Status Report and Action Plan for Countries and Territories. UNEP/DEWA/RS.02-1
108	Pogonoski, J., Pollard, D., and Paxton, J. (2002) Marine and Esturarine Fishes: conservation overview and action plan for Australian threatened and potentially thtreatened. Commonwealth of Australia, Environment australia, Canberra.
144	Protected Matters Search Tool, DEH [http://www.deh.gov.au/erin/ert/epbc/imap/map.html]
120	Recovery Plan for Albatrosses and Giant Petrels (on EA website)
170	Recovery plan for marine turtles in Australia. 2003.Environment Australia: http://www.deh.gov.au/coasts/species/turtles/recovery/index.html
119	Reid, T.A., Hindell, M.A., Eades, D.W., Newman, M. (2002) Seabird Atlas of South-eastern Australian Waters. Birds Australia Monograph 4, Birds Australia, Melbourne
127	Shaughnessy, P. D. 1999. The Action Plan for Australian Seals. Environment Australia. Canberra, ACT. Pp. 62.
151	The status of Australia's seabirds. 1996. Eds. Ross G, Weaver K, Greig J. Proceedings of the National Seabird Workshop, Canberra 1993. Commonwealth of Australia.
12	www.absa.asn.au/recoveries

Scoping Document S2B1. Benthic Habitats

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

A list of the benthic habitats that occur within the jurisdictional boundary of the Eastern Tuna and Billfish Fishery. Shading denotes habitats over which no effort occurs.

ERAEF record No.	ERAEF Habitat Number	Sub-biome	Feature	Habitat type	SGF Score	Depth (m)	Image available	Reference image location
4153	306	coastal margin	shelf	mud, irregular, mixed faunal community	033	0-25	N	
4154	308	coastal margin	shelf	mud, irregular, octocorals	035	0-25	Y	GoC Image data
4155	312	coastal margin	shelf	mud, subcrop, small sponges	052	0-25	Y	GoC Image Data
4156	314	coastal margin	shelf	mud, subcrop, mixed faunal community	053	0-25	N	
4157	317	coastal margin	shelf	mud, subcrop, low encrusting mixed fauna	056	0-25	N	
4158	330	coastal margin	shelf	Gravel, directed scour, no fauna	310	0-25	Y	GoC Image data
4159	334	coastal margin	shelf	Gravel, irregular, no fauna	330	0-25	Y	GoC Image data
4160	340	coastal margin	shelf	Gravel, subcrop, mixed faunal community	353	0-25	Y	GoC Image data
4161	342	coastal margin	shelf	Gravel, subcrop, octocorals	355	0-25	Y	GoC Image data
4162	**345**	coastal margin	shelf	Biogenic, subcrop, no fauna	750	0-25	Y	GoC Image Data
4163	364	coastal margin	shelf	Biogenic, subcrop, large sponges	751	0-25	Y	GoC Image Data
4164	365	coastal margin	shelf	Biogenic, subcrop, mixed faunal community	753	0-25	Y	GoC Image Data
4165	367	coastal margin	shelf	Biogenic, subcrop, Octocorals	755	0-25	Y	GoC Image Data
4166	369	coastal margin	shelf	Biogenic, subcrop, small/ low encrustors	756	0-25	Y	GoC Image Data
4167	372	coastal margin	shelf, fringing reef	Biogenic, low outcrop, large erect sponges	761	0-25	Y	GoC Image Data

ERAEF record No.	ERAEF Habitat Number	Sub-biome	Feature	Habitat type	SGF Score	Depth (m)	Image available	Reference image location
4168	373	coastal margin	shelf, fringing reef	Biogenic, low outcrop, mixed faunal community	763	0-25	Y	GoC Image Data
4169	374	coastal margin	shelf, fringing reef	Biogenic, low outcrop, octocorals	765	0-25	Y	GoC Image Data
4170	376	coastal margin	shelf, fringing reef	Biogenic, low outcrop, encrustors	766	0-25	Y	GoC Image Data
4171	378	coastal margin	shelf, fringing reef	Biogenic, low outcrop, large sponges	771	0-25	Y	GoC Image Data
4172	380	coastal margin	shelf, fringing reef	Biogenic, low outcrop, mixed faunal community	773	0-25	Y	GoC Image Data
4173	382	coastal margin	shelf, fringing reef	Biogenic, low outcrop, octocorals	775	0-25	Y	GoC Image Data
4174	384	coastal margin	shelf, fringing reef	Biogenic, low outcrop, encrustors	776	0-25	Y	GoC Image Data
4175	386	coastal margin	shelf, fringing reef	Biogenic, low outcrop, sedentary	777	0-25	Y	GoC Image Data
4176	388	coastal margin	shelf, fringing reef	Biogenic, high outcrop, octocorals	785	0-25	Y	GoC Image Data
4177	391	coastal margin	shelf, fringing reef	Biogenic, high outcrop, mixed faunal community	787	0-25	Y	GoC Image Data
4178	394	coastal margin	shelf	mud, directed scour, seagrass	01SG	0-25	N	f
4179	395	coastal margin	shelf	mud, wave rippled, seagrass	02SG	0-25	N	f
4180	396	coastal margin	shelf	mud, irregular, seagrass	03SG	0-25	N	f
4181	398	coastal margin	shelf	mud, subcrop, bivalve beds	05BV	0-25	N	g
4182	400	coastal margin	shelf	mud, subcrop, hard corals	05HC	0-25	N	
4183	401	coastal margin	shelf	mud, subcrop, seagrass	05SG	0-25	N	f
4184	402	coastal margin	shelf	fine sediments, directed scour, seagrass	11SG	0-25	N	f
4185	403	coastal margin	shelf	fine sediments, wave rippled, seagrass	12SG	0-25	N	f
4186	405	coastal margin	shelf	fine sediments, irregular, seagrass	13SG	0-25	N	f
4187	406	coastal margin	shelf	fine sediments, subcrop, seagrass	15SG	0-25	N	f
4188	408	coastal margin	shelf	coarse sediments, directed scour, seagrass	21SG	0-25	N	f
4189	409	coastal margin	shelf	coarse sediments, wave rippled, seagrass	22SG	0-25	N	f
4190	411	coastal margin	shelf	coarse sediments, irregular, seagrass	23SG	0-25	N	f
4191	413	coastal margin	shelf	Coarse sediments, subcrop, bivalve beds	25BV	0-25	N	g
4192	414	coastal margin	shelf	coarse sediments, subcrop, seagrass	25SG	0-25	N	f
4193	418	coastal margin	shelf	Gravel, irregular, seagrass	33SG	0-25	Y	f
4194	420	coastal margin	shelf	Gravel, subcrop, hard corals	35HC	0-25	Y	GoC Image data

ERAEF record No.	ERAEF Habitat Number	Sub-biome	Feature	Habitat type	SGF Score	Depth (m)	Image available	Reference image location
4195	422	coastal margin	shelf	Biogenic, subcrop, hard corals	65HC	0-25	Y	GoC Image Data
4196	423	coastal margin	shelf	Biogenic, subcrop, seagrass	65SG	0-25	N	f
4197	425	coastal margin	shelf, fringing reef	Biogenic, low outcrop, hard corals	66HC	0-25	Y	GoC Image Data
4198	426	coastal margin	shelf, fringing reef	Biogenic, low outcrop, seagrass	66SG	0-25	N	f
4199	428	coastal margin	shelf, fringing reef	Biogenic, high outcrop, hard corals	68HC	0-25	Y	GoC Image Data
4200	429	coastal margin	shelf, fringing reef	Biogenic, high outcrop, seagrass	68SG	0-25	N	f
4201	432	coastal margin	shelf	Biogenic, subcrop, bivalve beds	75BV	0-25	N	g
4202	435	coastal margin	shelf	Biogenic, low outcrop, bivalve beds	76BV	0-25	N	g
4203	299	inner shelf	shelf	mud, flat, no fauna	000	25- 100	N	
4204	300	inner shelf	shelf	mud, flat, low encrusting sponges	002	25- 100	N	
4205	301	inner shelf	shelf	mud, flat, octocorals	005	25- 100	Y	GoC Image Data
4206	302	inner shelf	shelf	mud, flat, sedentary (eg seapens)	007	25- 100	Y	GoC Image Data
4207	303	inner shelf	shelf	mud, directed scour, no fauna	010	25- 100	Y	GoC Image Data
4208	304	inner shelf	shelf	mud, directed scour, mixed faunal community	013	25- 100	Y	GoC Image Data
4209	305	inner shelf	shelf	mud, directed scour, bioturbators	019	25- 100	Y	GoC Image Data
4210	307	inner shelf	shelf	mud, irregular, mixed faunal community	033	25- 100	Y	GoC Image Data
4211	309	inner shelf	shelf	mud, irregular, bioturbators	039	25- 100	Y	GoC Image Data
4212	310	inner shelf	shelf	mud, subcrop, erect sponges	051	25- 100	Y	GoC Image Data
4213	311	inner shelf	shelf	mud, subcrop, small sponges	052	25- 100	Y	GoC Image Data
4214	313	inner shelf	shelf	mud, subcrop, mixed faunal community	053	25- 100	Y	GoC Image Data
4215	315	inner shelf	shelf	mud, subcrop, octocorals	055	25- 100	Y	GoC Image Data
4216	316	inner shelf	shelf	mud, subcrop, low encrusting mixed fauna	056	25- 100	Y	GoC Image Data
2198	094	inner shelf	shelf	Fine sediments, unrippled, small sponges	102	25- 100	Y	Norfanz Image Collection
4217	318	Inner shelf	shelf	fine sediments, irregular, no fauna	130	25- 100	Y	GoC Image Data
4218	092	inner shelf	shelf	fine sediments, irregular, small sponges	132	25- 100	Y	GoC Image Data
4219	319	inner shelf	shelf	fine sediments, irregular, octocorals	135	25- 100	Y	GoC Image Data
4220	320	inner shelf	shelf	fine sediments, irregular, low encrustings	136	25- 100	Y	GoC Image Data

ERAEF record No.	ERAEF Habitat Number	Sub-biome	Feature	Habitat type	SGF Score	Depth (m)	Image available	Reference image location
4221	321	inner shelf	shelf	fine sediments, irregular, bioturbators	139	25- 100	Y	GoC Image Data
4222	013	inner shelf	shelf	coarse sediments, flat, large sponges	201	25- 100	Y	GoC Image Data
4223	322	inner shelf	shelf	Coarse sediments, flat, mixed faunal community	203	25- 100	Y	GoC Image Data
4224	234	inner shelf	shelf	Coarse sediments, flat, solitary epifauna	207	25- 100	Y	GoC Image Data
1992	191	inner shelf	shelf	coarse sediments, wave rippled, small sponges	222	25- 100	N	
2081	200	inner shelf	shelf	coarse sediments, wave rippled, encrustors	226	25- 100	N	
4225	323	inner shelf	shelf	coarse sediments, irregular, small sponges	232	25- 100	Y	Goc Image Data
4226	324	inner shelf	shelf	coarse sediments, irregular, octocorals	235	25- 100	Y	Goc Image Data
4228	006	inner shelf	shelf	coarse sediments, subcrop, large sponges	251	25- 100	Y	GoC Image Data
2219	282	inner shelf	shelf	Coarse sediments, subcrop, mixed faunal community	253	25- 100	Y	Norfanz Image Collection
4230	325	inner shelf	shelf	gravel, flat, large sponges	301	25- 100	Y	GoC Image Data
4231	326	inner shelf	shelf	gravel, flat, mixed faunal community	303	25- 100	Y	GoC Image Data
4232	327	inner shelf	shelf	gravel, flat, octocorals	305	25- 100	Y	GoC Image Data
4233	328	inner shelf	shelf	gravel, flat, encrustors	306	25- 100	Y	GoC Image Data
4234	329	inner shelf	shelf	gravel, flat, sedentary	307	25- 100	Y	GoC Image Data
4235	331	inner shelf	shelf	gravel/ pebble, directed scour, large sponges	311	25- 100	Y	GoC Image data
4236	001	inner shelf	shelf	gravel/ pebble, directed scour, mixed faunal community	313	25- 100	Y	GoC Image data
4237	332	inner shelf	shelf	gravel/ pebble, directed scour, octocorals	315	25- 100	Y	GoC Image data
4238	333	inner shelf	shelf	gravel/ pebble, directed scour, sedentary	317	25- 100	Y	GoC Image data
4239	242	inner shelf	shelf	Gravel, irregular, no fauna	330	25- 100	Y	GoC Image Data
4240	335	inner shelf	shelf	Gravel, irregular, small sponges	332	25- 100	Y	GoC Image Data
4241	336	inner shelf	shelf	Gravel, irregular, octocorals	335	25- 100	Y	GoC Image Data
4242	337	inner shelf	shelf	Gravel, irregular, low encrustings	336	25- 100	Y	GoC Image Data
4243	338	inner shelf	shelf	gravel/ pebble, subcrop, large sponges	351	25- 100	Y	GoC Image Data
4244	339	inner shelf	shelf	gravel/ pebble, subcrop, mixed faunal community	353	25- 100	Y	GoC Image Data
4245	341	inner shelf	shelf	gravel/ pebble, subcrop, octocorals	355	25- 100	Y	GoC Image Data
4246	343	inner shelf	shelf	gravel/ pebble, subcrop, sedentary	357	25- 100	Y	GoC Image Data

ERAEF record No.	ERAEF Habitat Number	Sub-biome	Feature	Habitat type	SGF Score	Depth (m)	Image available	Reference image location
2068	199	inner shelf	shelf	cobble, wave rippled, low/ encrusting mixed fauna	426	25- 100	N	
4247	344	inner shelf	shelf	Sedimentary rock (?), subcrop, no fauna	650	25- 100	Y	GoC Image Data
4248	**345**	inner shelf	shelf	Sedimentary rock (?), Subcrop, large sponges	651	25- 100	Y	GoC Image Data
4249	346	inner shelf	shelf	Sedimentary rock (?), subcrop, mixed faunal community	653	25- 100	Y	GoC Image Data
4250	347	inner shelf	shelf	Sedimentary rock (?), Subcrop, Octocorals	655	25- 100	Y	GoC Image Data
4251	348	inner shelf	shelf	Sedimentary rock (?), subcrop, small/ low encrustors	656	25- 100	Y	GoC Image Data
4252	349	inner shelf	shelf	Sedimentary Rock (?), subcrop, sedentary	657	25- 100	Y	GoC Image Data
4253	350	inner shelf	shelf, bioherm	Sedimentary rock (?), low outcrop, large sponges	661	25- 100	Y	GoC Image Data
4254	351	inner shelf	shelf, bioherm	Sedimentary rock (?), low outcrop, mixed faunal community	663	25- 100	Y	GoC Image Data
4255	352	inner shelf	shelf, bioherm	Sedimentary rock (?), low outcrop, octocorals	665	25- 100	Y	GoC Image Data
4256	353	inner shelf	shelf, bioherm	Sedimentary rock (?), low outcrop, encrustors	666	25- 100	Y	GoC Image Data
4257	354	inner shelf	shelf, bioherm	Sedimentary rock (?), low outcrop, sedentary	667	25- 100	Y	GoC Image Data
4258	004	inner shelf	shelf, bioherm	Sedimentary rock (?), low outcrop, large sponges	671	25- 100	Y	GoC Image Data
4259	355	inner shelf	shelf, bioherm	Sedimentary rock (?), low outcrop, mixed faunal community	673	25- 100	Y	GoC Image Data
4260	356	inner shelf	shelf, bioherm	Sedimentary rock (?), low outcrop, octocorals	675	25- 100	Y	GoC Image Data
4261	357	inner shelf	shelf, bioherm	Sedimentary rock (?), low outcrop, encrustors	676	25- 100	Y	GoC Image Data
4262	358	inner shelf	shelf, bioherm	Sedimentary rock (?), low outcrop, sedentary	677	25- 100	Y	GoC Image Data
4263	359	inner shelf	shelf, bioherm	Sedimentary rock (?), high outcrop, mixed faunal community	683	25- 100	Y	GoC Image Data
4264	360	inner shelf	shelf, bioherm	Sedimentary rock (?), high outcrop, octocorals	685	25- 100	Y	GoC Image Data
4265	361	inner shelf	shelf, bioherm	Sedimentary rock (?), high outcrop, encrustors	686	25- 100	Y	GoC Image Data
4266	003	inner shelf	shelf, bioherm	Sedimentary rock (?), high outcrop, mixed faunal community	693	25- 100	Y	GoC Image Data
4267	362	inner shelf	shelf, bioherm	Sedimentary rock (?), high outcrop, octocorals	695	25- 100	Y	GoC Image Data
4268	363	inner shelf	shelf, bioherm	Sedimentary rock (?), high outcrop, encrustors	696	25- 100	Y	GoC Image Data
4269	273	inner shelf	shelf, fringing reef, bioherm	Biogenic, subcrop, large sponges	751	25- 100	Y	GoC Image Data
4270	366	inner shelf	shelf, fringing reef, bioherm	Biogenic, subcrop, mixed faunal community	753	25- 100	Y	GoC Image Data
4271	368	inner shelf	shelf, fringing reef, bioherm	Biogenic, subcrop, octocorals	755	25- 100	Y	GoC Image Data

ERAEF record No.	ERAEF Habitat Number	Sub-biome	Feature	Habitat type	SGF Score	Depth (m)	Image available	Reference image location
4272	274	inner shelf	shelf, fringing reef, bioherm	Biogenic, subcrop, small/ low encrustors	756	25- 100	Y	GoC Image Data
4273	370	inner shelf	shelf, fringing reef, bioherm	Biogenic, subcrop, sedentary	757	25- 100	Y	GoC Image Data
4274	371	inner shelf	shelf, fringing reef, bioherm	Biogenic, low outcrop, large sponges	761	25- 100	Y	GoC Image Data
4275	275	inner shelf	shelf, fringing reef, bioherm	Biogenic, low outcrop, mixed faunal community	763	25- 100	Y	GoC Image Data
4276	276	inner shelf	shelf, fringing reef, bioherm	Biogenic, low outcrop, octocorals	765	25- 100	Y	GoC Image Data
4277	375	inner shelf	shelf, fringing reef, bioherm	Biogenic, low outcrop, encrustors	766	25- 100	Y	GoC Image Data
4278	377	inner shelf	shelf, fringing reef, bioherm	Biogenic, low outcrop, sedentary	767	25- 100	Y	GoC Image Data
4279	379	inner shelf	shelf, fringing reef, bioherm	Biogenic, low outcrop, large sponges	771	25- 100	Y	GoC Image Data
4280	277	inner shelf	shelf, fringing reef, bioherm	Biogenic, low outcrop, mixed faunal community	773	25- 100	Y	GoC Image Data
4281	381	inner shelf	shelf, fringing reef, bioherm	Biogenic, low outcrop, octocorals	775	25- 100	Y	GoC Image Data
4282	383	inner shelf	shelf, fringing reef, bioherm	Biogenic, low outcrop, encrustors	776	25- 100	Y	GoC Image Data
4283	385	inner shelf	shelf, fringing reef, bioherm	Biogenic, low outcrop, sedentary	777	25- 100	Y	GoC Image Data
4284	387	inner shelf	shelf, fringing reef, bioherm	Biogenic, high outcrop, mixed faunal community	783	25- 100	Y	GoC Image Data
4285	389	inner shelf	shelf, fringing reef, bioherm	Biogenic, high outcrop, octocorals	785	25- 100	Y	GoC Image Data
4286	390	inner shelf	shelf, fringing reef, bioherm	Biogenic, high outcrop, encrustors	786	25- 100	Y	GoC Image Data
4287	278	inner shelf	shelf, fringing reef, bioherm	Biogenic, high outcrop, mixed faunal community	793	25- 100	Y	GoC Image Data
4288	392	inner shelf	shelf, fringing reef, bioherm	Biogenic, high outcrop, octocorals	795	25- 100	Y	GoC Image Data
4289	393	inner shelf	shelf, fringing reef, bioherm	Biogenic, high outcrop, encrustors	796	25- 100	Y	GoC Image Data
4290	397	inner shelf	shelf	mud, subcrop, bivalve beds	05BV	25- 100	N	g
4291	399	inner shelf	shelf	mud, subcrop, hard corals	05HC	25- 100	Y	Npf Image Data

ERAEF record No.	ERAEF Habitat Number	Sub-biome	Feature	Habitat type	SGF Score	Depth (m)	Image available	Reference image location
4292	404	Inner shelf	shelf	fine sediments, irregular, hard corals	13HC	25- 100	Y	GoC Image Data
4293	407	inner shelf	shelf	Coarse sediments, flat, hard corals	20HC	25- 100	Y	GoC Image Data
4294	410	inner shelf	shelf	coarse sediments, irregular, hard corals	23HC	25- 100	Y	Goc Image Data
4295	412	inner shelf	shelf	Coarse sediments, subcrop, bivalve beds	25BV	25- 100	N	g
4296	415	inner shelf	shelf	gravel, flat, hard corals	30HC	25- 100	Y	GoC Image Data
4297	416	inner shelf	shelf	gravel/ pebble, directed scour, hard corals	31HC	25- 100	Y	GoC Image data
4298	417	inner shelf	shelf	Gravel, irregular, Hard corals	33HC	25- 100	Y	GoC Image Data
4299	419	inner shelf	shelf	gravel/ pebble, subcrop, hard corals	35HC	25- 100	Y	GoC Image Data
4300	421	inner shelf	shelf	Sedimentary Rock (?), subcrop, hard corals	65HC	25- 100	Y	GoC Image Data
4301	424	inner shelf	shelf, bioherm	Sedimentary rock (?), low outcrop, hard corals	66HC	25- 100	Y	GoC Image Data
4302	427	inner shelf	shelf, bioherm	Sedimentary rock (?), high outcrop, hard corals	68HC	25- 100	Y	GoC Image Data
4303	430	inner shelf	shelf, bioherm	Sedimentary rock (?), high outcrop, hard corals	69HC	25- 100	Y	GoC Image Data
4304	431	inner shelf	shelf	Biogenic, subcrop, bivalve beds	75BV	25- 100	N	g
4305	433	inner shelf	shelf, fringing reef, bioherm	Biogenic, subcrop, hard corals	75HC	25- 100	Y	GoC Image Data
4306	434	inner shelf	shelf	Biogenic, low outcrop, bivalve beds	76BV	25- 100	N	g
4307	436	inner shelf	shelf, fringing reef, bioherm	Biogenic, low outcrop, hard corals	76HC	25- 100	Y	GoC Image Data
4308	437	inner shelf	shelf, fringing reef, bioherm	Biogenic, high outcrop, hard corals	78HC	25- 100	Y	GoC Image Data
4309	438	inner shelf	shelf, fringing reef, bioherm	Biogenic, high outcrop, hard corals	79HC	25- 100	Y	GoC Image Data
2239	283	inner shelf	shelf	Bryozoan communities	XX6	25- 100	Y	Norfanz Image Collection
0123	012	inner-shelf	shelf	fine sediments, unrippled, large sponges	101	25- 100	Y	
0159	016	inner-shelf	shelf	fine sediments, unrippled, mixed faunal community	103	25- 100	Y	
0895	093	inner-shelf	shelf	fine sediments, unrippled, bioturbators	109	25- 100	N	
0147	014	inner-shelf	shelf	fine sediments, wave rippled, large sponges	111	25- 100	Y	
0919	095	inner-shelf	shelf	fine sediments, wave rippled, no fauna	120	25- 100	N	
0931	096	inner-shelf	shelf	fine sediments, wave rippled, small sponges	122	25- 100	N	
0871	091	inner-shelf	shelf	fine sediments, irregular, large sponges	131	25- 100	N	

ERAEF record No.	ERAEF Habitat Number	Sub-biome	Feature	Habitat type	SGF Score	Depth (m)	Image available	Reference image location
0098	010	inner-shelf	shelf	coarse sediments, current rippled, no fauna	210	25- 100	Y	
0859	090	inner-shelf	shelf	coarse sediments, current rippled, bioturbators	219	25- 100	N	
0110	011	inner-shelf	shelf	coarse sediments, wave rippled, large sponges	221	25- 100	Y	
0086	009	inner-shelf	shelf	coarse sediments, wave rippled, sedentary	227	25- 100	Y	
0847	089	inner-shelf	shelf	coarse sediments, irregular, encrustors	236	25- 100	N	
0956	098	inner-shelf	shelf	gravel, wave rippled, no fauna	320	25- 100	Y	SE Image Collection
0944	097	inner-shelf	shelf	gravel, wave rippled, bioturbators	329	25- 100	Y	SE Image Collection
0074	007	inner-shelf	shelf	gravel, debris flow, mixed faunal community	343	25- 100	Y	
0050	005	inner-shelf	shelf	cobble, debris flow, large sponges	441	25- 100	Y	
0968	099	inner-shelf	shelf	Igneous rock, high outcrop, large sponges	591	25- 100	N	
0014	002	inner-shelf	shelf	Sedimentary rock, outcrop, large sponges	691	25- 100	Y	
4360	173	outer shelf	shelf-break	mud, unrippled, no fauna	000	100- 200, 200- 700	N	SE Image Collection
4384	219	outer shelf	shelf	mud, unrippled, small or large sponges	001	100- 200	Y	WA Image Collection
4364	177	outer shelf	shelf	mud, unrippled, low encrusting sponges	002	100- 200	N	SE Image Collection
4385	220	outer shelf	shelf	Mud, flat, octocorals	005	100- 200	Y	WA Image Collection
4361	174	outer shelf	shelf-break	mud, unrippled, sedentary	007	100- 200, 200- 700	N	SE Image Collection
4365	178	outer shelf	shelf	mud, unrippled, bioturbators	009	100- 200	N	SE Image Collection
4400	279	outer shelf	shelf	mud, current rippled, no fauna	010	100- 200	Y	WA Image Collection
4386	223	outer shelf	shelf	mud, current rippled, bioturbators	019	100- 200	Y	WA Image Collection
4387	224	outer shelf	shelf	mud, wave rippled, no fauna	020	100- 200	Y	WA Image Collection
4388	225	outer shelf	shelf	Mud, irregular, bioturbators	039	100- 200	Y	WA Image Collection
4366	179	outer shelf	shelf	mud, subcrop, erect sponges	051	100- 200	N	SE Image Collection
4350	125	outer shelf	shelf	mud, subcrop, small sponges	052	100- 200	Y	SE Image Collection
4389	226	outer shelf	shelf	Mud, subcrop, mixed faunal community	053	100- 200	Y	WA Image Collection
4367	180	outer shelf	shelf	mud, subcrop, low encrusting mixed fauna	056	100- 200	N	SE Image Collection
4357	170	outer shelf	shelf-break	fine sediments, unrippled, no fauna	100	100- 200, 200- 700	N	SE Image Collection

ERAEF record No.	ERAEF Habitat Number	Sub-biome	Feature	Habitat type	SGF Score	Depth (m)	Image available	Reference image location
2258	113	outer shelf	shelf	Fine sediments, unrippled, small sponges	102	100- 200	Y	Norfanz Image Collection
4358	171	outer shelf	shelf-break	fine sediments, unrippled, octocorals	105	100- 200, 200- 700	N	SE Image Collection
4368	181	outer shelf	shelf	fine sediments, unrippled, encrustors	106	100- 200	N	SE Image Collection
4335	110	outer shelf	shelf	fine sediments, unrippled, bioturbators	109	100- 200	Y	SE Image Collection
4356	169	outer shelf	shelf-break	fine sediments, unrippled, bioturbators	109	100- 200, 200- 700	N	SE Image Collection
4369	183	outer shelf	shelf	fine sediments, current rippled, no fauna	110	100- 200	N	SE Image Collection
4370	184	outer shelf	shelf	fine sediments, current rippled, low/ encrusting sponges	112	100- 200	N	SE Image Collection
4342	117	outer shelf	shelf	fine sediments, wave rippled, no fauna	120	100- 200	N	SE Image Collection
4341	116	outer shelf	shelf	fine sediments, wave rippled, large sponges	121	100- 200	N	SE Image Collection
4344	119	outer shelf	shelf	fine sediments, wave rippled, small sponges	122	100- 200	N	SE Image Collection
4340	115	outer shelf	shelf	fine sediments, wave rippled, encrustors	126	100- 200	N	SE Image Collection
4343	118	outer shelf	shelf	fine sediments, wave rippled, sedentary	127	100- 200	N	SE Image Collection
4339	114	outer shelf	shelf	fine sediments, wave rippled, bioturbators	129	100- 200	Y	SE Image Collection
4331	106	outer shelf	shelf	fine sediments, irregular, no fauna	130	100- 200	N	SE Image Collection
4330	105	outer shelf	shelf	fine sediments, irregular, large sponges	131	100- 200	N	SE Image Collection
4332	107	outer shelf	shelf	fine sediments, irregular, small sponges	132	100- 200	N	SE Image Collection
4355	168	outer shelf	shelf-break	fine sediments, irregular, small sponges	132	100- 200, 200- 700	N	SE Image Collection
4371	185	outer shelf	shelf	fine sediments, irregular, low encrusting mixed fauna	136	100- 200	N	SE Image Collection
4354	167	outer shelf	shelf-break	fine sediments, irregular, bioturbators	139	100- 200, 200- 700	N	SE Image Collection
4372	187	outer shelf	shelf	fine sediments, irregular, bioturbators	139	100- 200	N	SE Image Collection
4373	188	outer shelf	shelf	fine sediments, rubble banks, low encrusting sponges	142	100- 200	N	SE Image Collection
4310	017	outer shelf	shelf	fine sediments, subcrop, large sponges	151	100- 200	Y	SE Image Collection
4334	109	outer shelf	shelf	fine sediments, subcrop, small sponges	152	100- 200	Y	SE Image Collection
4333	108	outer shelf	shelf	fine sediments, subcrop, mixed faunal community	153	100- 200	N	SE Image Collection
4374	189	outer shelf	shelf	fine sediments, subcrop, mixed low fauna	156	100- 200	N	SE Image Collection
4375	190	outer shelf	shelf	coarse sediments, unrippled, no fauna	200	100- 200	N	SE Image Collection

ERAEF record No.	ERAEF Habitat Number	Sub-biome	Feature	Habitat type	SGF Score	Depth (m)	Image available	Reference image location
4322	030	outer shelf	shelf	coarse sediments, unrippled, mixed faunal community	203	100- 200	Y	SE Image Collection
4390	233	outer shelf	shelf	Coarse sediments, unrippled, octocoral/ and bryozoans??	205	100- 200	Y	WA Image Collection
4318	026	outer shelf	shelf	coarse sediments, unrippled, encrustors	206	100- 200	Y	SE Image Collection
4319	027	outer shelf	shelf	coarse sediments, current rippled, no fauna	210	100- 200	Y	SE Image Collection
4317	025	outer shelf	shelf	coarse sediments, wave rippled, no fauna	220	100- 200	Y	SE Image Collection
4328	103	outer shelf	shelf	coarse sediments, wave rippled, small sponges	222	100- 200	N	SE Image Collection
4327	102	outer shelf	shelf	coarse sediments, wave rippled, encrustors	226	100- 200	N	SE Image Collection
4321	029	outer shelf	shelf	coarse sediments, irregular, large sponges	231	100- 200	Y	SE Image Collection
4312	019	outer shelf	terrace, shelf	coarse sediments, subcrop, large sponges	251	100- 200	Y	SE Image Collection
4326	101	outer shelf	shelf	coarse sediments, subcrop, small sponges	252	100- 200	N	SE Image Collection
4383	209	Outer shelf	terrace	Coarse sediments, Subcrop, Mixed faunal community	253	100- 200	Y	GAB Image Collection
4376	192	outer shelf	shelf	gravel/ pebble, current rippled, large sponges	311	100- 200	N	SE Image Collection
4377	193	outer shelf	shelf	gravel/ pebble, current rippled, mixed low fauna	316	100- 200	N	SE Image Collection
4345	120	outer shelf	shelf	gravel, current rippled, bioturbators	319	100- 200	N	SE Image Collection
4349	124	outer shelf	shelf	gravel, wave rippled, no fauna	320	100- 200	N	SE Image Collection
4348	123	outer shelf	shelf	gravel, wave rippled, large sponges	321	100- 200	N	SE Image Collection
4378	194	outer shelf	shelf	gravel/ pebble, wave rippled, low encrusting sponges	322	100- 200	N	SE Image Collection
4347	122	outer shelf	shelf	gravel, wave rippled, encrustors	326	100- 200	N	SE Image Collection
4379	195	outer shelf	shelf	gravel, wave rippled, encrustors	326	100- 200	N	SE Image Collection
4346	121	outer shelf	shelf	gravel, wave rippled, bioturbators	329	100- 200	Y	SE Image Collection
4316	024	outer shelf	shelf	gravel, irregular, encrustors	336	100- 200	Y	SE Image Collection
4380	196	outer shelf	shelf	gravel, wave rippled, encrustors	346	100- 200	N	SE Image Collection
4320	028	outer shelf	shelf	cobble, unrippled, large sponges	401	100- 200	Y	SE Image Collection
4381	197	outer shelf	shelf	cobble, unrippled, low/ encrusting mixed fauna	406	100- 200	N	SE Image Collection
4382	198	outer shelf	shelf	cobble, current rippled, low/ encrusting mixed fauna	416	100- 200	N	SE Image Collection
4323	032	outer shelf	shelf	cobble, subcrop, crinoids	454	100- 200	Y	SE Image Collection
4313	020	outer shelf	shelf	cobble, outcrop, crinoids	464	100- 200	Y	SE Image Collection

ERAEF record No.	ERAEF Habitat Number	Sub-biome	Feature	Habitat type	SGF Score	Depth (m)	Image available	Reference image location
4391	246	outer shelf	shelf	cobble/boulder (slab), outcrop, mixed low encrustors	466	100- 200	Y	WA Image Collection
4359	172	outer shelf	shelf-break	Igneous rock, high outcrop, no fauna	590	100- 200, 200- 700	N	SE Image Collection
4352	127	outer shelf	shelf	Sedimentary rock, subcrop, small sponges	652	100- 200	Y	SE Image Collection
4363	176	outer shelf	shelf-break	Sedimentary rock, subcrop, small sponges	652	100- 200, 200- 700	N	SE Image Collection
4314	022	outer shelf	shelf	Sedimentary rock, subcrop, mixed faunal community	653	100- 200	Y	SE Image Collection
4362	175	outer shelf	shelf-break	Sedimentary rock, subcrop, crinoids	654	100- 200, 200- 700	N	SE Image Collection
4392	254	outer shelf	shelf	Sedimentary rock (?), low outcrop, large erect sponges	661	100- 201	Y	WA Image Collection
4393	255	outer shelf	shelf	Sedimentary rock (?) low outcrop, mixed faunal community	663	100- 200	Y	WA Image Collection
4315	023	outer shelf	shelf	Sedimentary rock, outcrop, large sponges	671	100- 200	Y	SE Image Collection
4394	258	outer shelf	shelf	Sedimentary rock (?), low outcrop, mixed faunal community	673	100- 200	Y	WA Image Collection
4395	259	outer shelf	shelf	Sedimentary rock (?), low outcrop, encrustors	676	100- 200	Y	WA Image Collection
4396	260	outer shelf	shelf	Sedimentary rock (?), outcrop, solitary	677	100- 200	Y	WA Image Collection
4401	280	outer shelf	shelf	Sedimentary rock (?), high outcrop, solitary	681	100- 201	Y	WA Image Collection
4397	263	outer shelf	shelf	Sedimentary rock (?), high outcrop, ?small sponges	682	100- 200	Y	WA Image Collection
4398	266	outer shelf	shelf	Sedimentary rock (?), high outcrop, large sponges	691	100- 200	Y	WA Image Collection
4399	268	outer shelf	shelf	Sedimentary rock (?), high outcrop, mixed faunal community	693	100- 200	Y	WA Image Collection
4311	018	outer shelf	shelf	Sedimentary rock, outcrop, encrustors	696	100- 200	Y	SE Image Collection
4402	281	outer shelf	shelf	Rock/ biogenic matrix, low outcrop, mixed faunal community	763	100-200	Y	WA Image Collection
2331	166	outer shelf	shelf-break	Bryozoan based commmunities	XX6	100- 200	Y	Norfanz Image Collection
0980	100	outer-shelf	shelf	mud, unrippled, sedentary	007	100- 200	Y	SE Image Collection
1130	112	outer-shelf	shelf	fine sediments, unrippled, no fauna	100	100- 200	Y	SE Image Collection
1118	111	outer-shelf	shelf	fine sediments, unrippled, large sponges	101	100- 200	Y	SE Image Collection
1030	104	outer-shelf	shelf	fine sediments, current rippled, bioturbators	119	100- 200	Y	SE Image Collection
1243	121	outer-shelf	shelf	gravel, wave rippled, bioturbators	329	100- 200	Y	SE Image Collection
1307	126	outer-shelf	shelf	Sedimentary rock, subcrop, large sponges	651	100- 200	Y	SE Image Collection
0667	065	outer-shelf	canyon	Sedimentary rock, outcrop, small sponges	672	100- 200	Y	SE Image Collection

ERAEF record No.	ERAEF Habitat Number	Sub-biome	Feature	Habitat type	SGF Score	Depth (m)	Image available	Reference image location
4443	202	upper slope	terrace	Mud, Unrippled, No fauna	000	200-700	Y	GAB Image Collection
4438	143	upper slope	slope	mud, unrippled, large sponges	001	200- 700	N	SE Image Collection
4447	227	upper slope	slope	Fine sediments, unrippled, sponges	101	200- 700	Y	WA Image Collection
2340	137	upper slope	slope	Fine sediments, unrippled, small sponges	102	200- 700	Y	Norfanz Image Collection
4448	231	upper slope	slope	Fine sediments, irregular, glass sponge	137	200- 700	Y	WA Image Collection
4409	041	upper slope	slope	fine, irregular, bioturbators	139	200- 700	3	WA Image Collection
4408	040	upper slope	slope	fine sediments, subcrop, sedentary	157	200- 700	Y	SE Image Collection
2351	284	upper slope	slope	Coarse sediments, unrippled, large sponges	201	200- 700	Y	Norfanz Image Collection
2352	285	upper slope	slope	Coarse sediments, unrippled, octocorals	205	200- 700	Y	Norfanz Image Collection
4410	043	upper slope	slope	coarse sediments, unrippled, low mixed encrustors	206	200- 700	Y	SE Image Collection
4449	235	upper slope	slope	Coarse sediments, rippled, no fauna	210	200- 700	Y	WA Image Collection
4450	236	upper slope	slope	Coarse sand, rippled, solitary epifauna	217	200- 700	Y	WA Image Collection
4451	237	upper slope	slope	Coarse sand, wave rippled, bryozoan turf	226	200- 700	Y	WA Image Collection
4452	238	upper slope	slope	Coarse sediments, irregular, octocorals	235	200- 700	Y	WA Image Collection
4453	239	upper slope	slope	Coarse sediments, subcrop, large sponges	251	200- 700	Y	WA Image Collection
4454	240	upper slope	slope	Sedimentary, subcrop, octocorals	255	200- 700	Y	WA Image Collection
4455	241	upper slope	slope	Coarse sediments, subcrop, low encrusting community	256	200- 700	Y	WA Image Collection
4434	139	upper slope	slope	gravel, debris flow, no fauna	340	200- 700	N	SE Image Collection
4433	138	upper slope	slope	gravel, debris flow, encrustors	346	200- 700	Y	SE Image Collection
2370	286	upper slope	slope	Cobble/ boulder, debris, sedentary	447	200- 700	Y	Norfanz Image Collection
2372	247	upper slope	slope	Boulders, low outcrop, no fauna	470	200- 700	Y	Norfanz Image Collection
2373	287	upper slope	slope	slabs and boulders, low outcrop, octocorals	475	200- 700	Y	Norfanz Image Collection
2374	288	upper slope	slope	Igneous Rock (?), low outcrop, octocorals	565	200- 700	Y	Norfanz Image Collection
2375	289	upper slope	slope	Igneous Rock (?), low outcrop, mixed faunal community	573	200- 700	Y	Norfanz Image Collection
2376	290	upper slope	slope	Igneous Rock (?), high outcrop, no fauna	590	200- 700	Y	Norfanz Image Collection
2377	291	upper slope	slope	Igneous Rock (?), high outcrop, mixed faunal community	593	200- 700	Y	Norfanz Image Collection
4457	251	upper slope	slope	Sedimentary, subcrop, no fauna	650	200- 700	Y	WA Image Collection

ERAEF record No.	ERAEF Habitat Number	Sub-biome	Feature	Habitat type	SGF Score	Depth (m)	Image available	Reference image location
4403	033	upper slope	slope	Sedimentary rock, subcrop, mixed faunal community	653	200- 700	Y	SE Image Collection
4442	148	upper slope	terrace, slope	Sedimentary rock, Subcrop, Octocorals (gold corals / seawhips)	655	200-700	Y	GAB Image Collection
4406	036	upper slope	slope	Sedimentary, subcrop, small encrustors	656	200- 700	Y	WA Image Collection
2384	292	upper slope	slope	Sedimentary Rock (?), subcrop, sedentary	657	200- 700	Y	Norfanz Image Collection
4458	256	upper slope	slope	Sedimentary, outcrop, octocorals	665	200- 700	Y	WA Image Collection
4405	035	upper slope	slope	Sedimentary rock, outcrop, encrustors	666	200- 700	Y	SE Image Collection
4459	257	upper slope	shelf break	Sedimentary, low outcrop, no fauna	670	200- 700	3	WA Image Collection
4440	145	upper slope	slope, canyon	Sedimentary, low outcrops on steep slope, large sponges	671	200- 700	2	WA Image Collection
4444	216	upper slope	canyon	Sedimentary rock, low outcrop, Octocorals	675	200-700	Y	GAB Image Collection
4460	261	upper slope	slope	Sedimentary, outcrop, sedentary (anemones)	677	200- 700	Y	WA Image Collection
4461	264	upper slope	slope	Sedimentary, high outcrop, octocoral	683	200- 700	Y	WA Image Collection
4407	039	upper slope	slope	Sedimentary rock, outcrop, crinoids	684	200- 700	Y	SE Image Collection
4445	217	upper slope	canyon	Sedimentary rock, High Outcrop, Small encrustors	686	200-700	Y	GAB Image Collection
4446	218	upper slope	canyon	Sedimentary rock, High Outcrop, Sedentary	687	200-700	Y	GAB Image Collection
4462	265	upper slope	slope	Sedimentary rock (mudstone?), high outcrop, no fauna	690	200- 700	3	WA Image Collection
4463	267	upper slope	slope	Sedimentary rock (mudstone?), high outcrop, small sponges	692	200- 700	Y	WA Image Collection
4464	269	upper slope	slope	Sedimentary, outcrop, octocorals	695	200- 700	Y	WA Image Collection
4404	034	upper slope	slope	Sedimentary rock, outcrop, encrustors	696	200- 700	Y	SE Image Collection
4465	270	upper slope	slope	Sedimentary, high outcrop, solitary epifauna	697	200- 700	Y	WA Image Collection
2400	293	upper slope	slope	Rock/ biogenic matrix, low outcrop, mixed faunal community	763	200- 700	Y	Norfanz Image Collection
2401	128	upper slope	slope	Bryozoan based communities	XX6	200- 700	Y	Norfanz Image Collection
1488	142	upper-slope	slope	mud, unrippled, encrustors	006	200- 700	Y	SE Image Collection
1512	144	upper-slope	slope	mud, unrippled, sedentary	007	200- 700	Y	SE Image Collection
1476	141	upper-slope	slope	mud, unrippled, bioturbators	009	200- 700	Y	SE Image Collection
1464	140	upper-slope	slope	mud, irregular, bioturbators	039	200- 700	Y	SE Image Collection
0463	046	upper-slope	slope	fine sediments, unrippled, no fauna	100	200- 700	Y	SE Image Collection
1416	136	upper-slope	slope	fine sediments, unrippled, encrustors	106	200- 700	Y	SE Image Collection

ERAEF record No.	ERAEF Habitat Number	Sub-biome	Feature	Habitat type	SGF Score	Depth (m)	Image available	Reference image location
0787	078	upper-slope	canyon	fine sediments, unrippled, sedentary	107	200- 700	Y	SE Image Collection
0439	044	upper-slope	slope, canyon	fine sediments, unrippled, bioturbators	109	200- 700	Y	SE Image Collection
1392	133	upper-slope	slope	fine sediments, current rippled, no fauna	110	200- 700	N	
0751	073	upper-slope	canyon	fine sediments, irregular, encrustors	136	200- 700	Y	SE Image Collection
1404	134	upper-slope	slope	fine sediments, subcrop, large sponges	151	200- 700	N	
0775	077	upper-slope	canyon, slope	fine sediments, subcrop, small sponges	152	200- 700	Y	SE Image Collection
0451	045	upper-slope	slope	coarse sediments, unrippled, sedentary	207	200- 700	Y	SE Image Collection
0763	076	upper-slope	canyon, slope	coarse sediments, irregular, low mixed encrustors	236	200- 700	Y	SE Image Collection
0739	072	upper-slope	canyon	coarse sediments, irregular, bioturbators	239	200- 700	Y	SE Image Collection
1356	130	upper-slope	slope	cobble, debris flow, no fauna	440	200- 700	Y	SE Image Collection
1380	132	upper-slope	slope	cobble, debris flow, small sponges	442	200- 700	Y	SE Image Collection
1368	131	upper-slope	slope	cobble, debris flow, octocorals	445	200- 700	N	
1344	129	upper-slope	slope	cobble, debris flow, encrustors	446	200- 700	Y	SE Image Collection
0703	069	upper-slope	canyon	cobble, outcrop, crinoids	464	200- 700	Y	SE Image Collection
0811	081	upper-slope	seamount	Sedimentary rock, unrippled, no fauna	600	200- 700	Y	SE Image Collection
0835	085	upper-slope	seamount	Sedimentary rock, unrippled, encrustors	606	200- 700	Y	SE Image Collection
0691	067	upper-slope	canyon, slope	Sedimentary rock, subcrop, large sponges	651	200- 700	Y	SE Image Collection
0715	070	upper-slope	canyon	Sedimentary rock, subcrop, small sponges	652	200- 700	Y	SE Image Collection
1536	146	upper-slope	slope	Sedimentary rock, low outcrop, small sponges	672	200- 700	Y	SE Image Collection
0727	071	upper-slope	canyon	Sedimentary rock, outcrop, encrustors	676	200- 700	Y	SE Image Collection
0799	080	upper-slope	seamount	Sedimentary rock, outcrop, encrustors	676	200- 700	Y	SE Image Collection
0679	066	upper-slope	canyon	Sedimentary rock, outcrop, crinoids	694	200- 700	Y	SE Image Collection
4508	161	mid-slope	slope	mud, unrippled, small sponges	002	700- 1500	N	SE Image Collection
4520	221	mid-slope	slope	Mud, irregular, crinoids	005	700-1500	Y	WA Image Collection
4521	222	mid-slope	slope	Mud, flat, solitary	007	700-1500	Y	WA Image Collection
4505	158	mid-slope	slope	mud, current rippled, bioturbators	019	700- 1500	N	SE Image Collection
4507	160	mid-slope	slope	mud, irregular, sedentary	037	700- 1500	N	SE Image Collection

ERAEF record No.	ERAEF Habitat Number	Sub-biome	Feature	Habitat type	SGF Score	Depth (m)	Image available	Reference image location
4506	159	mid-slope	slope	Mud, irregular, bioturbators	039	700-1500	Y	WA Image Collection
2408	156	mid-slope	slope	Fine sediments, unrippled, no fauna	100	700- 1500	Y	Norfanz Image Collection
0643	063	mid-slope	slope	fine sediments, unrippled, octocorals	105	700- 1500	Y	SE Image Collection
4522	228	mid-slope	slope	Fine, unrippled, solitary	107	700-1500	Y	WA Image Collection
2411	294	mid-slope	slope	Fine sediments, unrippled, bioturbators	109	700- 1500	Y	Norfanz Image Collection
4523	230	mid-slope	slope	fine sediments, irregular, no fauna	130	700-1500	Y	WA Image Collection
0619	061	mid-slope	slope	fine sediments, irregular, bioturbators	139	700- 1500	Y	SE Image Collection
0571	057	mid-slope	slope	fine sediments, subcrop, bioturbators	150	700- 1500	Y	SE Image Collection
4524	232	mid-slope	slope	Fine sediments, subcrop, octocorals	155	700-1500	Y	WA Image Collection
2416	295	mid-slope	slope	Fine sediments, subcrop, encrustors	156	700- 1500	Y	Norfanz Image Collection
4499	153	mid-slope	slope	coarse sediments, unrippled, no fauna	200	700- 1500	N	SE Image Collection
0631	062	mid-slope	slope	coarse sediments, unrippled, octocorals	205	700- 1500	Y	SE Image Collection
4496	150	mid-slope	slope	coarse sediments, current rippled, no fauna	210	700- 1500	N	SE Image Collection
4497	151	mid-slope	slope	coarse sediments, current rippled, octocorals	215	700- 1500	N	SE Image Collection
4512	207	mid-slope	terrace	Coarse sediments, directed scour, Small encrustors / erect forms (including bryozoans)	216	700-1500	Y	GAB Image Collection
2421	152	mid-slope	slope	Coarse sediments, current rippled, sedentary	217	700- 1500	Y	Norfanz Image Collection
4498	152	mid-slope	slope	coarse sediments, current rippled, sedentary	217	700- 1500	N	SE Image Collection
2422	296	mid-slope	slope	Coarse sediments, irregular, no fauna	230	700- 1500	Y	Norfanz Image Collection
4513	208	mid-slope	seamount	Coarse sediments, Highly irregular, Mixed faunal community	233	700-1500	Y	GAB Image Collection
0595	059	mid-slope	slope	coarse sediments, irregular,low encrusting	236	700- 1500	Y	SE Image Collection
2424	297	mid-slope	slope	Coarse sediments, subcrop, no fauna	250	700- 1500	Y	Norfanz Image Collection
2425	298	mid-slope	slope	Coarse sediments, low outcrop, no fauna	260	700- 1500	Y	Norfanz Image Collection
4525	243	mid-slope	slope	Gravel, irregular, low encrustings	336	700-1500	2	WA Image Collection
0583	058	mid-slope	slope	cobble, unrippled, small sponges	402	700- 1500	Y	SE Image Collection
4526	244	mid-slope	slope	Igneous rock/boulder, rubble bank, none	440	700-1500	Y	WA Image Collection
4500	154	mid-slope	slope	cobble, debris flow, crinoids	444	700- 1500	N	SE Image Collection
4501	155	mid-slope	slope	slabs/ boulders, debris flow, octocorals	445	700- 1500	Y	SE Image Collection

ERAEF record No.	ERAEF Habitat Number	Sub-biome	Feature	Habitat type	SGF Score	Depth (m)	Image available	Reference image location
0487	050	mid-slope	slope	cobble, debris flow, encrustors	446	700- 1500	Y	SE Image Collection
4514	210	mid-slope	seamount	Cobble/ boulder, Debris flow / rubble banks, Sedentary: e.g. seapens	447	700-1500	Y	GAB Image Collection
4527	245	mid-slope	slope	boulders and slabs, subcropping, octocorals	455	700-1500	Y	WA Image Collection
0499	051	mid-slope	slope	cobble, outcrop, no fauna	460	700- 1500	Y	SE Image Collection
0607	060	mid-slope	slope	cobble, outcrop, crinoids	464	700- 1500	Y	SE Image Collection
0655	064	mid-slope	slope	Sedimentary slab and mud boulders, outcrop, crinoids	464	700- 1500	Y	SE Image Collection
4528	248	mid-slope	slope	Igneous rock, rubble bank, no fauna	540	700-1500	Y	WA Image Collection
4529	249	mid-slope	seamount	Igneous rock, rubble bank, octocorals	545	700-1500	Y	WA Image Collection
4515	211	mid-slope	seamount	Igneous / metamorphic rock, Subcrop, Small encrustors	556	700-1500	Y	GAB Image Collection
4516	212	mid-slope	seamount	Igneous / metamorphic rock, Subcrop, Sedentary: e.g. seapens	557	700-1500	Y	GAB Image Collection
0523	053	mid-slope	slope	Igneous rock, low outcrop, sedentary	567	700- 1500	Y	SE Image Collection
4530	250	mid-slope	seamount	Igneous rock, low outcrop, no fauna	570	700-1500	Y	WA Image Collection
4517	213	mid-slope	seamount	Igneous / metamorphic rock, Low Outcrop, Octocorals	575	700-1500	Y	GAB Image Collection
4518	214	mid-slope	seamount	Igneous / metamorphic rock, Low Outcrop, Small encrustors	576	700-1500	Y	GAB Image Collection
4519	215	mid-slope	seamount	Igneous / metamorphic rock, Low Outcrop, Sedentary	577	700-1500	Y	GAB Image Collection
4476	049	mid-slope	slope	Igneous rock, high outcrop, crinoids	594	700- 1500	Y	SE Image Collection
4504	157	mid-slope	slope	Igneous rock, high outcrop, octocoral	595	700-1500	Y	WA Image Collection
0547	055	mid-slope	slope	Sedimentary rock, unrippled, sedentary	607	700- 1500	Y	SE Image Collection
4509	162	mid-slope	slope	Sedimentary rock, debris flow, crinoids	644	700- 1500	N	SE Image Collection
4511	164	mid-slope	slope	Sedimentary rock, subcrop, crinoids	654	700- 1500	Y	SE Image Collection
1740	165	mid-slope	slope	Sedimentary rock, subcrop, octocorals	655	700- 1500	Y	SE Image Collection
4531	252	mid-slope	slope	Sedimentary, subcrop, small encrustors	656	700-1500	2	WA Image Collection
4532	253	mid-slope	slope	rock (conglomerate/sedimentary), subcrop, bioturbators	659	700-1500	Y	WA Image Collection
0559	056	mid-slope	slope, canyons, seamounts	Sedimentary rock, outcrop, mixed faunal community	673	700- 1500	Y	SE Image Collection
0511	052	mid-slope	slope	Sedimentary rock, outcrop, octocorals	675	700- 1500	Y	SE Image Collection
0823	084	mid-slope	seamount	Sedimentary rock, outcrop, sedentary	677	700- 1500	Y	SE Image Collection

ERAEF record No.	ERAEF Habitat Number	Sub-biome	Feature	Habitat type	SGF Score	Depth (m)	Image available	Reference image location
4533	262	mid-slope	slope	sedimentary/mudstone, high outcrop, no fauna	680	700-1500	Y	WA Image Collection
0535	054	mid-slope	slope	Sedimentary rock, outcrop, crinoids	694	700- 1500	Y	SE Image Collection
4510	163	mid-slope	terrace	Sedimentary rock, High Outcrop, Octocorals	695	700-1500	Y	GAB Image Collection

Scoping Document S2B2. Pelagic Habitats

A list of the pelagic habitats for the Eastern Tuna and Billfish Fishery. Shading denotes habitats occurring within the jurisdictional boundary of the fishery that are not subject to effort from Pelagic Longlining methods.

ERAEF Habitat Number	Pelagic Habitat type	Depth (m)	Comments	Reference
P1	Eastern Pelagic Province - Coastal	0 – 200		dow167A1, A2, A4
P2	Eastern Pelagic Province - Oceanic	0 – > 600	this is a compilation of the range covered by Oceanic Community (1) and (2)	dow167A1, A2, A4
P4	North Eastern Pelagic Province - Oceanic	0 – > 600	this is a compilation of the range covered by Oceanic Community (1) and (2)	dow167A1, A2, A4
P5	Northern Pelagic Province - Coastal	0 – 200		dow167A1, A2, A4
P7	Southern Pelagic Province - Coastal	0 – 200	this is a compilation of the range covered by Coastal pelagic Tas and GAB	dow167A1, A2, A4
P8	Southern Pelagic Province - Oceanic	0 – > 600	this is a compilation of the range covered by Oceanic Communities (1, 2 and 3)	dow167A1, A2, A4
P9	Southern Pelagic Province - Seamount Oceanic	0 – > 600	this is a compilation of the range covered by Seamount Oceanic Communities (1, 2 and 3)	dow167A1, A2, A4
P12	Eastern Pelagic Province - Seamount Oceanic	0 – > 600	this is a compilation of the range covered by Seamount Oceanic Communities (1) and (2)	dow167A1, A2, A4
P14	North Eastern Pelagic Province - Coastal	0 – 200		dow167A1, A2, A4
P15	North Eastern Pelagic Province - Plateau	0 – > 600	this is a compilation of the range covered by the Northeastern Plateau Community (1) and (2)	dow167A1, A2, A4
P16	North Eastern Pelagic Province - Seamount Oceanic	0 – > 600		dow167A1, A2, A4

Scoping Document S2C1. Demersal Communities

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

Demersal communities that underlie the pelagic communities in which fishing activity occurs in the ETBF (x). Shaded cells indicate all communities within the province.

Demersal community	Cape	North Eastern Transition	North Eastern	Central Eastern Transition	Central Eastern	South Eastern Transition	Central Bass	Tasmanian	Western Tas Transition	Southern	South Western Transition	Central Western	Central Western Transition	North Western	North Western Transition	Timor	Timor Transition	Heard & McDonald Is	Macquarie Is
Inner Shelf 0 – 110m [1,2]		x	x	x	x			x											
Outer Shelf 110 – 250m [1,2,]		x	x	x	x			x											
Upper Slope 250 – 565m [3]	x	x	x	x	x			x		x									
Mid–Upper Slope 565 – 820m[3]	x	x	x	x	x			x		x									
Mid Slope 820 – 1100m[3]	x	x	x	x	x			x		x									
Lower slope/ Abyssal > 1100m[6]	x	x	x	x	x			x											
Reef 0 -110m[7, 8]			x																
Reef 110-250m[8]																			
Seamount 0 – 110m	x		x																
Seamount 110- 250m	x		x																
Seamount 250 – 565m	x		x																
Seamount 565 – 820m	x		x																
Seamount 820 – 1100m	x		x																

Demersal community	Cape	North Eastern Transition	North Eastern	Central Eastern Transition	Central Eastern	South Eastern Transition	Central Bass	Tasmanian	Western Tas Transition	Southern	South Western Transition	Central Western	Central Western Transition	North Western	North Western Transition	Timor	Timor Transition	Heard & McDonald Is	Macquarie Is
Seamount 1100 – 3000m			x	x															
Plateau 0 – 110m			x																
Plateau 110- 250m[4]			x																
Plateau 250 – 565m[4]			x																
Plateau 565 – 820m[5]			x																
Plateau 820 – 1100m[5]			x																

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

Scoping Document S2C2. Pelagic Communities

Pelagic communities in which fishing activity occurs in the ETBF (x). Shaded cells indicate all communities that exist in the province.

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

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

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

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

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

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

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

Scoping Document S3 Components and Sub-components Identification of Objectives

Component	Core Objective	Sub-component	Example Operational Objectives	Example Indicators	**Rationale**
	"What is the general goal?"	*As shown in sub-component model diagrams at the beginning of this section.*	*"What you are specifically trying to achieve"*	*"What you are going to use to measure performance"*	*Rationale flagged as 'EMO' where Existing Management Objective in place, or 'AMO' where there is an existing AFMA Management Objective in place for other Commonwealth fisheries (assumed that squid fishery will fall into line).*

Component	Core Objective	Sub-component	Example Operational Objectives	Example Indicators	**Rationale**
Target Species	Avoid recruitment failure of the target species Avoid negative consequences for species or population sub-components	1. Population size	1.1 No trend in biomass 1.2 Maintain biomass above a specified level 1.3 Maintain catch at specified level 1.4 Species do not approach extinction or become extinct	Biomass, numbers, density, CPUE, yield	1.1 Increases in biomass of the target species would be acceptable. 1.2. No biomass level is specified. 1.3. No catch levels are specified. 1.4. This is a general objective for all AFMA fisheries. In general these objectives underlie the sustainable management of the Fishery, for both target bait and target species.
		2. Geographic range	2.1 Geographic range of the population, in terms of size and continuity does not change outside acceptable bounds	Presence of population across the GAB	2.1
		3. Genetic structure	3.1 Genetic diversity does not change outside acceptable bounds	Frequency of genotypes in the population, effective population size (N_e), number of spawning units	3.1
		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

Component	Core Objective	Sub-component	Example Operational Objectives	Example Indicators	**Rationale**
		5. Reproductive Capacity	5.1 Fecundity of the population does not change outside acceptable bounds (e.g. more than X% of reference population fecundity) 2 Recruitment to the population does not change outside acceptable bounds	Egg production of population Abundance of recruits	5.1 5.2
		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 behavior that are deleterious to the species and populations are to be avoided.
Byproduct and Bycatch	Avoid recruitment failure of the byproduct and bycatch species Avoid negative consequences for species or population sub-components	1. Population size	1.1 No trend in biomass 1.2 Species do not approach extinction or become extinct 1.3 Maintain biomass above a specified level 1.4 Maintain catch at specified level	Biomass, numbers, density, CPUE, yield	1.1 1.2 1.3 1.4
		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
		3. Genetic structure	3.1 Genetic diversity does not change outside acceptable bounds	Frequency of genotypes in the population, effective population size (N_e), number of spawning units	3.1

Component	Core Objective	Sub-component	Example Operational Objectives	Example Indicators	**Rationale**
		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
		5 Reproductive Capacity	5.1 Fecundity of the population does not change outside acceptable bounds (e.g. more than X% of reference population fecundity) Recruitment to the population does not change outside acceptable bounds	Egg production of population Abundance of recruits	5.1
		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
TEP species	Avoid recruitment failure of TEP species Avoid negative consequences for TEP species or population sub-components Avoid negative impacts on the population from fishing	1. Population size	1.1 Species do not further approach extinction or become extinct 1.2 No trend in biomass 1.3 Maintain biomass above a specified level 1.4 Maintain catch at specified level	Biomass, numbers, density, CPUE, yield	1.1 1.2 1.3 1.4

Component	Core Objective	Sub-component	Example Operational Objectives	Example Indicators	**Rationale**
		2. Geographic range	2.1 Geographic range of the population, in terms of size and continuity does not change outside acceptable bounds	Presence of population across space, i.e. the GAB	2.1
		3. Genetic structure	3.1 Genetic diversity does not change outside acceptable bounds	Frequency of genotypes in the population, effective population size (N_e), number of spawning units	3.1
		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
		5. Reproductive Capacity	5.1 Fecundity of the population does not change outside acceptable bounds (e.g. more than X% of reference population fecundity) Recruitment to the population does not change outside acceptable bounds	Egg production of population Abundance of recruits	5.1
		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

Component	Core Objective	Sub-component	Example Operational Objectives	Example Indicators	**Rationale**
		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
Habitats	Avoid negative impacts on the quality of the environment Avoid reduction in the amount and quality of habitat	1. Water quality	1.1 Water quality does not change outside acceptable bounds	Water chemistry, noise levels, debris levels, turbidity levels, pollutant concentrations, light pollution from artificial light	1.1
		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
		3. Substrate quality	3.1 Sediment quality does not change outside acceptable bounds	Sediment chemistry, stability, particle size, debris, pollutant concentrations	3.1
		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
		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
Communities	Avoid negative impacts on the composition/function/distribution/structure of the community	1. Species composition	1.1 Species composition of communities does not vary outside acceptable bounds	Species presence/absence, species numbers or biomass (relative or absolute) Richness Diversity indices Evenness indices	1.1

Component	Core Objective	Sub-component	Example Operational Objectives	Example Indicators	**Rationale**
		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
		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
		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
		5. Bio- and geo-chemical cycles	5.1 Cycles do not vary outside acceptable bounds	Indicators of cycles, salinity, carbon, nitrogen, phosphorus flux	5.1

2.2.4 Hazard Identification (Step 4)

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

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

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

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

Scoping Document S4. Hazard Identification Scoring Sheet

This table is completed once for each sub-fishery. **Table 4** 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
Sub-fishery Name: Pelagic Longlining
Date completed: August 2, 2005 last updated

Direct impact of Fishing	Fishing Activity	Score (0/1)	Documentation of Rationale
Capture	Bait collection	1	Coral Sea sector – bait is frozen squid and pilchards (imported). Sthn 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.

Direct impact of Fishing	Fishing Activity	Score (0/1)	Documentation of Rationale
	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.
	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 as 7 - 32% of target fish are damaged by shark and discarded, while small fish <12 - 15 kg bigeye and yellowfin 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	Possible oil spills, detergents other cleaning agents or chemicals.
	Exhaust	1	Occurs through steaming and engine operations.

Direct impact of Fishing	Fishing Activity	Score (0/1)	Documentation of Rationale
	Gear loss	1	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	A vessel is in the water as a part of regular fishing activity
	Activity/ presence on water	1	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. Via Ian Freeman: January 28, 2004: "Tony Foster makes many of the bait nets for ETBF operators and most are around 7-8 fathoms deep (12.8-14.6m). Nets to catch bait for poling operations are deeper, around 11-14 fathoms as they need greater quantities of bait for chumming. Tony advised that the bait nets often touch the bottom but he didn't think they would disturb the sediment as they are usually set over hard bottom around headlands, small islands etc".
	Fishing	1	Fishing gear may mix the water column, as does boat movement during regular operations.
	Boat launching	0	Occurs in marinas and ports which are outside the scope of the ERAEF
	Anchoring/ mooring	1	May have a localized affect 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 (specify the particular example within each activity area)	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	0	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.
	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

Table 4. Examples of fishing activities (Modified from Fletcher et al. 2002).

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

Direct Impact of Fishing	Fishing Activity	Examples of Activities Include
	reballasting)	
	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	Non-biological material may be introduced in the form of debris from fishing vessels or mother ships. This includes debris from the fishing process: e.g. cardboard thrown over from bait boxes, straps and netting bags lost. Debris from non-fishing activities can also contribute to this e.g. Crew rubbish – discarding or food scraps, plastics or other rubbish. Discarding at sea is regulated by MARPOL, which forbids the discarding of plastics.
	Chemical pollution	Chemicals can be introduced to water, sediment and atmosphere through: oil spills, detergents other cleaning agents, any chemicals used during processing or fishing activities.
	Exhaust	Exhaust can be introduced to the atmosphere and water through operation of fishing vessels
	Gear loss	The loss of gear will result in the addition of non-biological material, this includes hooks, line, sinkers, nets, otter boards, light sticks, buoys etc.
	Navigation /steaming	The navigation and steaming of vessels will introduce noise and visual stimuli into the environment. Boat collisions and/or sinking of vessels. Echo-sounding may introduce noise that may disrupt some species (e.g. whales, orange roughy)
	Activity /presence on water	The activity or presence of fishing vessels on the water will noise and visual stimuli into the environment.
Disturb physical processes		Any activities that will disturb physical processes, particularly processes related to water movement or sediment and hard substrate (e.g. boulders, rocky reef) processes.
	Bait collection	Bait collection may disturb physical processes if the gear contacts seafloor-disturbing sediment, or if the gear disrupts water flow patterns.

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

2.2.5 Bibliography (Step 5)

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

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

- Assessment Report
- Management Plan
- Management Regulations
- Management Plan and Regulation Guidelines
- AFMA At a glance web page http://www.afma.gov.au/fisheries/etbf/at_a_glance.php
- Bycatch Action Plans
- Data Summary Reports (logbook and observer)

Other publications that may provided information include

- BRS Fishery Status Reports
- Strategic Plans

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

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

In this case, 24 out of 26 possible internal activities were identified as occurring in this fishery. Four out of 6 external activities were identified. Thus, a total of 28 activity-component scenarios will be considered at Level 1. This results in 140 total scenarios (of 160 possible) to be developed and evaluated using the unit lists (species, habitats, communities).

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

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

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

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

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

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

2.3.2 Score spatial scale of activity (Step 2)

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

Spatial scale score of activity

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

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

2.3.3 Score temporal scale of activity (Step 3)

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

Temporal scale score of activity

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

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

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

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

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

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

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

2.3.6 Select the most appropriate operational objective (Step 6)

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

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

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

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

Level	Score	Description
Severe	5	occasional but very severe and localized or less severe but widespread and frequent
Catastrophic	6	local to regional severity or continual and widespread

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

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

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

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

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

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

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

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

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

High	2	Disagreement between experts Data exists and is considered sound Consensus between experts Consequence is constrained by logical consideration

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

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

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

2.3.1 Level 1 (SICA) Document L1.1 Target species:

Direct impact of fishing	Fishing Activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
Capture	Bait collection	1	4	5	Population size	Blue (slimy) Mackeral, yellowtail scad	1.1, 1.3, 1.4	3	2	2	Baitfishing for live bait is restricted to inshore locations, by small purse seining. The intensity reflects the moderate scale at which bait fishing occurs. Live bait constitutes 28% of bait used in 2003-04 (Lynch 2004). Consequence for the population of baitfish species is monitored by reported catch as a requirement of state licence, and AFMA. Confidence high, constrained by logical consideration
	Fishing	1	6	6	Population size	Swordfish	1.1, 1.3, 1.4	3	4	2	Swordfish decline in CPUE clearly documented in recent report by Campbell and Hobday (2003). Confidence is high that this pattern is real.
	Incidental behaviour	1	4	5	Population size	Yellowfin tuna	1.1, 1.3, 1.4	1	1	2	Recreational fishing for target species such as yellowfin or other baitfishing considered to be non-existent or so minor compared with commercial fishing levels, may not even be occurring. Confidence high, constrained by logical consideration
Direct impact without capture	Bait collection	1	4	5	Behavior and movement	Blue (slimy) Mackeral, yellowtail scad	6.1	2	2	1	Baitfishing for live bait is restricted to inshore locations, by small purse seining. No live squid catch takes place. Attraction of predator species to the area where baitfish are escaping is unlikely, may lead to some dispersal of schools due to baiting activities. Confidence low due to lack of data, information, expertise.
	Fishing	1	6	6	Population size	Swordfish	1.1, 1.3, 1.4	2	1	1	Escaping target species such as swordfish not expected to die as a result of hook ingestion, thus impacts on population size minimal. Confidence is low, the amount of escaping of target species is not well known.
	Incidental behaviour	1	6	5	Population size	Yellowfin tuna	1.1, 1.3, 1.4	1	1	2	This species used as an example of the target species that may be targeted by incidental behavior. The escapes would be less than the captures, which were considered minor. The consequence on the population of escaped animals subsequently dieing, if they do, is unlikely to be detectable. Confidence high, constrained by logical consideration

Direct impact of fishing	Fishing Activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
	Gear loss	1	6	6	Population size	Swordfish	1.1, 1.3, 1.4	1	1	2	Lost gear may drift for a while before balling up, or entangling benthic relief. Baits soon fall off, longline gear unlikely to ghost fish. Swallowing of light sticks may have some incidental mortality, but overall consequence for the population considered low. Confidence high, constrained by logical consideration
	Anchoring/ mooring	1	5	5	Behavior and movement	Blue (slimy) Mackerel, yellowtail scad	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: low likelihood of direct interaction with anchoring/ mooring lines. Consequence: low. Confidence: high, logical consideration of interactions.
	Navigation/ steaming	1	6	6	Behavior and movement	Yellowfin Tuna	6.1	1	1	1	The target species are not known for reacting to vessels and/or following them or changing behavior in response to them. Confidence low because of no information of expert opinion here.
Addition/ movement of biological material	Translocation of species	1	6	6	Population size	Blue (slimy) Mackerel, yellowtail scad	1.3	3	4	2	Translocation of species can have major effects on local communities; i.e. the introduction of an exotic pathogen in frozen imported Sardinops feed used by SA SBT farms precipitated a mass disease event and mortality in the local pilchard species, which reduced the population size of bait species in SA, WA. Gaughan (2002). Bait and foreign feed usage needs to be carefully monitored. Confidence that the consequence would be major is high based on comparisons to elsewhere.
	On board processing	1	6	6	Behavior and movement	Yellowfin tuna	6.1	1	1	2	The target species are 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. Confidence high due to logical consideration.
	Discarding catch	1	6	6	Behavior and movement	Yellowfin tuna	6.1	1	1	2	The target species are 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. Confidence high due to logical consideration.
	Stock enhancement	0									
	Provisioning	1	6	6	Behavior and movement	Yellowfin tuna	6.1	1	1	2	Target species are not known to feed on discarded baits from the vessel. Yellowfin tuna considered the most likely of an unlikely set of species. Thus any impact on the behavior and movement of these fish considered remote. Confidence high due to logistical constraints.

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	Behavior and movement	Yellowfin tuna	6.1	1	1	2	Target species are not known to feed organic wastes released from the vessel. Yellowfin tuna considered the most likely of an unlikely set of species. Thus any impact on the behavior and movement of these fish considered remote. Confidence high due to logistical constraints.
Addition of non-biological material	Debris	1	6	6	Population size	Swordfish	1.1, 1.3, 1.4	3	1	2	Swordfish may be the most likely target species to interact with debris, such as through ingestion of light-sticks discarded as gear is recovered. This might be quite widespread, but the impact on population size through mortality as a consequence is expected to be minor to non-existent. Confidence high through logical consideration.
	Chemical pollution	1	6	6	Behavior and movement	Blue (slimy) Mackerel, yellowtail scad	6.1	2	2	1	Chemical pollution is considered likely to occur when the boats 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 target species. These species may be attracted to chemical slicks in the water. Confidence in this scenario is low, no real information or logical considerations.
	Exhaust	1	6	6	Behavior and movement	Yellowfin tuna	6.1	1	1	2	The impact of exhaust on any of the target species is considered so remote that no pathway can be specified. Confidence is high that at current fishing levels, exhaust does not affect the surface ocean in a way that can be detected at this time.
	Gear loss	1	6	6	Behavior and movement	Yellowfin tuna	6.1	2	2	2	Gear loss in the pelagic ocean may drift and form a "FAD" such that some species aggregate underneath lost gear. Yellowfin may be the most likely of the target species to respond in this way. The consequence of this on the overall behavioral patterns of the population are judged to be minor. High confidence.
	Navigation/ steaming	1	6	6	Behavior and movement	Yellowfin Tuna	6.1	1	1	1	Introduction of noise into the environment not believed to be an issue for the target species. Yellowfin used as the worst case, because they are surface orientated, and noise may interfere with their orientation of school forming behavior. Confidence low about this scenario, but no reasonable alternative scenarios can be provided.
	Activity/ presence on water	1	6	6	Behavior and movement	Yellowfin Tuna	6.1	1	1	1	Activity not believed to be an issue for the target species. Yellowfin used as the worst case, because they are surface orientated. Confidence low about this scenario, but no reasonable alternative scenarios can be provided.

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	Behavior and movement	Blue (slimy) Mackerel, yellowtail scad	6.1	2	2	2	Disruption of the sediments may occur when baitfishing is undertaken through the contact of purse 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. The scale of this relative to natural disturbance is considered very low. High confidence due to logical consideration.
	Fishing	1	6	6	Behavior and movement	Striped marlin	6.1	1	1	2	The act of 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. High confidence due to logical consideration.
	Boat launching	0									
	Anchoring/ mooring	1	5	5	Behavior and movement	Blue (slimy) Mackerel, yellowtail scad	6.1	2	1	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. The scale of this relative to natural disturbance is considered very low. High confidence due to logical consideration.
	Navigation/steaming	1	6	6	Behavior and movement	Yellowfin tuna	6.1	1	1	2	Disruption of the surface waters through steaming may result in mixing that enhances local productivity. The scale of this relative to natural disturbance is considered very low. High confidence due to logical consideration.
External Impacts (specify the particular example within each activity area)	Other fisheries	1	5	6	Population size	Bigeye tuna,	1.1, 1.3, 1.4	3	3	2	Bigeye stocks are considered to be subject to over fishing in both regional and internationally managed waters. The status of swordfish is uncertain but localized depletion is occurring. (BRS 2004). The impact of that level of fishing is believed to have an influence on the population size. The level of catch is known from assessments with some confidence. High confidence assigned to this scenario.
	Aquaculture	0									
	Coastal development	0									
	Other extractive activities	1	5	6	Behavior and movement	Swordfish	6.1	1	1	1	Cannot suggest a real scenario that links these activities to the pelagic species of interest. Swordfish used because most vulnerable in Australian waters. Confidence low, because scenarios unknown.
	Other non-extractive activities	1	6	6	Behavior and movement	Swordfish	6.1	1	1	1	Cannot suggest a real scenario that links these activities to the pelagic species of interest. Swordfish used because most vulnerable in Australian waters. Confidence low, because scenarios unknown.
	Other anthropogenic activities	1	4	5	Behavior and movement	Swordfish	6.1	1	1	1	Cannot suggest a real scenario that links these activities to the pelagic species of interest. Swordfish used because most vulnerable in Australian

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
											waters. Confidence low, because scenarios unknown.

2.3.1 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	Behavior and movement	Bronze whaler shark	6	1	2	1	Bronze whalers attracted to burley. The inshore sharks may by captured within the bait sets and incidentally captured. Confidence low due to lack of data.
	Fishing	1	6	6	Population size	Southern bluefin tuna, blue shark	1.1, 1.3, 1.4	4	3	1	The levels of SBT catch are unknown, however SBT is currently nominated for listing due to decline in stock size. Observer data do not agree with the logbook data, blue shark are another with possible impact. Confidence low due to lack of data.
	Incidental behaviour	1	4	5	Population size	Shark species	1.1, 1.3, 1.4	1	1	1	Some shark species may be captured during trolling or hand lining, little impact expected. Confidence low due to lack of data.
Direct impact without capture	Bait collection	1	4	5	Behavior and movement	Bronze whaler shark	6	1	1	1	The inshore sharks may be entangled and then escape with injuries. This is expected to be lower consequence than direct capture from baiting activities.
	Fishing	1	6	6	Population size	Blue Marlin	1.1, 1.3, 1.4	3	2	1	Blue marlin may escape from gear, but impaired capacity to recover from stress of capture may result in subsequent mortality. Might be a widespread occurrence. Minimal impact on population as a result of this activity. Confidence low due to lack of data.
	Incidental behaviour	1	6	5	Population size	Blue shark	1.1, 1.3, 1.4	1	1	1	Fishing with recreational gear might lead to hooking and escape of animals. Intensity considered low as downtime at sea is low for longline crews. Mouth hooking likely to be of little consequence, but might be some internally hooked animals that later die. Confidence low due to lack of data.
	Gear loss	1	6	6	Population size	Bronze whaler shark	1.1, 1.3, 1.4	1	1	1	Loss of gear may lead to ghost fishing, as it drifts lower to the bottom, or in inshore regions, might capture sharks, such as whalers. Ghost fishing considered rare for this gear, and gear recovered if fitted with radio beacons. Confidence low due to lack of data.
	Anchoring/ mooring	1	5	5	Behavior and movement	Bronze whaler shark	6	1	1	2	Anchors sometimes attract sharks (metallic objects); sharks might remain in these areas, may bite and lose teeth altering ability to forage. Intensity negligible, as anchoring is rare and confined to shallow locations. Sharks replace teeth frequently. Confidence high due to logical consideration.
	Navigation/steaming	1	6	6	Behavior and movement	Blue sharks	6	1	1	1	Activity on the water may lead to a change in the movement patterns and/or behavior of scavenging species. The impact of this on overall movement patterns is considered negligible, Confidence low due to lack of data.
Addition/ movement of biological material	Translocation of species	1	6	6	Population size	Prey species	1.1, 1.3, 1.4	2	3	1	The ingestion of diseased imported bait may affect bycatch/ byproduct species. Intensity: minor providing bait dispersed, and AQUIS regulations are followed. Consequence: moderate impact for bycatch and byproduct species, if pathogen is spread via ingestion. Confidence low due to lack of data on possible species

Direct impact of fishing	Fishing Activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
											affected.
	On board processing	1	6	6	Behavior and movement	Blue shark	6	3	2	1	Processing of catch resulting in discarding of body parts can attract scavenging species. Processing of catch is common in the area of the fishery (moderate intensity), and the consequence is considered greatest with regard to movement and behavior, however the consequence is considered minor at most. Confidence low due to lack of data.
	Discarding catch	1	6	6	Behavior and movement	Blue shark	6	2	2	1	Discarding of catch can attract scavenging species. Processing of catch is common in the area of the fishery, but apparently limited volumes (minor intensity), and the consequence is considered greatest with regard to movement and behavior, however the consequence is considered minor at most. Confidence low due to lack of data.
	Stock enhancement	0									
	Provisioning	1	6	6	Behavior and movement	Blue shark	6	1	2	1	Baiting the hooks can attract species that benefit by eating the provided food. They may aggregate in the area of fishing activity, with modified behavior or movement patterns. There is a limited volume of additional food from such sources (negligible intensity), and the consequence is considered greatest with regard to movement and behavior, however the consequence is considered minor at most. Confidence low due to lack of data.
	Organic waste disposal	1	6	6	Behavior and movement	Blue shark	6	1	1	1	Organic waste disposal can attract species, however, the limited volume of additional food from such sources and the area over which a single disposal event might occur is negligible (intensity). The consequence is considered greatest with regard to movement and behavior, however the consequence is considered negligible at most. Confidence low due to lack of data, but logic also constrains the consequence score to a low value.
Addition of non-biological material	Debris	1	6	6	Population size	Any species	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 and Consequence: deemed to be negligible as loss should be accidental not intentional. Confidence low due to lack of data, so conservative score used.
	Chemical pollution	1	6	6	Population size	Any species	1.1, 1.3, 1.4	1	1	1	While the potential for chemicals to enter the environment from boats 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 for population size of any target species considered negligible. Confidence low due to lack of data.

Direct impact of fishing	Fishing Activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
	Exhaust	1	6	6	Behavior and movement	Any species	6	1	1	2	The 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. This activity is occurring over a wide area, with negligible intensity and consequence. Confidence high due to logical consideration.
	Gear loss	1	6	6	Behavior and movement	Mahi mahi (dolphin fish)	6	1	1	1	Gear that is lost may eventually settle on substrate, however lost gear may act as FADs to bycatch/byproduct species if it floats at the surface. Most gear that remains floating is light sticks and perhaps balls of lost line. While gear loss may potentially occur over a wide geographic area, the actual volume of material lost, while unknown, is not believed to be large. Aggregation around lost material, a change in behavior by aggregating species, was considered a greater consequence (but still negligible) than changes to population size through availability of new structure, or loss of natural. Confidence low due to lack of data.
	Navigation/ steaming	1	6	6	Behavior and movement	Any species	6	1	1	2	Introduction of light, noise by vessels considered negligible consequence for any bycatch or byproduct species. Confidence high due to logical consideration.
	Activity/ presence on water	1	6	6	Behavior and movement	Any species	6	1	1	2	Vessels do attract animals, but effects on the behavior and movement (worst case) considered negligible. Confidence high due to logical consideration.
Disturb physical processes	Bait collection	1	4	5	Behavior and movement	Inshore species	6	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 and Consequence considered negligible. Confidence low due to lack of data.
	Fishing	1	6	6	Behavior and movement	Offshore species	6	1	1	1	This fishery 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 non target species Confidence: recorded as low because of insufficient knowledge for this fishery
	Boat launching	0									
	Anchoring/ mooring	1	5	5	Behavior and movement	Inshore species	6	1	1	2	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, constrained by logic.

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	Behavior and movement	Any species	6	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 was scored as high because it was considered unlikely for there to be strong interactions between Navigation/steaming, physical processes and non target species, constrained by logic
External Impacts (specify the particular example within each activity area)	Other fisheries	1	5	6	Population size	Blue shark	1.1, 1.3, 1.4	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 re mixing between Pacific Ocean and Australian EEZ, and re stock assessments these catches may affect domestic fishery, and domestic catches can affect these stocks (links). Intensity: could have measurable major impact both direct and indirect on non-target species once linkages understood. Consequence: cumulative effects could be major and affect population size of non-target species. Confidence: Until there is better information difficult to score therefore low confidence.
	Aquaculture	0									
	Coastal development	0									
	Other extractive activities	1	5	6	Behavior and movement	Porbeagle Shark	6	1	1	1	Fishery covers a large spatial area and occurs through out the year. Oil and gas industry off eastern Victoria. May be pollution from petrochemical industry in both shallow and deep water. 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 and not affect behavior of non target species. Confidence: Until there is better information difficult to score, therefore low confidence.
	Other non-extractive activities	1	6	6	Behavior and movement	Tiger shark	6	1	1	1	Fishery covers a large spatial area and occurs through out 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: Until there is better information difficult to score therefore low confidence.
	Other anthropogenic activities	1	4	5	Behavior and movement	Any species that is at surface, such as moonfish	6	1	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

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
											effects expected to be negligible. Confidence: Until there is better information difficult to score therefore low confidence.

2.3.1 Level 1 (SICA) Document L1.3 - TEP 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	Little penguin, shearwaters	1.1, 1.3, 1.4	1	2	1	Bait collection is permitted for own use in fishing for scheduled species. Purse seine, may occur at night. Little penguins may become entrapped in purse seine nets if fishing close to coast. Use of lights at night may attract shearwaters, which can collide with vessel structures. Intensity: negligible because current live bait catch is relatively low, and purse seine shots are quick so time for other TEP species such as sygnathids to aggregate on gear is short. However need to monitor risks to species if collection of live bait increases. Consequence: considered minor because scale and intensity currently low. Level of bait catch it is unlikely to impact TEP species in terms population size, unless substantial removal of prey species targeted as bait (i.e. pilchards and Little penguins) Confidence recorded as low because of insufficient knowledge on live bait fish distribution, and capture.
	Fishing	1	6	6	Population size/Interactions with fishery	Wandering Albatross, Flesh footed shearwater(turtles)	1.1, 1.3, 1.4, 7.1, 7.2	3	5	2	ETBF fishing occurs throughout year & covers a large area, pelagic longlining poses greatest threat to seabirds. The extent of mortality is generally poorly reported, and AFMA observer actual coverage of the ETBF for 2003-04 was 3.5%, which differed from intended coverage (Lynch 2004). Species like Wandering albatross, with <12 breeding pairs in Australian waters, are particularly vulnerable to fishing, where capture of 1 individual will impact on the species population size. Although trends in capture are reducing for Albatross generally, Flesh footed shearwaters are being caught at levels which may be unsustainable, partly due to their ability to dive to baits which makes mitigation for these species awkward, & fishing occurring within the proximity to Lord Howe breeding grounds (Baker 2002). TAP and Bycatch action plan address bycatch issues, many of which are now managed through a suite of compulsory and voluntary mitigation measures (See Scoping for specifics).
	Incidental behaviour	1	4	5	Behavior and movement	Seals	6.1	2	1	1	Offshore, during discarding or recovery of gear, seals may be attracted to boat and Fishing operations, rarely take caught fish from hooks. Intensity: occurs infrequently in space and time. Consequence: potential injury to seals, but of a negligible consequence over the scale of the fishery. Confidence recorded as low at this stage as record of interactions are poorly recorded.

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	Little penguin	1.1, 1.3, 1.4, 7.1, 7.2	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 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: considered 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 Little penguins. Confidence recorded as low because of insufficient knowledge on trophic relationships.
	Fishing	1	6	6	Population size/Interaction with fishery	Wandering Albatross, Flesh footed shearwater	1.1, 1.3, 1.4, 7.1, 7.2	3	5	2	Fishing occurs throughout year in the ETBF and covers a large area. Interactions referred to in observer records as 'light' or 'heavy' contact with the boat superstructure or gear do not identify resulting injury to species (Lynch 2004). The post interaction effect on seabirds is unclear, however it is likely that 'heavy' 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. TAP and Bycatch action plan address bycatch issues, many of which are now being managed, through a suite of compulsory and voluntary mitigation measures (See Scoping for specifics). Intensity: moderate over the spatial scale of the fishery. Consequence: severe for Wanderers which reach reproductive maturity at 7-16 years, delaying recovery of species. Likely to be (3) for shearwaters because recent reports of interactions are substantial.
	Incidental behaviour	1	6	5	Behavior and movement	Seals	6.1	2	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: minor because recreational activities are limited and such interactions a rare part of these. Consequence: Assumed minor with regard to population size of the TEP species in question (precautionary scoring). Confidence recorded as low due to lack of data.
	Gear loss	1	6	6	Population size	Leatherback turtle	1.1, 1.3, 1.4	2	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. TEP species may be entangled or caught as gear drifts. Lost gear tends to ball up reducing likelihood of entanglement. Intensity: considered minor because only occurs occasionally, gear is recovered whenever possible. Consequence: minor because although it can continue to fish/entangle, it soon forms a ball. Confidence was scored as low because data on interactions is

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
											rare, and experts disagree.
	Anchoring/ mooring	1	5	5	Behavior and movement	Sygnathids	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: low likelihood of direct interaction with anchoring/ mooring lines. Consequence: low. Confidence: high, logical consideration of interactions.
	Navigation/steaming	1	6	6	Behavior and movement	Whales	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 TEP species unlikely. Confidence was scored as high due to logical consideration.
Addition/ movement of biological material	Translocation of species	1	6	6	Population size	Bottlenose dolphin	1.1, 1.3, 1.4	2	3	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. Consequence: moderate because translocation of species and transmission of disease to local bait species. This could affect population size of TEP species dependent on these as a food source. The fishery is offshore where contact with local bait species is reduced. Confidence was scored as low because of a lack of data and understanding of pathogens and marine diseases
	On board processing	1	6	6	Behavior and movement	Great Winged Petrel	6.1	3	3	1	On board processing occurs. TAP regulations prohibit discharge of offal during line setting or hauling to reduce attractiveness to seabirds. Great winged petrel most common species chasing or diving for baits (Lynch 2004). Intensity moderate; waste expected to be taken up quickly by opportunistic scavengers or sink to benthos and be scavenged by benthic species. TEP species in the area might also scavenge and change behavior, increasing opportunity of harmful interactions. Boat-following behaviors are common. Consequence: moderate as unlikely to affect behaviour movement of TEP species for more than a few days while boats in the area. Confidence was scored as low due to uncertainty about the volume of on board processing and the time birds spend around vessels.
	Discarding catch	1	6	6	Behavior and movement	Great Winged Petrel	6.1	3	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, & bycatch species occurs. Intensity: moderate. Consequence: moderate as behaviour movement of TEP species modified only while vessels in the area and waste expected to be taken up quickly by opportunistic scavengers or sink to benthos baits (Lynch 2004). Confidence was scored as low because of a lack of data on effects of discarding on

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
											TEPS.
	Stock enhancement	0									
	Provisioning	1	6	6	Behavior and movement	Killer whale	6.1	2	2	1	Toothed cetaceans (whales and dolphins) swim along lines and pick off tuna; this behavior can result in fishers moving to a new area. Intensity can be locally important, but minor overall. The consequence on behavior and movement is temporary, although some areas appear to have animals that do this a lot. Confidence was scored as low because of a lack of verified observer data.
	Organic waste disposal	1	6	6	Behavior and movement	Fleshy footed shearwater	6.1	1	2	2	Fishing activity occurs throughout the year in the ETBF. Domestic boats are generally at sea for 3-7 days some spend 7-20 days at sea. 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 TEP species. Seabirds were chosen because they were considered to be readily attracted toward fishing vessels dispensing organic waste. Boats subject to MARPOL. Intensity was scored as negligible because there was remote likelihood of seabirds being adversely affected (aggregation during feeding frenzy a natural process). Organic waste disposal in its own right was considered to have minimal consequence on seabirds, however, it was considered that disposal of organic waste is likely to increase chances of other negative interactions e.g. collision or entanglement. Confidence in the consequence score was high because organic waste disposal considered unlikely to have detectable impacts on seabirds.
Addition of non-biological material	Debris	1	6	6	Population size	All Turtles, seabirds	1.1, 1.3, 1.4	2	2	2	Addition of debris by this fishery expected to be accidental not routine. Boats subject to MARPOL rules. Although discarding of insubstantial bits of plastic suggest diligence required. Plastics bits consumed by turtles and seabirds can cause intestinal obstruction, transfer to chicks, 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. Consequence: minor against background of other impacts, detectable only on autopsy, but well documented. Confidence. High confidence of ingestion, origin of material uncertain..

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	All Turtles	1.1, 1.3, 1.4	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 up to 20 days and maintenance is required. TEP species unlikely to be affected unless 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. Consequence: considered negligible due to dilution and mixing of materials. Confidence: Limited domestic observer data indicated crews diligent waste therefore high confidence
	Exhaust	1	6	6	Population size	Fleshy-footed shearwater	1.1, 1.3, 1.4	1	1	2	Exhaust from running engine hazard occurs over a large range/scale. Air quality most likely affected, which may affect the behavior and movement. Intensity: negligible because exhaust considered low impact to TEP species i.e. not physically affected, unlikely to be measurable, effects more likely to be short term and effect air quality, but they still hang around. Consequence: considered negligible because species unlikely to avoid fumes so unlikely to affect behaviour and movement of target species. Confidence: considered high because exhaust unlikely to impact on behaviour/movement of TEP species
	Gear loss	1	6	6	Population size	Leatherback turtle	1.1, 1.3, 1.4	2	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. TEP species may be entangled or caught as gear drifts. Lost gear tends to ball up reducing likelihood of entanglement. Intensity: considered minor because only occurs occasionally, gear is recovered whenever possible. Consequence: minor because although it can continue to fish/entangle, it soon forms a ball. Confidence was scored as low because data on interactions is rare, and experts disagree.
	Navigation/ steaming	1	6	6	Behavior and movement	Fleshy-footed shearwater	6.1	2	2	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: minor, because type of impact on behaviour and movement of species may lead to a temporary move to/away at the time but no change to long-term patterns. Consequence: minor impacts on behavior and movement. Confidence: low, due to lack of information.

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	Behavior and movement	Fleshy-footed shearwater	6.1	3	2	1	The environment will be impacted by noise and visual stimuli which does affect behavior and movement. Intensity: moderate impact on behaviour and movement of TEP species due to scale of fishing. Consequence: Behavior modified only for hours while vessels present, animals disperse each night, may visit same area next day and then move on. Confidence: no good data on time of perturbed behavior, conservatively scored as a result.
Disturb physical processes	Bait collection	1	4	5	Behavior and movement	Little penguin	6.1	2	2	1	Disturbance of the sediments might lead to temporary reduction in visibility that impacts the feeding behavior (reduced efficiency), prey detection by penguins. Consequence; minor. Confidence: low, insufficient knowledge on live bait fish distribution, and capture, and possible effects on the physical processes
	Fishing	1	6	6	Behavior and movement	Turtles	6.1	1	1	2	This fishery a pelagic fishery using longlines. 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, no changes to physical processes Confidence: high; logical consideration.
	Boat launching	0									
	Anchoring/ mooring	1	5	5	Behavior and movement	Syganthids	6.1	1	1	2	Longline vessels rarely anchor or moor in anchorages. Intensity: Expected to be negligible. Intensity likely to be related to time at sea. However unlikely to directly effect TEP species but may effect benthic processes which may indirectly effect TEP species Consequence: negligible. Confidence: high; logical consideration
	Navigation/steaming	1	6	6	Behavior and movement	Whales	6.1	2	1	2	Navigation/ steaming occurs throughout the year over the entire fishery. Intensity: minor, 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 no impact on physical processes that might affect conditions that then change behaviour or movement of TEP species. Confidence: high, logical consideration.
External Impacts (specify the particular example within each activity area)	Other fisheries	1	5	6	Population size	Turtles, Seabirds, Mammals	1.1, 1.3, 1.4	4	4	1	Other fisheries operate in the same region, e.g. SBT, SPF, SKJ, WCPO Tuna fisheries, recreational fisheries NSW. Some TEP species are migratory and interact with international fishing operations in Pacific ocean. Uncertainties re mixing between offshore and the Australian fishery area. Intensity: major, these TEP species are captured over broad spatial scales. Consequence: cumulative effects could be major and affect population size, populations currently declining. Confidence: low, not clear where main consequence is expressed.
	Aquaculture	0									

Direct impact of fishing	Fishing Activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
	Coastal development	0									
	Other extractive activities	1	5	6	Behavior and movement	Seabirds/Whales	6.1	2	2	1	Oil and gas industry in Bass Strait and East coast of Victoria. May be pollution from petrochemical industry in both shallow and deep water Noise and visual stimuli as a part of operations may affect migratory species. Intensity: minor with regard to TEP species, but linkages need to be better understood. Consequence: cumulative effects expected to be minor and not affect population size or behaviour or movement of TEP species Confidence: Until there is better information difficult score therefore low confidence.
	Other non-extractive activities	1	6	6	Population size	Whales	1.1, 1.3, 1.4	3	2	1	Fishery covers a large spatial area and occurs through out the year. Lots of other shipping activities in the area, boat propellers, collisions could surfacing whales. Intensity: moderate due to scale of shipping. Consequence: effects expected to be minor and not affect population size of TEP species. Confidence: Until there is better information difficult to score therefore low confidence.
	Other anthropogenic activities	1	4	5	Behavior and movement	whales	6.1	2	2	1	Species may be disturbed by tourism (e.g. whale watching) charter boats, as collisions are reported. Intensity: minor Consequence: minor. Confidence: Low confidence due to lack of information

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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	Eastern coastal pelagic; fine sediments, wave rippled, large sponges, inner-shelf	5.1	2	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. Maybe some mixing of water; benthic habitats unlikely to be disturbed in the process. Intensity: minor; restricted locations. 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.
	Fishing	1	6	6	Habitat Structure	Eastern oceanic (1) pelagic; Eastern oceanic (1) seamount	5.1	1	1	2	Pelagic habitat, mixing of water may occur during fishing. Intensity: negligible, 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.
	Incidental behaviour	1	4	5	Water Quality	Eastern oceanic (1) pelagic; Eastern oceanic (1) seamount	2.1	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. Consequence: minor as a conservative score. Confidence: high given logic based on the scale and intensity of these activities.
Direct impact without capture	Bait collection	1	4	5	Habitat Structure	Eastern coastal pelagic	5.1	2	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: minor; 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	6	6	Habitat Structure	Eastern oceanic (1) pelagic; Eastern	5.1	1	1	2	Pelagic habitat, mixing of water may occur during fishing. Intensity: negligible, 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.

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
						oceanic (1) seamount					
	Incidental behaviour	1	6	5	Water Quality	Eastern oceanic (1) pelagic; Eastern oceanic (1) seamount	2.1	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. 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	Eastern oceanic (1) seamount	5.1	2	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 can litter benthic habitats. Intensity: minor; rare in space and time. Consequence: minor; some benthic habitats may be damaged by gear if it attaches to reefs or sponge gardens, however, while gear is floating it is modifying the pelagos, hence this scenario considered worst. Confidence: low because of a lack of data on extent of gear loss and breakdown times.
	Anchoring/ mooring	1	5	5	Habitat Structure	fine sediments, wave rippled, large sponges, inner-shelf	5.1	2	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: scored as minor as anchoring/mooring is not daily, and more likely to occur on soft bottom. Consequence: also scored as minor as anchoring considered to affect only a very small percentage of the area of the habitat. Confidence: was recorded as 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 oceanic (1) pelagic; Eastern oceanic (1) seamount	2.1	2	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: minor. 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.
Addition/ movement of biological material	Translocation of species	1	6	6	Water quality	Eastern oceanic (1) pelagic; Eastern	2.1	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

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
						oceanic (1) seamount					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 oceanic (1) pelagic; Eastern oceanic (1) seamount	2.1	1	1	2	On board processing occurs. Intensity: negligible impacts expected because 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. Consequence: negligible Unlikely to impact habitats because of scavenging. Confidence: high, expert consensus.
	Discarding catch	1	6	6	Water quality	Eastern oceanic (1) pelagic; Eastern oceanic (1) seamount	2.1	1	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: negligible 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 oceanic (1) pelagic; Eastern oceanic (1) seamount	2.1	1	1	2	Provisioning occurs through use bait and discarding. Shark and cetacean predation on longline fish relatively common. Intensity: negligible impacts expected 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. Consequence: negligible. Confidence: high, expert consensus.
	Organic waste disposal	1	6	6	Water quality	Eastern oceanic (1) pelagic; Eastern oceanic (1) seamount	2.1	1	1	2	Domestic boasts commonly spend 3-7 days at sea and up to 7-20 days at sea. Boats subject to MARPOL rules. Intensity: negligible if MARPOL rules adhered to. Consequence: negligible because organic waste likely to be scavenged or break down quickly so unlikely to affect habitats Confidence: Limited domestic observer data indicated crews diligent re waste, so high confidence
Addition of non-biological material	Debris	1	6	6	Habitat Structure	Eastern oceanic (1) pelagic; Eastern	5.1	1	1	2	Plastics may be an issue and are the most common debris item. Light sticks maybe litter issue. Boats subject to MARPOL regulations. Intensity: negligible if MARPOL rules adhered to. Consequence: negligible because debris by this fishery expected to be accidental not routine Confidence: Limited domestic observer data

Direct impact of fishing	Fishing Activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
						oceanic (1) seamount					indicated crews diligent re waste therefore high confidence
	Chemical pollution	1	6	6	Water quality	Eastern oceanic (1) pelagic; Eastern oceanic (1) seamount	2.1	2	2	2	Chemicals and light sticks used during fishing activities may be an issue as boats maybe out at sea up to 20 days. Habitats unlikely to be affected unless a major spill, but localized impact may resolve over natural mixing scale. Boats subject to MARPOL rules Intensity: minor if MARPOL rules adhered to. Consequence: minor because chemical pollution impacts expected to be minimal and therefore unlikely to directly affect habitats. Confidence: Limited domestic observer data indicated crews diligent waste therefore high confidence
	Exhaust	1	6	6	Air Quality	Eastern oceanic (1) pelagic; Eastern oceanic (1) seamount	3.1	1	1	2	Exhaust from running engine hazard occurs over a large range/scale. Intensity: negligible over broad spatial and temporal scales. Consequence: considered negligible because air quality likely to reestablish over very short time scales. Confidence: considered high because exhaust unlikely to impact air quality due to intensity and mixing of air column.
	Gear loss	1	6	6	Habitat Structure	Eastern oceanic (1) pelagic; Eastern oceanic (1) seamount	5.1	2	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: minor, because some benthic habitats may be damaged by gear if it attaches to reefs or sponge gardens. Consequence: conservatively scored as 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. Confidence: low because of a lack of data on extent of gear loss and breakdown times
	Navigation/ steaming	1	6	6	Air Quality, Water quality	Eastern oceanic (1) pelagic; Eastern oceanic (1) seamount	3.1, 2.1	3	1	2	Navigation/ steaming occurs throughout the year over the entire fishery. Intensity: moderate at broad spatial scale. Consequence: negligible because unlikely to affect water or air quality for a period of more than hours. Confidence: high logical consideration
	Activity/ presence on water	1	6	6	Air Quality	Eastern oceanic (1)	3.1	3	1	2	The environment will be impacted by noise and visual stimuli temporarily Intensity: moderate, vessels common over broad scale. Consequence: negligible

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
						pelagic; Eastern oceanic (1) seamount					because unlikely to impact habitats Confidence: high logical consideration
Disturb physical processes	Bait collection	1	4	5	Habitat Structure	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
	Fishing	1	6	6	Habitat Structure	Eastern oceanic (1) pelagic; Eastern oceanic (1) seamount	5.1	1	1	2	This fishery is a pelagic fishery using longlines which do not contact the benthos, and have little detectible 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: considered to have remote impact on physical processes that might change habitats. Confidence: high, logical constraints
	Boat launching	0									
	Anchoring/ mooring	1	5	5	Substrate quality	fine sediments, wave rippled, large sponges, inner-shelf	1.1	2	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: scored as minor as anchoring/mooring is not daily, and most likely to occur over 'soft' bottom, recovery would be likely to occur within hours to days. Consequence: minor as anchoring considered to affect only a very small percentage of the area of the habitat. Confidence: 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	Air Quality, Water quality	Eastern oceanic (1) pelagic; Eastern oceanic (1) seamount	3.1, 2.1	3	1	2	Navigation/ steaming occurs throughout the year over the entire fishery. Intensity: moderate at broad spatial scale. Consequence: negligible because unlikely to affect water or air quality for a period of more than hours. Confidence: high logical consideration

Direct impact of fishing	Fishing Activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
External Impacts (specify the particular example within each activity area)	Other fisheries	1	5	6	Habitat Structure	Eastern oceanic (1) seamount	5.1	3	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. Confidence high
	Aquaculture	0									
	Coastal development	0									
	Other extractive activities	1	5	6	Habitat Structure	Eastern oceanic (1) pelagic	5.1	2	3	1	Activities such as oil drilling and cable laying may have impact that exceeds fishing. Confidence is low.
	Other non-extractive activities	1	6	6	Habitat Structure	Eastern oceanic (1) pelagic; Eastern oceanic (1) seamount	5.1	3	2	1	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. The confidence is low due to lack of information.
	Other anthropogenic activities	1	4	5	Habitat Structure	Inner shelf benthic habitats	5.1	2	1	1	The fishery takes place offshore, away from the tourism and recreational activities associated with tourism. Consequence scored as minor at best, due in part to the low confidence due to lack of data.

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

Direct impact of fishing	Fishing Activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
Capture	Bait collection	1	4	5	Species composition	Central Eastern Province outer shelf	4.1	2	2	1	Bait collection (28% bait caught; Lynch, 2004) 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: minor because current live bait catch is low impact, unlikely to be detectable against background variability. Consequence: minor, unlikely to impact species composition more than 5%. 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 (1) pelagic; Eastern oceanic (1) seamount	4.1	4	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 has grown rapidly in recent years, although there is evidence of declining relative CPUE indices (Campbell, 2005). This level of fishing may affect the state of some communities, including seamounts. The intensity of fishing over some seamount communities appears to be relatively high (GIS and logbook analysis). Consequence: considered 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: is low as the information collection system is in development stage and is currently considered inadequate for the scale of the fishery. No community studies with information at this stage.
	Incidental behaviour	1	4	5	Species composition	Central Eastern Province outer shelf	4.1	1	1	1	Offshore fishery unlikely that activities might impact communities. Intensity: at this stage assumed negligible. Consequence: negligible at this stage assumed unlikely to affect communities. Confidence: low at this stage as the information collection system is in the development stage. To be reviewed once results of the Data Collection Programme and Observer Programme are completed.
Direct impact without capture	Bait collection	1	4	5	Species composition	Central Eastern Province outer shelf	4.1	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. Much 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.

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
											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 (1) pelagic; Eastern oceanic (1) seamount	4.1	2	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: considered minor because of the intensity and spatial scale of the fishery. Need to establish this level of catch is sustainable so that communities are not affected over time. Confidence: low due to insufficient data and conflicting opinion.
	Incidental behaviour	1	6	5	Species composition	Central Eastern Province outer shelf	4.1	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.
	Gear loss	1	6	6	Species composition	Central Eastern Province outer shelf	4.1	1	2	1	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 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	1	Longline vessels rarely anchor or moor in anchorages. If occurs 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 scored high because activity itself is unlikely, and consensus opinion.
	Navigation/ steaming	1	6	6	Species composition	Eastern oceanic (1) pelagic; Eastern oceanic (1) seamount	3.1	2	2	2	Navigation/steaming occurs throughout the year over the entire fishery, including seamounts. Intensity: minor impact, may lead to some animals following the vessel, changing the distribution of those animals. Consequence: minor impact on communities. Confidence: high because it was considered unlikely for there to be strong interactions between navigation/steaming and communities given expert opinion.

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 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: considered minor. Consequence: considered 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 (1) pelagic; Eastern oceanic (1) seamount	3.1	2	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 (1) pelagic; Eastern oceanic (1) seamount	3.1	1	1	1	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: low because of a lack of verified observer data.
	Stock enhancement	0									
	Provisioning	1	6	6	Distribution of community	Eastern oceanic (1) pelagic Eastern oceanic (1) seamount	3.1	3	1	1	Provisioning occurs through use of bait and discarding. Intensity: moderate, occurs for every shot. 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 (1) pelagic; Eastern oceanic (1) seamount	3.1	1	1	2	Boats subject to MARPOL rules Intensity: negligible if MARPOL rules followed. Consequence: negligible because organic waste likely to be scavenged or break down quickly. Confidence: Limited domestic observer data indicated crews diligent re waste, therefore high confidence
Addition of non-biological material	Debris	1	6	6	Species composition	Eastern oceanic (1) pelagic; Eastern	1.1	1	1	2	Plastics may be an issue, entanglement, ingestion, litter, however vessels are subject to MARPOL regulations. Intensity: negligible if MARPOL rules 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

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
						oceanic (1) seamount					be accidental not routine. Confidence: high confidence- domestic observer data indicated crews are diligent re waste.
	Chemical pollution	1	6	6	Species composition	Eastern oceanic (1) pelagic; Eastern oceanic (1) seamount	3.1	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 20 days. Communities unlikely to be affected unless a major spill, but localized impact as small vessels. Boats subject to MARPOL rules. Intensity: negligible if MARPOL rules followed. Consequence: negligible because chemical pollution impacts expected to be minimal and therefore unlikely to directly impact communities. Confidence: Limited domestic observer data indicated crews are diligent with regard to waste therefore high confidence that minimum sticks lost.
	Exhaust	1	6	6	Distribution of community	Eastern oceanic (1) pelagic; Eastern oceanic (1) 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 effect air quality. Consequence: considered negligible because distribution communities not likely to be affected. Confidence: high, logical consensus.
	Gear loss	1	6	6	Distribution of community	Eastern oceanic (1) pelagic; Eastern oceanic (1) 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.
	Navigation/ steaming	1	6	6	Distribution of community	Eastern oceanic (1) pelagic; Eastern oceanic (1) seamount	3.1	3	2	1	Navigation/steaming is a large component of the operations Intensity: moderate, occurs frequently in all locations. Consequence: minor, seabirds do follow boats, but changes not persistent beyond a day. Confidence: low, limited data.
	Activity/ presence on water	1	6	6	Distribution of community	Eastern oceanic (1) pelagic; Eastern oceanic (1) seamount	3.1	3	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.

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	Distribution of community	Central Eastern Province outer shelf	1.1	2	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. This is precautionary scoring as confidence is 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 (1) pelagic; Eastern oceanic (1) 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.
	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 (1) pelagic; Eastern oceanic (1) 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 (specify the particular example within each activity area)	Other fisheries ;Southern Bluefin Tuna Fishery (SBT), Small Pelagics Fishery (SPF), SESSF, Skipjack Fishery (SKJ).	1	5	6	Trophic size structure	Eastern oceanic (1) pelagic; Eastern oceanic (1) seamount	4.1	3	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 re mixing between Pacific Ocean and Australian EEZ, and re stock assessments these catches may affect domestic fishery, and domestic catches can affect these stocks (links). Intensity: moderate could have measurable major impact both direct and indirect on communities once linkages understood Consequence: moderate cumulative effects could be major and affect many communities. Confidence: Until there is better information difficult score therefore low confidence.
	Aquaculture	0									
	Coastal development	0									

Direct impact of fishing	Fishing Activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
	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 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: Until there is better information difficult to score therefore low confidence.
	Other non-extractive activities	1	6	6	Distribution of community	Eastern coastal pelagic	3.1	3	2	1	Shipping and other similar activities not believed to play an important role in this offshore area. Moderate intensity, as shipping lanes are important in the area, but the consequence expected to be minor. Confidence: low, due to limited information for the group to consider.
	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 through out 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: Until there is better information difficult score therefore low confidence.

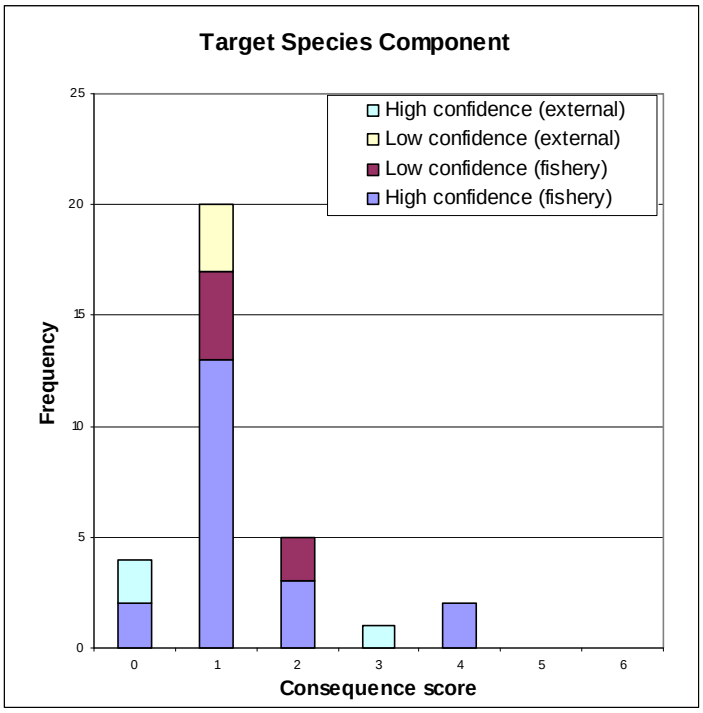
2.3.11 Summary of SICA results

The report provides 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).

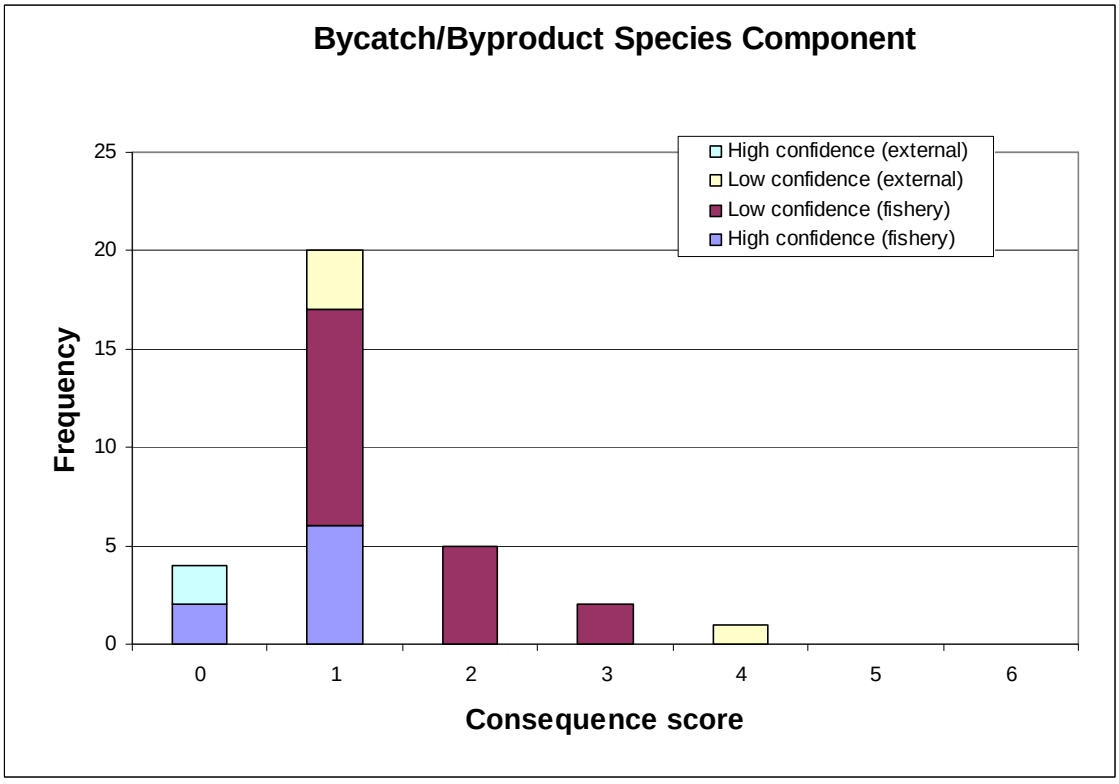
Level 1 (SICA) Document L1.6. Summary table of consequence scores for all activity/component combinations.

Direct impact	Activity	Target species	Byproduct & bycatch species	TEP species	Habitats	Communities
Capture	Bait collection	2	2	2	2	2
	Fishing	**4**	3	**5**	1	3
	Incidental behaviour	1	1	1	2	1
Direct impact without capture	Bait collection	2	1	1	2	2
	Fishing	1	2	**5**	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	4	3	3	2	4
	On board processing	1	2	3	1	1
	Discarding catch	1	2	3	1	1
	Stock enhancement					
	Provisioning	1	2	2	1	1
	Organic waste disposal	1	1	2	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	2	1	2
	Activity/ presence on water	1	1	2	1	2
Disturb physical processes	Bait collection	2	1	2	1	2
	Fishing	1	1	1	1	1
	Boat launching					
	Anchoring/ mooring	1	1	1	2	1
	Navigation/steaming	1	1	1	1	1
Note: external hazards are not considered at Level 2 in the PSA analysis						
External Impacts (specify the particular example within each activity area)	Other fisheries	**3**	4	4	1	3
	Aquaculture					
	Coastal development					
	Other extractive activities	1	1	2	**3**	1
	Other non-extractive activities	1	1	2	2	2
	Other anthropogenic activities	1	1	2	1	2

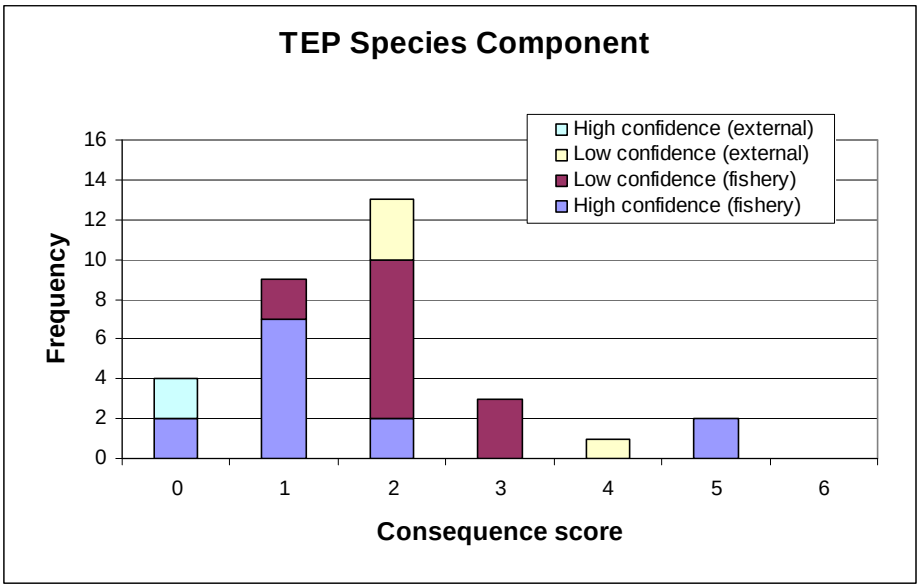
Target species: Frequency of consequence score differentiated between high and low confidence.



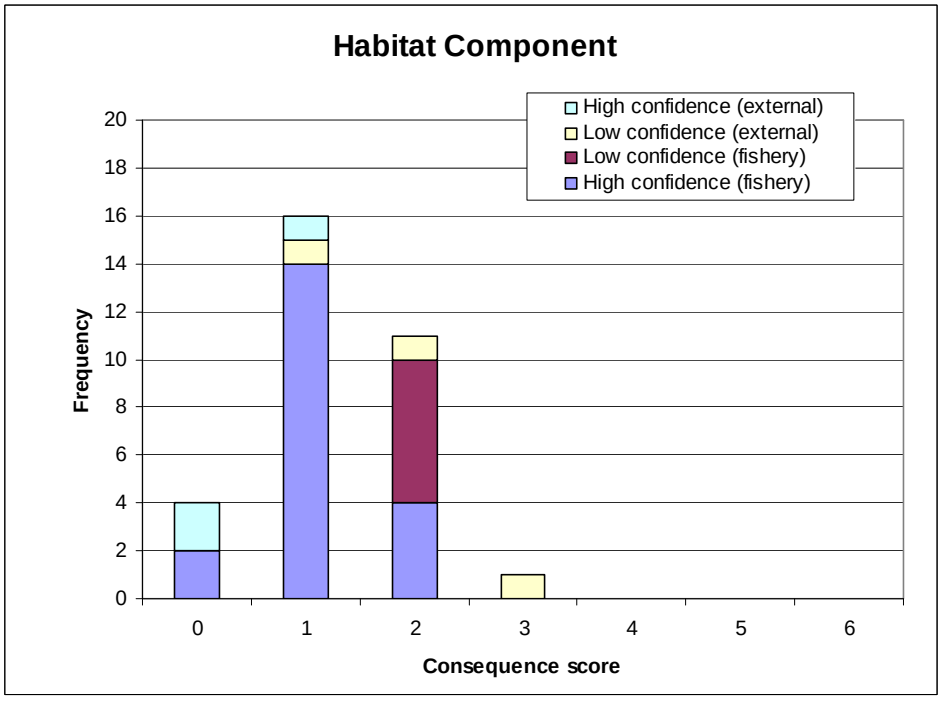
Byproduct and bycatch species: Frequency of consequence score differentiated between high and low confidence



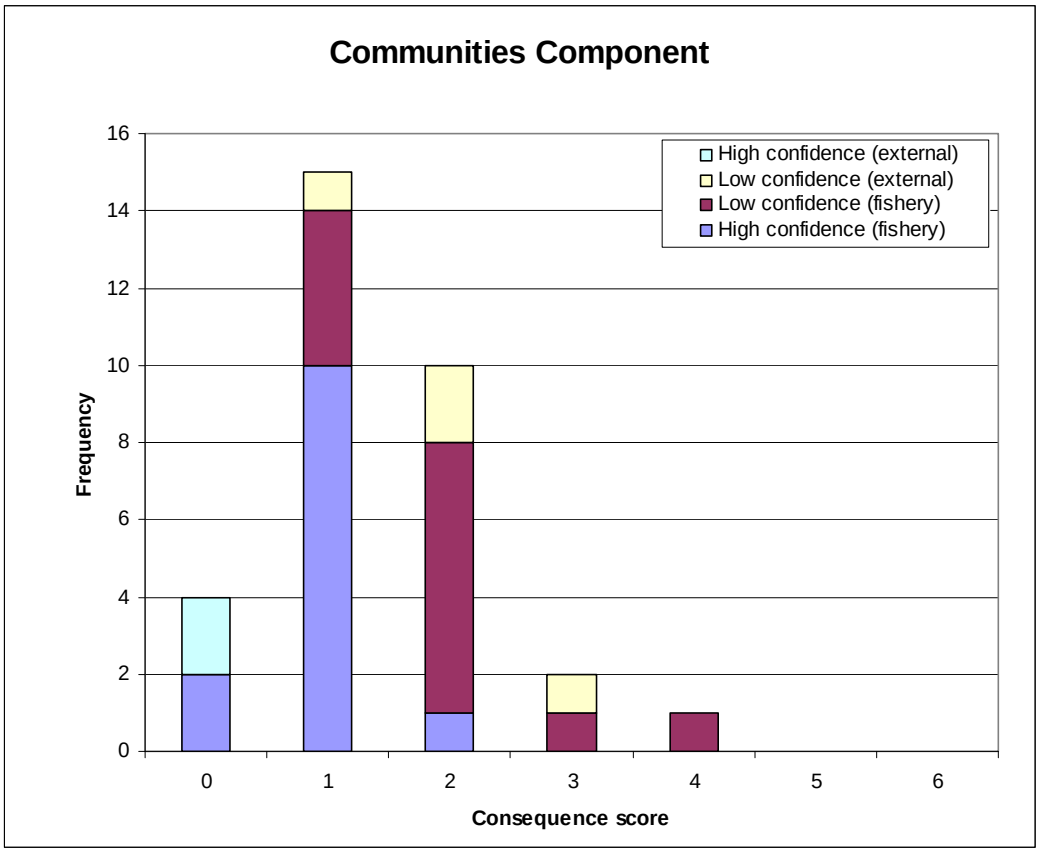
TEP species: Frequency of consequence score differentiated between high and low confidence (SICA excel workbook)



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



Communities: Frequency of consequence score differentiated between high and low confidence (SICA excel workbook)



2.3.12 Evaluation/discussion of Level 1

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

- Fishing (direct impacts on all ecological components except habitats,
- Fishing without capture (direct impact on TEP species),
- Translocation of species (impact on all components except habitats)
- On board processing (impact on TEP species), and
- Discarding catch (impact on TEP species).

The direct impacts of fishing hazard was scored as moderate for bycatch and communities components, major for the Target component, and severe for the TEP component. Confidence scoring was high for Target and TEP components, but low for the Bycatch and Communities.

Risks to species Components, from Translocation, On-board processing and Discarding, were all assessed with low confidence scores. Translocation was considered to be a major risk (4) to both Target and Communities components.

Documented CPUE declines for the target species “swordfish” formed the basis of the high confidence major risk scoring for the Target Species component. Observer data and anecdotal evidence for seabird interactions with the ETBF activities are noted as the

dominant factors in the severe risk high confidence scoring for the TEP component, for both fishing with and without capture.

Translocation of species was assessed as a moderate risk to bycatch and TEP components, but as a major risk to Target and Communities components, due to the potential for the introduction of pathogens through the use of imported baits. Evidence from other fishery areas has previously shown the consequence of this hazard.

2.3.13 Components to be examined at Level 2

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

- Target
- Bycatch/Byproduct
- TEP, and
- Communities.

The SICA has removed the Habitat components from further analysis, as this component was judged to be impacted with low consequence by the set of activities considered.

2.4 Level 2 Productivity and Susceptibility Analysis (PSA)

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

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

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

Species

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

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

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

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

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

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

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

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

Habitats

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

Aspect	Attribute	Concept	Rationale
Susceptability			
Availability	General depth range (Biome)	Spatial overlap of subfishery with habitat defined at biomic scale	Habitat occurs within the management area
Encounterability	Depth zone and feature type	Habitat encountered at the depth and location at which fishing activity occurs	Fishing takes place where habitat occurs

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

Communities

PSA methods for communities are still under development. Consequently, it has not yet been possible to undertake Level 2 risk analyses for communities.

During the Level 2 assessment, each unit of analysis within the ecological component (species, habitat, or community) is scored for risk with regard to attributes in these two classes and the output graphed to produce a PSA plot (**Figure 13**).

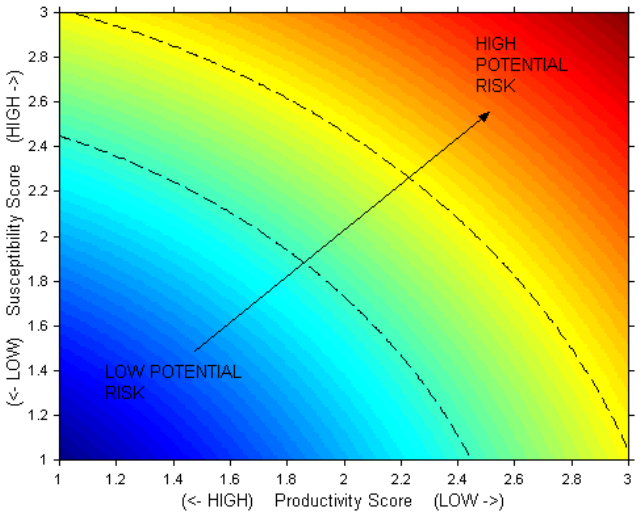


Figure 13. The axes on which risk of the ecological units is plotted. The *x*-axis includes attributes that influence the productivity of a unit, or its ability to recover after impact from fishing. The *y*-axis includes attributes that influence the susceptibility of the unit to impacts from fishing. The combination of susceptibility and productivity determines the relative risk to a unit, i.e. units with high susceptibility and low productivity are at highest risk, while units with low susceptibility and high productivity are at lowest risk. The contour lines divide regions of equal risk and group units of similar risk level.

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

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

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

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

The following taxa appear in catch records, logbooks and observer reports. They were excluded from the PSA because they are not identified at the species level. In all cases, a species within these taxa is included in the PSA.

ERA species ID	Taxa	Scientific name	CAAB code	Family name	Common name	Explanation for why taxa excluded
58	Chondrichthyan	Hexanchidae - undifferentiated	37005000	Hexanchidae	Seven gilled shark	group code
1762	Teleost	Bramidae - undifferentiated	37342000	Bramidae	pomfrets	group code
1764	Teleost	Tetraodontidae - undifferentiated	37467000	Tetraodontidae	toadfishes	group code
2066	Teleost	Alepisauridae - undifferentiated	37128000	Alepisauridae	lancetfishes	group code
2076	Teleost	Exocoetidae - undifferentiated	37233000	Exocoetidae	flyingfishes	group code
2077	Teleost	Hemiramphidae - undifferentiated	37234000	Hemiramphidae	garfishes	group code
2093	Teleost	Apogonidae, Dinolestidae - undifferentiated	37327000	Apogonidae, Dinolestidae	cardinalfishes & long-finned pikes	group code
2094	Teleost	Carangidae - undifferentiated	37337000	Carangidae	trevallies	group code
2106	Teleost	Sphyraenidae - undifferentiated	37382000	Sphyraenidae	pikes	group code
2118	Teleost	Scombridae - undifferentiated	37441000	Scombridae	mackerels	group code
2119	Teleost	Istiophoridae - undifferentiated	37444000	Istiophoridae	marlins	group code
2128	Teleost	Molidae - undifferentiated	37470000	Molidae	ocean sunfishes	group code
2141	Teleost	Sparidae - undifferentiated	37353000	Sparidae	breams	group code
1407	Not Allocated	MIXED SPIECES	37999999		OTHER	group code
2129	Not Allocated	Cheloniidae - undifferentiated	39020000	Cheloniidae	sea turtles	group code
2277	Not Allocated	Teuthoidea	22620000		squid	group code
2278	Not Allocated	Seal	41000000		seal	group code
2045	Chondrichthyan	Rajidae - undifferentiated	37031000	Rajidae	skates	group code
2046	Chondrichthyan	Dasyatidae - undifferentiated	37035000	Dasyatidae	stingrays	group code

ERA species ID	Taxa	Scientific name	CAAB code	Family name	Common name	Explanation for why taxa excluded
1581	Marine bird	Sulidae - undifferentiated	40047000	Sulidae	gannets and boobies	group code
816	Chondrichthyan	Dasyatis violacea	37035010	Dasyatididae	Pelagic Stingray	group code
853	Chondrichthyan	Manta birostris	37041004	Myliobatidae	Manta Ray	group code
956	Chondrichthyan	Hydrolagus ogilbyi	37042001	Chimaeridae	Ogilbys Ghost Shark	group code
2051	Chondrichthyan	Callorhinchidae - undifferentiated	37043000	Callorhinchidae	elephantfishes	group code
1766	Marine bird	Diomedeidae - undifferentiated	40040000	Diomedeidae	albatrosses	group code
2047	Chondrichthyan	Myliobatidae - undifferentiated	37039000	Myliobatidae	eagle rays	group code
2048	Chondrichthyan	Rhinopteridae - undifferentiated	37040000	Rhinopteridae	cownose rays	group code
2049	Chondrichthyan	Mobulidae - undifferentiated	37041000	Mobulidae	devilrays	group code
1765	Chondrichthyan	Sharks - other	37990003	Multi-family group	Sharks (other)	group code
2145	Chondrichthyan	Skates & rays, unspecified	37990018	Multi-family group	skates and rays	group code
1998	Invertebrate	Order Teuthoidea - undifferentiated	23615000	Order Teuthoidea	squid	group code
1758	Chondrichthyan	Sphyrnidae - undifferentiated	37019000	Sphyrnidae	hammerhead sharks	group code
2035	Chondrichthyan	Alopiidae - undifferentiated	37012000	Alopiidae	thresher sharks	group code
2034	Chondrichthyan	Lamnidae - undifferentiated	37010000	Lamnidae	mackerel sharks	group code
1757	Chondrichthyan	Carcharhinidae, Hemigaleidae - undifferentiated	37018000	Carcharhinidae, Hemigaleidae	whaler and weasel sharks	group code
2042	Chondrichthyan	Squalidae - undifferentiated	37020000	Squalidae	dogfishes	group code
1690	Marine bird	Pachyptila spp.	40041000	Procellariidae	Prions	group code
1359	Chondrichthyan	Carcharhinus, Loxodon & Rhizoprionodon spp	37018901	Carcharhinidae	Blacktip sharks	group code
919	Teleost	Gadus morhua	37226790	Gadidae	Cod - unspecified	group code
624	Teleost	Luvarus imperialis	37443001	Luvaridae	Luvar	

2.4.2 and 2.4.3 Level 2 PSA (steps 2 and 3)

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

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

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

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

The PSA Tables also report on “missing information” (the number of attributes with missing data that therefore score at the highest risk level by default). There are seven attributes used to score productivity and four aspects (availability, encounterability, selectivity and post capture mortality) used to score susceptibility (though encounterability is the average of two attributes). An attribute or aspect is scored as missing if there are no data available to score it, and it has defaulted to high risk for this reason. For some species, attributes may be scored on

information from related species or other supplementary information, and even though this information is indirect and less reliable than if species specific information was available, this is not scored as a missing attribute.

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

Observer data and observer expert knowledge are important sources of information in the PSA analyses, particularly for the bycatch and TEP components. The level of observer data for this fishery is regarded as medium. An AFMA observer program has been operating since July 2003, and coverage varies depending on the fishing location. Information on target and byproduct species is well collected, and bycatch attempts are made, but may be compromised by taxonomic difficulties. Interactions with TEP species are recorded, although again, taxonomic resolution is weak for some taxa (e.g. whales and seabirds).

Summary of Species PSA results (Target, Byproduct, Bycatch, TEP)

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

Target species *Eastern Tuna and Billfish Longline Fishery*

ERA species ID	Scientific name	Common name	Average logbook catch (kg) (2001-04)	Missing > 3 attributes (Y/N)	Missing productivity attributes (out of 7)	Missing susceptibility attributes (out of 5)	Productivity (additive) (1- low, 3- high)	Susceptibility (mult) (1- low, 3- high)	2D vulnerability value (P&S) (low-high range=1.41-4.24)	Susceptibility override used?	2D P&S vulnerability category	High/Med risk category (Refer 2.4.8)	Comments
Teleost													
213	Xiphias gladius	Broad Billed Swordfish	1,971,746	N	0	0	1.86	3.00	3.53	Y	High	Spatial uncertainty	Override: availability risk increased to 3. Aggregations targeted. Expert comment Hobday
884	Tetrapturus audax	Striped marlin	627,325	N	0	1	1.86	2.33	2.98	N	Med	Spatial uncertainty	
895	Thunnus alalunga	Albacore	573,087	N	0	0	1.71	1.89	2.55	N	Low		
62	Thunnus obesus	Bigeye Tuna	934,828	N	0	0	1.71	1.89	2.55	N	Low		
212	Thunnus albacares	Yellowfin Tuna	2,635,679	N	0	0	1.57	1.89	2.46	N	Low		
1088	Trachurus declivis	Jack Mackerel	2	N	0	0	1.29	1.44	1.93	N	Low		
540	Trachurus novaezelandiae	Yellow tail scad	0	N	0	0	1.29	1.44	1.93	N	Low		
210	Scomber australasicus	Blue Mackerel	3	N	0	0	1.29	1.22	1.77	N	Low		

Byproduct species *Eastern Tuna and Billfish Longline Fishery*

ERA species ID	Scientific name	Common name	Average logbook catch (kg) (2001-04)	Missing > 3 attributes (Y/N)	Missing productivity attributes (out of 7)	Missing susceptibility attributes (out of 5)	Productivity (additive) (1- low, 3-high)	Susceptibility (mult) (1- low, 3-high)	2D vulnerability value (P&S) (low-high range=1.41-4.24)	Susceptibility override used?	2D P&S vulnerability category	High/Med risk category (Refer 2.4.8)	Comments
Chondrichthyan													
370	Isurus paucus	Longfin Mako	150	N	0	0	2.71	2.33	3.58	N	High	Spatial uncertainty	
808	Carcharhinus obscurus	Dusky Shark	3,778	N	0	0	3.00	1.67	3.43	N	High	Low overlap	
972	Lamna nasus	Porbeagle shark	1,381	N	0	0	2.71	1.67	3.19	N	High	Low overlap	
535	Carcharhinus brachyurus	Bronze Whaler	32,018	N	0	0	2.86	1.22	3.11	N	Med	Low overlap	
551	Galeocerdo cuvier	Tiger Shark	8,386	N	0	0	2.86	1.22	3.11	N	Med	Low overlap	
633	Centroscymnus plunketi	Plunket's shark	0	N	0	0	2.71	1.44	3.07	Y	Med	Low attribute score	see deepwater dogfish
1361	Centroscymnus spp.	Black Shark - (roughskin)	0	N	2	1	2.71	1.44	3.07	Y	Med	Low attribute score	see deepwater dogfish
862	Pseudocarcharias kamoharai	Crocodile Shark	0	N	2	0	2.57	1.67	3.06	N	Med	Low attribute score	
179	Alopias vulpinus	Thintail Thresher Shark, thresher shark	2,496	N	0	0	2.57	1.67	3.06	N	Med	Low overlap	
375	Alopias pelagicus	Pelagic Thresher	0	N	0	0	2.57	1.67	3.06	N	Med	Low overlap	
1039	Prionace glauca	Blue Shark	22,586	N	0	0	2.57	1.67	3.06	N	Med	Low overlap	
621	Carcharhinus falciformis	Silky Shark	244	N	0	0	2.57	1.67	3.06	N	Med	Low overlap	
469	Carcharhinus leucas	Bull Shark	90	N	0	0	2.71	1.22	2.98	N	Med	Low overlap	
880	Sphyrna lewini	Scalloped Hammerhead	13,958	N	0	0	2.71	1.22	2.98	N	Med	Low overlap	

ERA species ID	Scientific name	Common name	Average logbook catch (kg) (2001-04)	Missing > 3 attributes (Y/N)	Missing productivity attributes (out of 7)	Missing susceptibility attributes (out of 5)	Productivity (additive) (1- low, 3-high)	Susceptibility (mult) (1- low, 3-high)	2D vulnerability value (P&S) (low-high range=1.41-4.24)	Susceptibility override used?	2D P&S vulnerability category	High/Med risk category (Refer 2.4.8)	Comments
552	Sphyrna zygaena	Smooth hammerhead	38	N	0	0	2.71	1.22	2.98	Y	Med	Low overlap	Override: encounterability, mor of a benthopelagic species than other hammerheads: expert comment R. Daley
964	Isurus oxyrinchus	Shortfinned Mako or Blue Pointer	107,967	N	0	0	2.43	1.67	2.95	N	Med	Low overlap	
625	Carcharhinus longimanus	Oceanic Whitetip Shark	17,199	N	0	0	2.43	1.67	2.95	N	Med	Low overlap	
489	Centroscymnus crepidater	Deepwater dogfish	0	N	0	0	2.57	1.30	2.88	Y	Med	Low attribute score	Overide: selectivity reduced to to 1. deepwater demersal species. Expert comment R. Daley
491	Centroscymnus owstoni	Owston's dogfish	0	N	0	0	2.57	1.30	2.88	Y	Med	Low attribute score	see deepwater dogfish
809	Centroscymnus coelolepis	Portuguese dogfish	0	N	2	0	2.57	1.30	2.88	Y	Med	Low attribute score	see deepwater dogfish
647	Carcharhinus tilstoni	Australian blacktip	0	N	0	0	2.29	1.67	2.83	N	Med	Low overlap	
630	Carcharhinus sorrah	Sorrah shark	0	N	0	0	2.14	1.44	2.58	N	Low		
Teleost													
1533	Mola ramsayi	[an ocean sunfish]	0	N	2	0	2.57	1.22	2.85	Y	Med	Low attribute score	Override: encountearability, selectivity: a drifting plankton feeder that is not an active smimmer and not attracted to baited hooks. Expert comment Daley.
255	Thunnus maccoyii	Southern Bluefin Tuna	86,236	N	0	0	2.00	2.33	3.07	N	Med	Spatial uncertainty	
215	Centrolophus niger	Rudderfish	231,852	N	0	0	1.71	2.33	2.90	N	Med	Low overlap	
842	Lampris guttatus	Spotted moonfish	0	N	1	0	2.00	1.89	2.75	N	Med	Low overlap	
897	Thunnus orientalis	Northern Bluefin Tuna	9,027	N	0	1	1.86	1.89	2.65	N	Med	Spatial	

ERA species ID	Scientific name	Common name	Average logbook catch (kg) (2001-04)	Missing > 3 attributes (Y/N)	Missing productivity attributes (out of 7)	Missing susceptibility attributes (out of 5)	Productivity (additive) (1- low, 3-high)	Susceptibility (mult) (1- low, 3-high)	2D vulnerability value (P&S) (low-high range=1.41-4.24)	Susceptibility override used?	2D P&S vulnerability category	High/Med risk category (Refer 2.4.8)	Comments
												uncertainty	
169	Paristiopterus gallipavo	Yellow-Spotted Boarfish	33	N	3	0	2.29	1.22	2.59	N	Low		
899	Thunnus tonggol	Long-tail tuna	0	N	0	1	1.57	1.89	2.46	N	Low		
259	Acanthocybium solandri	Wahoo	18,512	N	0	1	1.57	1.89	2.46	N	Low		
148	Seriola lalandi	Yellowtail Kingfish	38	N	0	0	1.71	1.44	2.24	N	Low		
204	Ruvettus pretiosus	Oilfish	6,565	N	0	0	1.71	1.44	2.24	N	Low		
64	Katsuwonus pelamis	Skipjack Tuna	4,232	N	0	0	1.57	1.44	2.13	N	Low		
211	Sarda australis	Australian bonito	42	N	0	1	1.57	1.44	2.13	N	Low		
845	Lepidocybium flavobrunneum	Escolar or Black Oil fish	65,012	N	0	0	1.71	1.22	2.11	N	Low		
162	Argyrosomus hololepidotus	Jewfish	0	N	0	0	1.71	1.07	2.02	N	Low		
908	Auxis thazard	Frigate mackerel	0	N	0	1	1.29	1.44	1.93	N	Low		
593	Elagatis bipinnulata	Rainbow runner	13	N	0	0	1.43	1.22	1.88	N	Low		
152	Brama brama	Ray's Bream	7,751	N	0	0	1.43	1.22	1.88	N	Low		
1069	Seriolella punctata	Spotted Warehou	0	N	0	0	1.43	1.22	1.88	N	Low		
814	Coryphaena hippurus	Dolphin Fish (mahi mahi)	269,208	N	0	0	1.43	1.15	1.83	N	Low		
682	Pristipomoides filamentosus	Rosy Jobfish / King Snapper	4	N	0	0	1.43	1.07	1.79	N	Low		
123	Lepidoperca pulchella	Orange Perch	9	N	0	0	1.29	1.22	1.77	N	Low		
1121	Parastromateus niger	Black pomfret	2	N	0	0	1.14	1.22	1.67	N	Low		

Bycatch (discard) species *Eastern Tuna and Billfish Longline Fishery*

ERA species ID	Scientific name	Common name	Average logbook catch (kg) (2001-04)	Missing > 3 attributes (Y/N)	Missing productivity attributes (out of 7)	Missing susceptibility attributes (out of 5)	Productivity (additive) (1- low, 3-high)	Susceptibility (mult) (1- low, 3-high)	2D vulnerability value (P&S) (low-high range=1.41-4.24)	Susceptibility override used?	2D P&S vulnerability category	High/Med risk category (Refer 2.4.8)	Comments
Chondrichthyan													
905	Zameus squamulosus	Velvet dogfish	0	N	0	0	2.43	1.89	3.08	N	Med	*Other	
590	Dalatias licha	Black Shark	0	N	0	0	2.57	1.67	3.06	N	Med	Low attribute score	
604	Deania calcea	Brier Shark	0	N	0	0	2.71	1.30	3.01	N	Med	Low attribute score	
60	Notorynchus cepedianus	Broadnose sevengill shark	0	N	0	0	2.57	1.22	2.85	N	Med	Low overlap	
936	Galeorhinus galeus	School Shark, Tope shark	26	N	0	0	2.57	1.22	2.85	N	Med	Low overlap	
629	Carcharhinus plumbeus	Sandbar shark	15	N	0	0	2.57	1.22	2.85	N	Med	Low overlap	
1077	Squalus acanthias	White-spotted dogfish	0	N	0	0	2.57	1.15	2.82	N	Med	Low overlap	
660	Squatina australis	Australian Angel Shark	9	N	0	0	2.57	1.15	2.82	N	Med	Low overlap	
963	Isistius brasiliensis	Cookie-cutter shark (cigar shark)	7	N	0	0	2.29	1.44	2.70	N	Med	Low overlap	
Teleost													
852	Makaira mazara	Blue Marlin	0	N	0	1	2.00	2.33	3.07	N	Med	Spatial uncertainty	
836	Istiophorus platypterus	Sailfish	4,580	N	0	1	1.86	2.33	2.98	N	Med	Spatial uncertainty	
562	Regalecus glesne	oarfish ("king of herrings")	32	N	3	0	2.57	1.44	2.95	N	Med	Low attribute score	
810	Lampris guttatus & Lampris immaculatus	Moonfish	7,956	N	3	0	2.43	1.67	2.95	N	Med	Low attribute score	

ERA species ID	Scientific name	Common name	Average logbook catch (kg) (2001-04)	Missing > 3 attributes (Y/N)	Missing productivity attributes (out of 7)	Missing susceptibility attributes (out of 5)	Productivity (additive) (1- low, 3-high)	Susceptibility (mult) (1- low, 3-high)	2D vulnerability value (P&S) (low-high range=1.41-4.24)	Susceptibility override used?	2D P&S vulnerability category	High/Med risk category (Refer 2.4.8)	Comments
883	Tetrapturus angustirostris	Short Bill Spearfish	16,299	N	0	0	1.71	2.33	2.90	N	Med	Spatial uncertainty	
252	Mola mola	Ocean sunfish	1,207	N	1	0	2.29	1.67	2.83	N	Med	Low attribute score	
644	Lampris immaculatus	Southern moonfish	0	N	3	0	2.43	1.44	2.83	N	Med	Low attribute score	
718	Lophotus lacepede	Crest Fish (J RTMP Obs)	0	N	3	0	2.43	1.44	2.83	N	Med	Low attribute score	
373	Alepisaurus ferox	Long-nosed lancet fish	0	N	3	0	2.43	1.22	2.72	N	Med	Low attribute score	
851	Makaira indica	Black Marlin	0	N	0	0	1.86	1.89	2.65	N	Med	Spatial uncertainty	
620	Scomberomorus commerson	Spanish Mackerel	8	N	0	1	1.71	1.89	2.55	N	Low		
623	Scomberomorus semifasciatus	Broad-barred Mackerel - Grey Mack	0	N	0	1	1.71	1.89	2.55	N	Low		
830	Gasterochisma melampus	Butterfly Mackerel	40	N	0	0	1.71	1.89	2.55	N	Low		
801	Muraenesox bagio	Common Pike Eel	0	N	2	0	2.14	1.22	2.47	N	Low		
377	Allothunnus fallai	Slender Tuna	0	N	0	1	1.57	1.89	2.46	N	Low		
372	Alepisaurus brevirostris	Short-nosed Lancet Fish	0	N	3	0	2.14	1.15	2.43	N	Low		
1038	Polyprion oxygeneios	Hapuku	0	N	0	0	2.00	1.30	2.38	N	Low		
958	Hyperoglyphe antarctica	Blue Eye Trevalla	0	N	0	0	2.00	1.30	2.38	N	Low		
86	Trachipterus arawatae	Ribbon or Dealfish	0	N	2	0	2.00	1.22	2.34	N	Low		
982	Macruronus novaezelandiae	Blue Grenadier	0	N	0	0	1.71	1.59	2.34	N	Low		

ERA species ID	Scientific name	Common name	Average logbook catch (kg) (2001-04)	Missing > 3 attributes (Y/N)	Missing productivity attributes (out of 7)	Missing susceptibility attributes (out of 5)	Productivity (additive) (1- low, 3-high)	Susceptibility (mult) (1- low, 3-high)	2D vulnerability value (P&S) (low-high range=1.41-4.24)	Susceptibility override used?	2D P&S vulnerability category	High/Med risk category (Refer 2.4.8)	Comments
1066	Rexea solandri	Gemfish	0	N	0	0	1.71	1.59	2.34	N	Low		
208	Lepidopus caudatus	Southern Frostfish	33	N	1	0	1.71	1.59	2.34	N	Low		
147	Rachycentron canadum	Cobia	364	N	0	0	1.71	1.44	2.24	N	Low		
149	Seriola hippos	Samsonfish	0	N	0	0	1.71	1.44	2.24	N	Low		
835	Gymnosarda unicolor	Dogtooth tuna	16	N	0	0	1.71	1.30	2.15	N	Low		
879	Sphyraena jello	Slender Barracuda	0	N	1	0	1.86	1.07	2.15	N	Low		
63	Euthynnus affinis	Eastern Little Tuna/Mackerel tuna	0	N	0	1	1.57	1.44	2.13	N	Low		
622	Scomberomorus munroi	Australian Spotted Mackerel-DoggySchol	0	N	0	1	1.57	1.44	2.13	N	Low		
550	Exocoetus volitans	Flying Fish	0	N	2	1	1.71	1.22	2.11	N	Low		
614	Sphyraena barracuda	Great Barracuda	0	N	0	0	1.71	1.15	2.06	N	Low		
882	Taractichthys longipinnis	Long finned Bream (pomfret)	0	N	0	0	1.43	1.44	2.03	N	Low		
594	Brama australis	Southern Rays Bream	0	N	1	0	1.43	1.44	2.03	N	Low		
158	Pagrus auratus	Snapper/Squirefish	33	N	0	0	1.71	1.07	2.02	N	Low		
181	Latridopsis forsteri	Bastard Trumpeter	0	N	0	0	1.71	1.07	2.02	N	Low		
618	Gempylus serpens	Snake mackerel	0	N	0	0	1.71	1.07	2.02	N	Low		
597	Aphareus rutilans	Rusty jobfish	14	N	0	0	1.57	1.15	1.95	N	Low		
1087	Thyrsites atun	Barracouta	139	N	0	0	1.57	1.15	1.95	N	Low		
873	Scomber scombrus	Atlantic mackerel	42	N	0	0	1.29	1.44	1.93	N	Low		
600	Etelis carbunculus	Ruby snapper; Northwest Ruby Fish	0	N	0	0	1.57	1.07	1.90	N	Low		
1012	Nemadactylus macropterus	Jackass Morwong	0	N	0	0	1.43	1.15	1.83	N	Low		
178	Nemadactylus	Queen snapper	0	N	0	0	1.43	1.15	1.83	N	Low		

ERA species ID	Scientific name	Common name	Average logbook catch (kg) (2001-04)	Missing > 3 attributes (Y/N)	Missing productivity attributes (out of 7)	Missing susceptibility attributes (out of 5)	Productivity (additive) (1- low, 3-high)	Susceptibility (mult) (1- low, 3-high)	2D vulnerability value (P&S) (low-high range=1.41-4.24)	Susceptibility override used?	2D P&S vulnerability category	High/Med risk category (Refer 2.4.8)	Comments
	valenciennesi												
605	Tilodon sexfasciatus	Moonlighter	25	N	0	0	1.43	1.07	1.79	N	Low		
607	Scorpis lineolata	Sweep	0	N	0	0	1.43	1.07	1.79	N	Low		
159	Acanthopagrus butcheri	Black Bream	0	N	0	0	1.29	1.07	1.68	N	Low		
165	Upeneichthys lineatus	Red Mullet/Blue- lined Goatfish	0	N	0	0	1.14	1.07	1.57	N	Low		

TEP species *Eastern Tuna and Billfish Longline Fishery*

ERA species ID	Scientific name	Common name	Average logbook catch (kg) (2001-04)	Missing > 3 attributes (Y/N)	Missing productivity attributes (out of 7)	Missing susceptibility attributes (out of 5)	Productivity (additive) (1- low, 3-high)	Susceptibility (mult) (1- low, 3-high)	2D vulnerability value (P&S) (low-high range=1.41-4.24)	Susceptibility override used?	2D P&S vulnerability category	High/Med risk category (Refer 2.4.8)	Comments
Chondrichthyan													
315	Carcharodon carcharias	White shark	0	N	0	0	2.86	1.44	3.20	Y	High	Low overlap	Override: Encounterability reducedfrom 3 to 2. Wide ranging species but more common inshore. Expert comment R. Daley
313	Carcharias taurus	Grey nurse shark	0	N	0	0	2.71	1.44	3.07	Y	Med	Low overlap	Override: Encounterability reducedfrom 3 to 2. Wide ranging species but more common inshore. Expert comment R. Daley
1067	Rhincodon typus	Whale shark	0	N	0	0	2.71	1.44	3.07	N	Med	Low attribute score	
Marine bird													
2764	Stercorius longicaudus	Long-tailed jaeger	0	Y	7	3	3.00	3.00	4.24	N	High	Missing data	
755	Diomedea gibsoni	Gibson's Albatross	0	N	1	1	2.86	3.00	4.14	N	High	Spatial uncertainty	
889	Thalassarche eremita	Chatham albatross	0	Y	3	2	2.86	3.00	4.14	N	High	Missing data	
1429	Diomedea dabbenena	Tristan Albatross	0	N	1	1	2.86	3.00	4.14	N	High	Spatial uncertainty	
1084	Thalassarche impavida	Campbell Albatross	0	N	1	1	2.71	3.00	4.05	N	High	Spatial uncertainty	
753	Diomedea epomophora	Southern Royal Albatross	0	N	1	1	2.57	3.00	3.95	N	High	Spatial uncertainty	
451	Diomedea exulans	Wandering Albatross	0	N	1	1	2.57	3.00	3.95	N	High	Spatial uncertainty	

ERA species ID	Scientific name	Common name	Average logbook catch (kg) (2001-04)	Missing > 3 attributes (Y/N)	Missing productivity attributes (out of 7)	Missing susceptibility attributes (out of 5)	Productivity (additive) (1- low, 3-high)	Susceptibility (mult) (1- low, 3-high)	2D vulnerability value (P&S) (low-high range=1.41-4.24)	Susceptibility override used?	2D P&S vulnerability category	High/Med risk category (Refer 2.4.8)	Comments
799	Diomedea sanfordi	Northern Royal Albatross	0	N	1	1	2.57	3.00	3.95	N	High	Spatial uncertainty	
1059	Puffinus pacificus	Wedge-tailed Shearwater	0	N	1	1	2.43	3.00	3.86	N	High	Spatial uncertainty	
1031	Thalassarche carteri	Indian Yellow-nosed Albatross	0	N	1	1	2.57	2.33	3.47	N	High	Spatial uncertainty	
894	Thalassarche salvini	Salvin's albatross	0	Y	3	1	2.57	2.33	3.47	N	High	Missing data	
2766	Catharacta maccormicki	South Polar skua	0	Y	7	3	3.00	1.67	3.43	Y	High	Missing data	Override: availability reduced to 1 -out of range, Expert commentAlistair Hobday
1032	Thalassarche bulleri	Buller's Albatross	0	N	1	1	2.43	2.33	3.37	N	High	Spatial uncertainty	
1033	Thalassarche cauta	Shy Albatross	0	N	1	1	2.43	2.33	3.37	N	High	Spatial uncertainty	
1035	Thalassarche chrysostoma	Grey-headed Albatross	0	N	1	1	2.43	2.33	3.37	N	High	Spatial uncertainty	
1085	Thalassarche melanophrys	Black-browed Albatross	0	N	1	1	2.43	2.33	3.37	N	High	Spatial uncertainty	
1009	Phoebetria palpebrata	Light-mantled Albatross	0	N	1	1	2.43	2.33	3.37	N	High	Spatial uncertainty	
628	Diomedea antipodensis	Antipodean Albatross	0	N	1	1	2.86	1.67	3.31	Y	High	Low attribute score	Override: availability reduced. Not on Fishing grounds. AFMA
1034	Thalassarche chlororhynchos	Yellow-nosed Albatross, Atlantic Yellow-	0	N	1	1	2.29	2.33	3.27	N	High	Spatial uncertainty	
1008	Phoebetria fusca	Sooty Albatross	0	N	1	1	2.29	2.33	3.27	N	High	Spatial uncertainty	
73	Macronectes giganteus	Southern Giant-Petrel	0	N	1	1	2.29	2.33	3.27	N	High	Spatial uncertainty	
981	Macronectes halli	Northern Giant-Petrel	0	N	1	1	2.29	2.33	3.27	N	High	Spatial uncertainty	
1086	Thalassarche steadi	White-capped Albatross	0	N	2	1	2.71	1.67	3.19	N	High	Low	

ERA species ID	Scientific name	Common name	Average logbook catch (kg) (2001-04)	Missing > 3 attributes (Y/N)	Missing productivity attributes (out of 7)	Missing susceptibility attributes (out of 5)	Productivity (additive) (1- low, 3-high)	Susceptibility (mult) (1- low, 3-high)	2D vulnerability value (P&S) (low-high range=1.41-4.24)	Susceptibility override used?	2D P&S vulnerability category	High/Med risk category (Refer 2.4.8)	Comments
												attribute score	
1428	Diomedea amsterdamensis	Amsterdam Albatross	0	N	1	1	2.57	1.67	3.06	Y	Med	Low attribute score	Override: availability reduced. Not on Fishing grounds. Expert comment Bob Stanley
1580	Calonectris leucomelas	streaked shearwater	0	Y	3	1	2.57	1.67	3.06	N	Med	Missing data	
1051	Pterodroma solandri	Providence Petrel	0	Y	3	1	2.57	1.67	3.06	N	Med	Missing data	
912	Phalacrocorax fuscescens	Black faced cormorant	0	N	1	1	2.57	1.44	2.95	Y	Med	Low attribute score	Override: availability reduced to 1 - not on fishing grounds, Expert comment from observer
939	Halobaena caerulea	Blue Petrel	0	Y	3	1	2.43	1.67	2.95	N	Med	Missing data	
1052	Lugensa brevirostris	Kerguelen Petrel	0	Y	3	1	2.43	1.67	2.95	N	Med	Missing data	
1003	Pachyptila turtur	Fairy Prion	0	Y	3	1	2.43	1.67	2.95	N	Med	Missing data	
1048	Pterodroma mollis	Soft-plumaged Petrel	0	Y	3	1	2.43	1.67	2.95	N	Med	Missing data	
1055	Puffinus carneipes	Flesh-footed Shearwater	0	N	1	1	2.43	1.67	2.95	Y	Med	Low attribute score	Override: availability reduced to 1 - not on fishing grounds, Expert comment from observer
918	Fregetta grallaria	White-bellied Storm-Petrel (Tasman Sea),	0	Y	3	1	2.43	1.67	2.95	N	Med	Missing data	
917	Fregetta tropica	Black-bellied Storm-Petrel	0	Y	3	1	2.43	1.67	2.95	N	Med	Missing data	
1045	Pterodroma cervicalis	White-necked Petrel	0	Y	3	1	2.57	1.22	2.85	Y	Med	Missing data	Override: availability reduced to 1 - not on fishing grounds, Expert comment from observer
1054	Puffinus bulleri	Buller's Shearwater	0	Y	3	1	2.57	1.22	2.85	Y	Med	Missing data	Override: availability reduced to 1 - not on fishing grounds, Expert comment from observer

ERA species ID	Scientific name	Common name	Average logbook catch (kg) (2001-04)	Missing > 3 attributes (Y/N)	Missing productivity attributes (out of 7)	Missing susceptibility attributes (out of 5)	Productivity (additive) (1- low, 3-high)	Susceptibility (mult) (1- low, 3-high)	2D vulnerability value (P&S) (low-high range=1.41-4.24)	Susceptibility override used?	2D P&S vulnerability category	High/Med risk category (Refer 2.4.8)	Comments
1694	Puffinus creatopus	Pink-footed Shearwater	0	Y	3	1	2.57	1.22	2.85	Y	Med	Missing data	Override: availability reduced to 1 - not on fishing grounds, Expert comment from observer
1017	Sterna bergii	Crested Tern	0	N	1	1	2.29	1.67	2.83	N	Med	Low attribute score	
1018	Sterna caspia	Caspian Tern	0	N	1	1	2.29	1.67	2.83	N	Med	Low attribute score	
314	Fulmarus glacialoides	Southern fulmar	0	N	1	1	2.43	1.44	2.83	Y	Med	Low attribute score	Override: availability reduced. Not on Fishing grounds. Observer data summaries
1043	Procellaria westlandica	Westland Petrel	0	N	2	1	2.43	1.44	2.83	Y	Med	Low attribute score	Override: availability reduced to 1 - not on fishing grounds, Expert comment from observer
325	Catharacta skua	Great Skua	0	N	1	1	2.43	1.44	2.83	Y	Med	Low attribute score	Override: availability reduced to 1 -out of range, Expert commentAlistair Hobday
1042	Procellaria parkinsoni	Black Petrel	0	N	2	1	2.43	1.22	2.72	Y	Med	Low attribute score	Override: availability reduced to 1 - not on fishing grounds, Expert comment from observer
1046	Pterodroma leucoptera	Gould's Petrel	0	Y	4	1	2.43	1.22	2.72	Y	Med	Missing data	Override: availability reduced to 1 - not on fishing grounds, Expert comment from observer
1047	Pterodroma macroptera	Great-winged Petrel	0	N	2	1	2.43	1.22	2.72	Y	Med	Low attribute score	Override: availability reduced to 1 - not on fishing grounds, Expert comment from observer

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1050	Pterodroma nigripennis	Black-winged Petrel	0	Y	3	1	2.43	1.22	2.72	Y	Med	Missing data	Override: availability reduced to 1 - not on fishing grounds, Expert comment from observer
1053	Puffinus assimilis	Little Shearwater (Tasman Sea)	0	Y	3	1	2.43	1.22	2.72	Y	Med	Missing data	Override: availability reduced to 1 - not on fishing grounds, Expert comment from observer
1060	Puffinus tenuirostris	Short-tailed Shearwater	0	N	1	1	2.43	1.22	2.72	Y	Med	Low attribute score	Override: encounterability reduced to 1, does not approach gear, Expert comment from observer
555	Garrodia nereis	Grey-backed storm petrel	0	Y	3	1	2.43	1.22	2.72	Y	Med	Missing data	Override: availability reduced to 1 - not on fishing grounds, Expert comment from observer
1610	Pterodroma heraldica	Herald Petrel	0	Y	3	1	2.43	1.22	2.72	N	Med	Missing data	
898	Eudyptula minor	Little Penguin	0	N	1	1	2.14	1.67	2.71	N	Med	Low attribute score	
1056	Puffinus gavia	Fluttering Shearwater	0	N	2	1	2.14	1.67	2.71	N	Med	Low attribute score	
1058	Puffinus huttoni	Hutton's Shearwater	0	N	2	1	2.14	1.67	2.71	N	Med	Low attribute score	
1016	Sterna bengalensis	Lesser crested tern	0	N	2	1	2.14	1.67	2.71	N	Med	Low attribute score	
1432	Phaethon rubricauda	Red-tailed Tropicbird	0	N	1	1	2.29	1.44	2.70	Y	Med	Low attribute score	Override: availability reduced to 1 - not on fishing grounds, Expert comment from observer

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1549	Morus capensis	Cape gannet	0	N	1	1	2.29	1.44	2.70	Y	Med	Low attribute score	Override: availability reduced to 1 - not on fishing grounds, Expert comment from observer
998	Morus serrator	Australasian Gannet	0	N	1	1	2.29	1.44	2.70	Y	Med	Low attribute score	Override: availability reduced to 1 - not on fishing grounds, Expert comment from observer
1433	Sula dactylatra	Masked Booby	0	N	1	1	2.29	1.44	2.70	Y	Med	Low attribute score	Override: availability reduced to 1 - not on fishing grounds, Expert comment from observer
881	Sula leucogaster	Brown boobies	0	N	1	1	2.29	1.44	2.70	Y	Med	Low attribute score	Override: availability reduced to 1 - not on fishing grounds, Expert comment from observer
1434	Sula sula	Red-footed Booby	0	N	1	1	2.29	1.44	2.70	Y	Med	Low attribute score	Override: availability reduced to 1 - not on fishing grounds, Expert comment from observer
829	Fregata ariel	Lesser frigatebird	0	N	1	1	2.29	1.44	2.70	Y	Med	Low attribute score	Override: availability reduced to 1 - not on fishing grounds, Expert comment from observer
975	Larus pacificus	Pacific Gull	0	N	1	1	2.29	1.44	2.70	Y	Med	Low attribute score	Override: availability reduced to 1 - not on fishing grounds, Expert comment from observer
1673	Thalassarche nov. sp.	Pacific Albatross	0	N	1	1	2.29	1.30	2.63	Y	Low		Override: availability reduced to 1 - not common on fishing grounds, Expert comment from observer
1014	Sterna albifrons	Little tern	0	N	1	1	2.00	1.67	2.60	N	Low		
1015	Sterna anaethetus	Bridled Tern	0	N	1	1	2.00	1.67	2.60	N	Low		

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1019	Sterna dougallii	Roseate tern	0	N	1	1	2.00	1.67	2.60	N	Low		
595	Daption capense	Cape Petrel	0	N	1	1	2.29	1.22	2.59	Y	Low		Override: availability reduced. Not on Fishing grounds. Observer data summaries
494	Procellaria cinerea	Grey petrel	0	N	1	1	2.29	1.22	2.59	Y	Low		Override:encounterability reduced to 1, poor diver, Expert comment from observer
504	Pterodroma lessoni	White-headed petrel	0	N	1	1	2.29	1.22	2.59	Y	Low		Override: availability reduced to 1 - not on fishing grounds, Expert comment from observer
1049	Pterodroma neglecta	Kermadec Petrel (western)	0	N	2	1	2.29	1.22	2.59	Y	Low		Override: availability reduced to 1 - not on fishing grounds, Expert comment from observer
1057	Puffinus griseus	Sooty Shearwater	0	N	1	1	2.29	1.22	2.59	Y	Low		Override: availability reduced to 1 - not on fishing grounds, Expert comment from observer
203	Anous stolidus	Common noddy	0	N	1	1	2.29	1.22	2.59	Y	Low		Override: availability reduced to 1 - not on fishing grounds, Expert comment from observer
1041	Procellaria aequinoctialis	White-chinned Petrel	0	N	1	1	2.29	1.15	2.56	Y	Low		Override: availability reduced to 1 - not on fishing grounds, encounterability reduced to 1, poor diver, Expert comment from observer

ERA species ID	Scientific name	Common name	Average logbook catch (kg) (2001-04)	Missing > 3 attributes (Y/N)	Missing productivity attributes (out of 7)	Missing susceptibility attributes (out of 5)	Productivity (additive) (1- low, 3-high)	Susceptibility (mult) (1- low, 3-high)	2D vulnerability value (P&S) (low-high range=1.41-4.24)	Susceptibility override used?	2D P&S vulnerability category	High/Med risk category (Refer 2.4.8)	Comments
1691	Pseudobulweria rostrata	Tahiti Petrel	0	N	1	1	2.29	1.07	2.53	Y	Low		Override: availability reduced to 1 - not on fishing grounds, encounterability reduced to 1, poor diver, Expert comment from observer
1435	Fregata minor	Great Frigatebird, Greater Frigatebird	0	N	1	1	2.14	1.22	2.47	Y	Low		Override: availability reduced to 1 - not on fishing grounds, Expert comment from observer
1438	Anous minutus	Black Noddy	0	N	1	1	2.14	1.22	2.47	Y	Low		Override: availability reduced to 1 - not on fishing grounds, Expert comment from observer
973	Larus dominicanus	Kelp Gull	0	N	1	1	2.14	1.22	2.47	Y	Low		Override: availability reduced to 1 - not on fishing grounds, Expert comment from observer
974	Larus novaehollandiae	Silver Gull	0	Y	3	1	2.14	1.22	2.47	Y	Low		Override: availability reduced to 1 - not on fishing grounds, Expert comment from observer
1582	Procelsterna cerulea	Grey ternlet	0	N	1	1	2.14	1.22	2.47	Y	Low		Override: availability reduced to 1 - not on fishing grounds, Expert comment from observer
1021	Sterna hirundo	Common tern	0	N	1	1	2.14	1.15	2.43	Y	Low		Override: availability reduced to 1 - not common on fishing grounds, Expert comment from observer
1023	Sterna paradisaea	Arctic tern	0	N	1	1	2.14	1.15	2.43	Y	Low		Override: availability reduced to 1 - not common on fishing grounds, Expert comment from observer

ERA species ID	Scientific name	Common name	Average logbook catch (kg) (2001-04)	Missing > 3 attributes (Y/N)	Missing productivity attributes (out of 7)	Missing susceptibility attributes (out of 5)	Productivity (additive) (1- low, 3-high)	Susceptibility (mult) (1- low, 3-high)	2D vulnerability value (P&S) (low-high range=1.41-4.24)	Susceptibility override used?	2D P&S vulnerability category	High/Med risk category (Refer 2.4.8)	Comments
1025	Sterna sumatrana	Black-naped tern	0	N	2	1	2.14	1.15	2.43	Y	Low		Override: availability reduced to 1 - not common on fishing grounds, Expert comment from observer
1020	Sterna fuscata	Sooty tern	0	N	1	1	2.14	1.07	2.40	Y	Low		Override: availability reduced to 1 - not common on fishing grounds, Expert comment from observer
556	Oceanites oceanicus	Wilson's storm petrel (subantarctic)	0	N	1	1	2.00	1.22	2.34	Y	Low		Override: availability reduced to 1 - not on fishing grounds, Expert comment from observer
1004	Pelagodroma marina	White-faced Storm-Petrel	0	N	1	1	2.00	1.22	2.34	Y	Low		Override: encouterability reduced to 1 - on fishing grounds, but doesn't aproach gear (refer to scoping
1024	Sterna striata	White-fronted Tern	0	N	1	1	2.00	1.15	2.31	Y	Low		Override: availability reduced to 1 - not common on fishing grounds, Expert comment from observer
1006	Pelecanoides urinatrix	Common Diving-Petrel	0	N	1	1	1.86	1.07	2.15	Y	Low		Override: availability reduced to 1 - not on fishing grounds, encounterability reduced to 1, poor diver, Expert comment from observer
Marine mammal													
1044	Pseudorca crassidens	False Killer Whale	0	N	1	0	2.86	2.33	3.69	Y	High	Spatial uncertainty	One killed in fishery
864	Delphinus capensis	Common dolphin, long-beaked	0	N	1	0	2.29	2.33	3.27	N	High	Spatial uncertainty	

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902	Feresa attenuata	Pygmy Killer Whale	0	N	0	0	2.86	1.44	3.20	Y	High	Low attribute score	Override: Encounterability reduced to 1, No records of capture on hooks; PCM reduced -likely to pull gear to surface - stakeholder meeting
934	Globicephala macrorhynchus	Short-finned Pilot Whale	0	N	0	0	2.86	1.44	3.20	Y	High	Low attribute score	Override: Encounterability reduced to 1, No records of capture on hooks; PCM reduced -likely to pull gear to surface - stakeholder meeting
987	Mesoplodon gingkodens	Gingko Beaked Whale	0	N	1	0	2.86	1.44	3.20	Y	High	Low attribute score	Override: ; PCM reduced -likely to pull gear to surface - stakeholder meeting
1440	Indopacetus pacificus	Longman's Beaked Whale	0	Y	4	1	3.00	1.02	3.17	Y	Med	Missing data	Override: Encounterability reduced to 1, No records of capture on hooks; PCM reduced -likely to pull gear to surface - stakeholder meeting
935	Globicephala melas	Long-finned Pilot Whale	0	N	0	0	2.86	1.30	3.14	Y	Med	Low attribute score	Override: Encounterability reduced to 1, No records of capture on hooks; PCM reduced -likely to pull gear to surface - stakeholder meeting
937	Grampus griseus	Risso's Dolphin	0	N	0	0	2.86	1.30	3.14	Y	Med	Low attribute score	Override: Encounterability reduced to 1, No records of capture on hooks; PCM reduced -likely to pull gear to surface - stakeholder meeting
1091	Tursiops truncatus	Bottlenose Dolphin	0	N	0	0	2.86	1.30	3.14	Y	Med	Low attribute score	Override: Encounterability reduced to 1, No records of capture on hooks; PCM reduced -likely to pull gear to surface - stakeholder meeting

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985	Mesoplodon bowdoini	Andrew's Beaked Whale	0	N	1	0	2.86	1.30	3.14	Y	Med	Low attribute score	Override: Encounterability reduced to 1, No records of capture on hooks; PCM reduced -likely to pull gear to surface - stakeholder meeting
1494	Tursiops aduncus	Indian Ocean bottlenose dolphin	0	N	1	0	2.86	1.22	3.11	Y	Med	Low attribute score	Override: Encounterability reduced to 1, No records of capture on hooks; PCM reduced -likely to pull gear to surface - stakeholder meeting
988	Mesoplodon grayi	Gray's Beaked Whale	0	N	1	0	2.86	1.22	3.11	Y	Med	Low attribute score	Override: ; PCM reduced -likely to pull gear to surface - stakeholder meeting
990	Mesoplodon layardii	Strap-toothed Beaked Whale	0	N	1	0	2.86	1.22	3.11	Y	Med	Low attribute score	Override: ; PCM reduced -likely to pull gear to surface - stakeholder meeting
1002	Orcinus orca	Killer Whale	0	N	0	0	2.86	1.20	3.10	Y	Med	Low attribute score	Override: Encounterability reduced to 1, No records of capture on hooks; PCM reduced -likely to pull gear to surface - stakeholder meeting
991	Mesoplodon mirus	True's Beaked Whale	0	N	0	0	2.86	1.20	3.10	Y	Med	Low attribute score	Override: Encounterability reduced to 1, No records of capture on hooks; PCM reduced -likely to pull gear to surface - stakeholder meeting
989	Mesoplodon hectori	Hector's Beaked Whale	0	N	0	0	2.86	1.15	3.08	Y	Med	Low attribute score	Override: ; PCM reduced -likely to pull gear to surface - stakeholder meeting

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970	Lagenodelphis hosei	Fraser's Dolphin	0	N	1	0	2.71	1.44	3.07	Y	Med	Low attribute score	Override: Encounterability reduced to 1, No records of capture on hooks; PCM reduced -likely to pull gear to surface - stakeholder meeting
1081	Stenella coeruleoalba	Striped Dolphin	0	N	0	0	2.71	1.44	3.07	Y	Med	Low attribute score	Override: Encounterability reduced to 1, No records of capture on hooks; PCM reduced -likely to pull gear to surface - stakeholder meeting
1083	Steno bredanensis	Rough-toothed Dolphin	0	N	0	0	2.71	1.44	3.07	Y	Med	Low attribute score	Override: Encounterability reduced to 1, No records of capture on hooks; PCM reduced -likely to pull gear to surface - stakeholder meeting
295	Hydrurga leptonyx	Leopard seal	0	N	0	0	2.71	1.44	3.07	Y	Med	Low attribute score	Override: PCM reduced -likely to pull gear to surface - stakeholder meeting
993	Mirounga leonina	Elephant seal	0	N	0	0	2.71	1.44	3.07	Y	Med	Low attribute score	Override: PCM reduced -likely to pull gear to surface - stakeholder meeting
1439	Balaenoptera bonaerensis	Antarctic Minke Whale	0	N	1	0	2.86	1.10	3.06	Y	Med	Low attribute score	Override: Encounterability reduced to 1, plankto feeder not attracted to baited hoods, Expert comment Ross Daley, PCM - likely to pull gear to surface - stakeholder meeting
968	Kogia breviceps	Pygmy Sperm Whale	0	N	0	0	2.86	1.10	3.06	Y	Med	Low attribute score	Override: Encounterability reduced to 1, No records of capture on hooks; PCM reduced -likely to pull gear to surface - stakeholder meeting

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986	Mesoplodon densirostris	Blainville's Beaked Whale	0	N	0	0	2.86	1.10	3.06	Y	Med	Low attribute score	Override: Encounterability reduced to 1, No records of capture on hooks; PCM reduced -likely to pull gear to surface - stakeholder meeting
1098	Ziphius cavirostris	Cuvier's Beaked Whale	0	N	0	0	2.86	1.10	3.06	Y	Med	Low attribute score	Override: Encounterability reduced to 1, No records of capture on hooks; PCM reduced -likely to pull gear to surface - stakeholder meeting
256	Balaenoptera acutorostrata	Minke Whale	0	N	0	0	2.86	1.05	3.04	Y	Med	Low attribute score	Override: Encounterability reduced to 1, plankto feeder not attracted to baited hoods, Expert comment Ross Daley, PCM - likely to pull gear to surface - stakeholder meeting
261	Balaenoptera borealis	Sei Whale	0	N	0	0	2.86	1.05	3.04	Y	Med	Low attribute score	Override: Encounterability reduced to 1, plankto feeder not attracted to baited hoods, Expert comment Ross Daley, PCM - likely to pull gear to surface - stakeholder meeting
262	Balaenoptera edeni	Bryde's Whale	0	N	0	0	2.86	1.05	3.04	Y	Med	Low attribute score	Override: Encounterability reduced to 1, plankto feeder not attracted to baited hoods, Expert comment Ross Daley, PCM - likely to pull gear to surface - stakeholder meeting

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268	Balaenoptera physalus	Fin Whale	0	N	0	0	2.86	1.05	3.04	Y	Med	Low attribute score	Override: Encounterability reduced to 1, plankto feeder not attracted to baited hoods, Expert comment Ross Daley, PCM - likely to pull gear to surface - stakeholder meeting
1036	Physeter catodon	Sperm Whale	0	N	0	0	2.86	1.05	3.04	Y	Med	Low attribute score	Override: Encounterability reduced to 1, No records of capture on hooks; PCM reduced -likely to pull gear to surface - stakeholder meeting
269	Berardius arnuxii	Arnoux's Beaked Whale	0	N	0	0	2.86	1.05	3.04	Y	Med	Low attribute score	Override: Encounterability reduced to 1, No records of capture on hooks; PCM reduced -likely to pull gear to surface - stakeholder meeting
959	Hyperoodon planifrons	Southern Bottlenose Whale	0	N	1	0	2.86	1.05	3.04	Y	Med	Low attribute score	Override: Encounterability reduced to 1, No records of capture on hooks; PCM reduced -likely to pull gear to surface - stakeholder meeting
1030	Tasmacetus shepherdi	Tasman Beaked Whale	0	N	1	0	2.86	1.05	3.04	Y	Med	Low attribute score	Override: Encounterability reduced to 1, No records of capture on hooks; PCM reduced -likely to pull gear to surface - stakeholder meeting
984	Megaptera novaeangliae	Humpback Whale	0	N	0	0	2.71	1.30	3.01	Y	Med	Low attribute score	Override: Encounterability reduced to 1, plankto feeder not attracted to baited hoods, Expert comment Ross Daley, PCM - likely to pull gear to surface - stakeholder meeting

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61	Lissodelphis peronii	Southern Right Whale Dolphin	0	N	1	0	2.71	1.30	3.01	Y	Med	Low attribute score	Override: Encounterability reduced to 1, No records of capture on hooks; PCM reduced -likely to pull gear to surface - stakeholder meeting
969	Kogia simus	Dwarf Sperm Whale	0	N	0	0	2.71	1.30	3.01	Y	Med	Low attribute score	Override: Encounterability reduced to 1, No records of capture on hooks; PCM reduced -likely to pull gear to surface - stakeholder meeting
813	Dugong dugon	Dugong	0	N	1	0	2.71	1.22	2.98	N	Med	Low attribute score	
612	Delphinus delphis	Common Dolphin	0	N	0	0	2.29	1.89	2.97	Y	Med	Spatial uncertainty	Override: Encounterability reduced to 1, No records of capture on hooks; PCM reduced -likely to pull gear to surface - stakeholder meeting
1007	Peponocephala electra	Melon-headed Whale	0	N	1	0	2.57	1.44	2.95	Y	Med	Low attribute score	Override: Encounterability reduced to 1, No records of capture on hooks; PCM reduced -likely to pull gear to surface - stakeholder meeting
1080	Stenella attenuata	Spotted Dolphin	0	N	1	0	2.57	1.44	2.95	Y	Med	Low attribute score	Override: Encounterability reduced to 1, No records of capture on hooks; PCM reduced -likely to pull gear to surface - stakeholder meeting
832	Lagenorhynchus cruciger	Hourglass dolphin	0	N	1	1	2.71	1.15	2.95	Y	Med	Low attribute score	Override: Encounterability reduced to 1, No records of capture on hooks; PCM reduced -likely to pull gear to surface - stakeholder meeting

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1076	Sousa chinensis	Indo-Pacific Humpback Dolphin	0	N	0	0	2.71	1.15	2.95	Y	Med	Low attribute score	Override: Encounterability reduced to 1, No records of capture on hooks; PCM reduced -likely to pull gear to surface - stakeholder meeting
896	Eubalaena australis	Southern Right Whale	0	N	0	0	2.71	1.05	2.91	Y	Med	Low attribute score	Override: Encounterability reduced to 1, plankto feeder not attracted to baited hoods, Expert comment Ross Daley, PCM - likely to pull gear to surface - stakeholder meeting
289	Caperea marginata	Pygmy Right Whale	0	N	1	0	2.71	1.05	2.91	Y	Med	Low attribute score	Override: Encounterability reduced to 1, plankto feeder not attracted to baited hoods, Expert comment Ross Daley, PCM - likely to pull gear to surface - stakeholder meeting
216	Arctocephalus forsteri	New Zealand Fur-seal	0	N	0	0	2.43	1.44	2.83	Y	Med	Low attribute score	Override: PCM reduced -likely to pull gear to surface - stakeholder meeting
860	Orcaella brevirostris	Irrawaddy dolphin	0	N	1	0	2.57	1.15	2.82	Y	Med	Low attribute score	Override: Encounterability reduced to 1, No records of capture on hooks; PCM reduced -likely to pull gear to surface - stakeholder meeting
265	Balaenoptera musculus	Blue Whale	0	N	0	0	2.57	1.05	2.78	Y	Med	Low attribute score	Override: Encounterability reduced to 1, plankto feeder not attracted to baited hoods, Expert comment Ross Daley, PCM - likely to pull gear to surface - stakeholder meeting

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253	Arctocephalus pusillus doriferus	Australian Fur Seal	0	N	0	0	2.29	1.44	2.70	Y	Med	Low attribute score	Override: Encounterability reduced to 1, No records of capture on hooks; PCM reduced -likely to pull gear to surface - stakeholder meeting
263	Arctocephalus tropicalis	Subantarctic fur seal	0	N	0	0	2.29	1.44	2.70	Y	Med	Low attribute score	Override: PCM reduced -likely to pull gear to surface - stakeholder meeting
1082	Stenella longirostris	Long-snouted Spinner Dolphin	0	N	0	0	2.43	1.15	2.69	Y	Med	Low attribute score	Override: Encounterability reduced to 1, No records of capture on hooks; PCM reduced -likely to pull gear to surface - stakeholder meeting
1000	Neophoca cinerea	Australian Sea-lion	0	N	0	0	2.43	1.15	2.69	Y	Med	Low attribute score	Override: Encounterability reduced to 1, No records of capture on hooks; PCM reduced -likely to pull gear to surface - stakeholder meeting
971	Lagenorhynchus obscurus	Dusky Dolphin	0	N	0	0	2.29	1.30	2.63	Y	Low		Override: Encounterability reduced to 1, No records of capture on hooks; PCM reduced -likely to pull gear to surface - stakeholder meeting
Marine reptile													
613	Dermochelys coriacea	Leathery turtle	0	N	2	0	2.57	2.33	3.47	Y	High	Spatial uncertainty	Override: PCM reduced -turtles released alive or dead Observer reports.
541	Chelonia mydas	Green turtle	0	N	1	0	2.43	1.89	3.08	Y	Med	Spatial uncertainty	Override: PCM reduced -turtles released alive or dead Observer reports.
1530	Disteira kingii	Spectacled seasnake	0	Y	3	1	2.71	1.44	3.07	Y	Med	Missing data	Override: selectivity reduced. Not caught on Hooks. Expert comment A. Hobday.

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1415	Aipysurus tenuis	Brown-lined Seasnake	0	Y	4	1	2.71	1.22	2.98	Y	Med	Missing data	Override: selectivity reduced. Not caught on Hooks. Expert comment A. Hobday.
1419	Ephalophis greyi	North-western Mangrove Seasnake	0	Y	4	1	2.71	1.22	2.98	Y	Med	Missing data	Override: selectivity reduced. Not caught on Hooks. Expert comment A. Hobday.
1681	Hydrophis atriceps	Black-headed seasnake	0	Y	3	1	2.71	1.22	2.98	Y	Med	Missing data	Override: selectivity reduced. Not caught on Hooks. Expert comment A. Hobday.
1682	Hydrophis belcheri	a seasnake	0	Y	4	1	2.71	1.22	2.98	Y	Med	Missing data	Override: selectivity reduced. Not caught on Hooks. Expert comment A. Hobday.
1531	Hydrophis czeblukovi	Fine-spined seasnake	0	Y	4	1	2.71	1.22	2.98	Y	Med	Missing data	Override: selectivity reduced. Not caught on Hooks. Expert comment A. Hobday.
1685	Hydrophis inornatus	Plain seasnake	0	Y	4	1	2.71	1.22	2.98	Y	Med	Missing data	Override: selectivity reduced. Not caught on Hooks. Expert comment A. Hobday.
1686	Hydrophis melanosoma	Black-banded robust seasnake	0	Y	4	1	2.71	1.22	2.98	Y	Med	Missing data	Override: selectivity reduced. Not caught on Hooks. Expert comment A. Hobday.
1687	Hydrophis pacificus	Large-headed Seasnake	0	Y	4	1	2.71	1.22	2.98	Y	Med	Missing data	Override: selectivity reduced. Not caught on Hooks. Expert comment A. Hobday.
1688	Hydrophis vorisi	A seasnake	0	Y	4	1	2.71	1.22	2.98	Y	Med	Missing data	Override: selectivity reduced. Not caught on Hooks. Expert comment A. Hobday.
1411	Aipysurus eydouxii	Spine-tailed Seasnake	0	Y	3	1	2.57	1.44	2.95	Y	Med	Missing data	Override: selectivity reduced. Not caught on Hooks. Expert comment A. Hobday.

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1408	Acalyptophis peronii	Horned Seasnake	0	N	3	0	2.71	1.15	2.95	Y	Med	Low attribute score	Override: selectivity reduced. Not caught on Hooks. Expert comment A. Hobday.
1416	Disteira major	Olive-headed Seasnake	0	N	3	0	2.71	1.15	2.95	Y	Med	Low attribute score	Override: selectivity reduced. Not caught on Hooks. Expert comment A. Hobday.
1422	Hydrophis mcdowelli	seasnake	0	N	3	0	2.71	1.15	2.95	Y	Med	Low attribute score	Override: selectivity reduced. Not caught on Hooks. Expert comment A. Hobday.
1423	Hydrophis ornatus	seasnake	0	N	3	0	2.71	1.15	2.95	Y	Med	Low attribute score	Override: selectivity reduced. Not caught on Hooks. Expert comment A. Hobday.
1005	Pelamis platurus	Yellow-bellied seasnake	0	N	3	0	2.71	1.15	2.95	N	Med	Low attribute score	Override: selectivity reduced. Not caught on Hooks. Expert comment A. Hobday.
1410	Aipysurus duboisii	Dubois' Seasnake	0	N	3	0	2.71	1.07	2.92	Y	Med	Low attribute score	Override: selectivity reduced. Not caught on Hooks. Expert comment A. Hobday.
254	Astrotia stokesii	Stokes' seasnake	0	N	3	0	2.71	1.07	2.92	Y	Med	Low attribute score	Override: selectivity reduced. Not caught on Hooks. Expert comment A. Hobday.
1421	Hydrophis coggeri	Slender-necked Seasnake	0	Y	4	0	2.71	1.07	2.92	Y	Med	Missing data	Override: selectivity reduced. Not caught on Hooks. Expert comment A. Hobday.
1689	Parahydrophis mertoni	Northern mangrove seasnake	0	Y	4	0	2.71	1.07	2.92	N	Med	Missing data	Override: selectivity reduced. Not caught on Hooks. Expert comment A. Hobday.
1420	Hydrelaps darwiniensis	Black-ringed Seasnake	0	Y	4	1	2.57	1.22	2.85	Y	Med	Missing data	Override: selectivity reduced. Not caught on Hooks. Expert comment A. Hobday.

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1683	Hydrophis caerulescens	Dwarf seasnake	0	Y	3	1	2.57	1.22	2.85	Y	Med	Missing data	Override: selectivity reduced. Not caught on Hooks. Expert comment A. Hobday.
1684	Hydrophis gracilis	Slender seasnake	0	Y	3	1	2.57	1.22	2.85	Y	Med	Missing data	Override: selectivity reduced. Not caught on Hooks. Expert comment A. Hobday.
844	Lepidochelys olivacea	Olive Ridley turtle	0	N	1	0	2.43	1.44	2.83	Y	Med	Low attribute score	Override: PCM reduced -turtles released alive or dead Observer reports.
857	Natator depressus	Flatback turtle	0	N	3	0	2.57	1.10	2.80	Y	Med	Low attribute score	Override: PCM reduced -turtles released alive or dead Observer reports.
1409	Aipysurus apraefrontalis	Short-nosed Seasnake	0	Y	4	0	2.57	1.07	2.79	Y	Med	Missing data	Override: selectivity reduced. Not caught on Hooks. Expert comment A. Hobday.
1412	Aipysurus foliosquama	Leaf-scaled Seasnake	0	Y	4	0	2.57	1.07	2.79	Y	Med	Missing data	Override: selectivity reduced. Not caught on Hooks. Expert comment A. Hobday.
1413	Aipysurus fuscus	Dusky Seasnake	0	Y	4	0	2.57	1.07	2.79	Y	Med	Missing data	Override: selectivity reduced. Not caught on Hooks. Expert comment A. Hobday.
324	Caretta caretta	Loggerhead	0	N	1	0	2.43	1.30	2.75	Y	Med	Low attribute score	Override: PCM reduced -turtles released alive or dead Observer reports.
822	Eretmochelys imbricata	Hawksbill turtle	0	N	1	0	2.43	1.30	2.75	Y	Med	Low attribute score	Override: PCM reduced -turtles released alive or dead Observer reports.
1679	Laticauda colubrina	Banded wide faced Sea krait	0	N	2	1	2.43	1.22	2.72	Y	Med	Low attribute score	Override: PCM reduced -turtles released alive or dead Observer reports.

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1680	Laticauda laticaudata	Large scaled sea krait	0	N	2	1	2.29	1.22	2.59	Y	Low		Override: selectivity reduced. Not caught on Hooks. Expert comment A. Hobday.
1414	Aipysurus laevis	Olive Seasnake, Golden Seasnake	0	N	1	1	2.29	1.22	2.59	Y	Low		Override: selectivity reduced. Not caught on Hooks. Expert comment A. Hobday.
1417	Emydocephalus annulatus	Turtle-headed Seasnake	0	N	3	0	2.29	1.07	2.53	Y	Low		Override: selectivity reduced. Not caught on Hooks. Expert comment A. Hobday.
1424	Lapemis hardwickii	Spine-bellied Seasnake	0	N	1	1	2.14	1.22	2.47	Y	Low		Override: selectivity reduced. Not caught on Hooks. Expert comment A. Hobday.
957	Hydrophis elegans	Elegant seasnake	0	N	2	0	2.14	1.07	2.40	Y	Low		Override: selectivity reduced. Not caught on Hooks. Expert comment A. Hobday.
1418	Enhydrina schistosa	Beaked Seasnake	0	N	0	0	2.00	1.07	2.27	Y	Low		Override: selectivity reduced. Not caught on Hooks. Expert comment A. Hobday.
Teleost													
308	Heteroclinus perspicillatus	Common weedfish	0	N	3	0	2.29	1.07	2.53	N	Low		
1074	Solenostomus cyanopterus	Blue-finned Ghost Pipefish, Robust Ghost	0	N	3	0	2.14	1.07	2.40	N	Low		
1075	Solenostomus paradoxus	Harlequin Ghost Pipefish, Ornate Ghost Pipefish	0	N	3	0	2.14	1.07	2.40	N	Low		
568	Doryrhamphus malus	Flagtail Pipefish, Negros Pipefish	0	N	0	0	1.57	1.15	1.95	N	Low		
1010	Phycodurus eques	Leafy Seadragon	0	N	0	0	1.57	1.07	1.90	N	Low		
1011	Phyllopteryx taeniolatus	Weedy Seadragon, Common Seadragon	0	N	0	0	1.57	1.07	1.90	N	Low		
949	Hippocampus taeniopterus	Spotted Seahorse, Yellow Seahorse	0	N	0	0	1.57	1.07	1.90	N	Low		

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361	Dunckerocampus dactyliophorus	Ringed Pipefish	0	N	0	0	1.57	1.07	1.90	N	Low		
569	Doryrhamphus melanopleura	Bluestripe Pipefish	0	N	0	0	1.57	1.07	1.90	N	Low		
55	Doryrhamphus janssi	Cleaner Pipefish, Janss' Pipefish	0	N	0	0	1.57	1.07	1.90	N	Low		
983	Maroubra perserrata	Sawtooth Pipefish	0	N	0	0	1.57	1.07	1.90	N	Low		
1667	Hippocampus kuda	Spotted Seahorse, Yellow Seahorse	0	N	0	0	1.57	1.07	1.90	N	Low		
1591	Halicampus boothae	[a pipefish]	0	N	0	0	1.43	1.22	1.88	N	Low		
1073	Solegnathus spinosissimus	spiny pipehorse	0	N	0	0	1.43	1.15	1.83	N	Low		
1585	Choeroichthys sculptus	[a pipefish]	0	N	0	0	1.43	1.15	1.83	N	Low		
563	Corythoichthys amplexus	Fijian Banded Pipefish, Brown-banded Pipefish	0	N	0	0	1.43	1.15	1.83	N	Low		
1592	Halicampus macrorhynchus	[a pipefish]	0	N	0	0	1.43	1.15	1.83	N	Low		
1070	Solegnathus dunckeri	Duncker's Pipehorse	0	N	0	0	1.43	1.15	1.83	N	Low		
1029	Syngnathoides biaculeatus	Double-ended Pipehorse, Alligator Pipefish	0	N	0	0	1.43	1.15	1.83	N	Low		
1072	Solegnathus robustus	Robust Spiny Pipehorse, Robust Pipehorse	0	N	0	0	1.43	1.07	1.79	N	Low		
549	Hippocampus angustus	Western Spiny Seahorse	0	N	0	0	1.43	1.07	1.79	N	Low		
1089	Trachyrhamphus bicoarctatus	Bend Stick Pipefish, Short-tailed Pipefish	0	N	0	0	1.43	1.07	1.79	N	Low		
360	Haliichthys taeniophorus	Ribboned Seadragon, Ribboned Pipefish	0	N	0	0	1.43	1.07	1.79	N	Low		
1092	Urocampus carinirostris	Hairy Pipefish	0	N	0	0	1.43	1.07	1.79	N	Low		
980	Lissocampus runa	Javelin Pipefish	0	N	0	0	1.43	1.07	1.79	N	Low		

ERA species ID	Scientific name	Common name	Average logbook catch (kg) (2001-04)	Missing > 3 attributes (Y/N)	Missing productivity attributes (out of 7)	Missing susceptibility attributes (out of 5)	Productivity (additive) (1- low, 3-high)	Susceptibility (mult) (1- low, 3-high)	2D vulnerability value (P&S) (low-high range=1.41-4.24)	Susceptibility override used?	2D P&S vulnerability category	High/Med risk category (Refer 2.4.8)	Comments
946	Hippocampus bleekeri	Pot bellied seahorse	0	N	0	0	1.43	1.07	1.79	N	Low		
953	Histiogamphelus briggsii	Briggs' Crested Pipefish, Briggs' Pipefish	0	N	0	0	1.43	1.07	1.79	N	Low		
961	Hypselognathus rostratus	Knife-snouted Pipefish	0	N	0	0	1.43	1.07	1.79	N	Low		
978	Leptoichthys fistularius	Brushtail Pipefish	0	N	0	0	1.43	1.07	1.79	N	Low		
966	Kaupus costatus	Deep-bodied Pipefish	0	N	0	0	1.43	1.07	1.79	N	Low		
995	Mitotichthys semistriatus	Half-banded Pipefish	0	N	0	0	1.43	1.07	1.79	N	Low		
979	Lissocampus caudalis	Australian Smooth Pipefish, Smooth Pipefish	0	N	0	0	1.43	1.07	1.79	N	Low		
1026	Stigmatopora argus	Spotted Pipefish	0	N	0	0	1.43	1.07	1.79	N	Low		
1027	Stigmatopora nigra	Wide-bodied Pipefish, Black Pipefish	0	N	0	0	1.43	1.07	1.79	N	Low		
1028	Stipecampus cristatus	Ring-backed Pipefish	0	N	0	0	1.43	1.07	1.79	N	Low		
1061	Pugnaso curtirostris	Pug-nosed Pipefish	0	N	0	0	1.43	1.07	1.79	N	Low		
994	Mitotichthys mollisoni	Mollison's Pipefish	0	N	0	0	1.43	1.07	1.79	N	Low		
1095	Vanacampus poecilolaemus	Australian Long-snout Pipefish, Long-snouted Pipefish	0	N	0	0	1.43	1.07	1.79	N	Low		
996	Mitotichthys tuckeri	Tucker's Pipefish	0	N	0	0	1.43	1.07	1.79	N	Low		
947	Hippocampus breviceps	Short-head Seahorse, Short-snouted Seaho	0	N	0	0	1.43	1.07	1.79	N	Low		
952	Hippocampus whitei	white's seahorse	0	N	0	0	1.43	1.07	1.79	N	Low		
938	Halicampus grayi	Mud Pipefish, Gray's Pipefish	0	N	0	0	1.43	1.07	1.79	N	Low		
566	Corythoichthys conspicillatus	Yellow-banded Pipefish, Network Pipefish	0	N	0	0	1.43	1.07	1.79	N	Low		
114	Acentronura breviperula	Hairy Pygmy Pipehorse	0	N	0	0	1.43	1.07	1.79	N	Low		

ERA species ID	Scientific name	Common name	Average logbook catch (kg) (2001-04)	Missing > 3 attributes (Y/N)	Missing productivity attributes (out of 7)	Missing susceptibility attributes (out of 5)	Productivity (additive) (1- low, 3-high)	Susceptibility (mult) (1- low, 3-high)	2D vulnerability value (P&S) (low-high range=1.41-4.24)	Susceptibility override used?	2D P&S vulnerability category	High/Med risk category (Refer 2.4.8)	Comments
1583	Bulbonaricus davaoensis	[a pipefish]	0	N	0	0	1.43	1.07	1.79	N	Low		
546	Campichthys tricarinatus	Three-keel Pipefish	0	N	0	0	1.43	1.07	1.79	N	Low		
288	Campichthys tryoni	Tryon's Pipefish	0	N	0	0	1.43	1.07	1.79	N	Low		
388	Choeroichthys brachysoma	Pacific Short-bodied Pipefish, Short-bodied pipefish	0	N	0	0	1.43	1.07	1.79	N	Low		
1584	Choeroichthys cinctus	[a pipefish]	0	N	0	0	1.43	1.07	1.79	N	Low		
389	Choeroichthys suillus	Pig-snouted Pipefish	0	N	0	0	1.43	1.07	1.79	N	Low		
1586	Corythoichthys haematopterus	[a pipefish]	0	N	0	0	1.43	1.07	1.79	N	Low		
52	Corythoichthys intestinalis	Australian Messmate Pipefish, Banded Pipefish	0	N	0	0	1.43	1.07	1.79	N	Low		
578	Corythoichthys ocellatus	Orange-spotted Pipefish, Ocellated Pipefish	0	N	0	0	1.43	1.07	1.79	N	Low		
1587	Corythoichthys paxtoni	[a pipefish]	0	N	0	0	1.43	1.07	1.79	N	Low		
452	Corythoichthys schultzi	Schultz's Pipefish	0	N	0	0	1.43	1.07	1.79	N	Low		
1588	Cosmocampus darrosanus	[a pipefish]	0	N	0	0	1.43	1.07	1.79	N	Low		
580	Cosmocampus howensis	Lord Howe Pipefish	0	N	0	0	1.43	1.07	1.79	N	Low		
1589	Cosmocampus maxweberi	[a pipefish]	0	N	0	0	1.43	1.07	1.79	N	Low		
904	Festucalex cinctus	Girdled Pipefish	0	N	0	0	1.43	1.07	1.79	N	Low		
1590	Festucalex gibbsi	[a pipefish]	0	N	0	0	1.43	1.07	1.79	N	Low		
914	Filicampus tigris	Tiger Pipefish	0	N	0	0	1.43	1.07	1.79	N	Low		
54	Halicampus brocki	Brock's Pipefish	0	N	0	0	1.43	1.07	1.79	N	Low		
359	Halicampus dunckeri	Red-hair Pipefish, Duncker's Pipefish	0	N	0	0	1.43	1.07	1.79	N	Low		

ERA species ID	Scientific name	Common name	Average logbook catch (kg) (2001-04)	Missing > 3 attributes (Y/N)	Missing productivity attributes (out of 7)	Missing susceptibility attributes (out of 5)	Productivity (additive) (1- low, 3-high)	Susceptibility (mult) (1- low, 3-high)	2D vulnerability value (P&S) (low-high range=1.41-4.24)	Susceptibility override used?	2D P&S vulnerability category	High/Med risk category (Refer 2.4.8)	Comments
1593	Halicampus mataafae	[a pipefish]	0	N	0	0	1.43	1.07	1.79	N	Low		
57	Halicampus nitidus	Glittering Pipefish	0	N	0	0	1.43	1.07	1.79	N	Low		
454	Halicampus spinirostris	Spiny-snout Pipefish	0	N	0	0	1.43	1.07	1.79	N	Low		
942	Heraldia nocturna	Upside-down Pipefish	0	N	0	0	1.43	1.07	1.79	N	Low		
943	Hippichthys cyanospilos	Blue-speckled Pipefish, Blue-spotted Pipefish	0	N	0	0	1.43	1.07	1.79	N	Low		
944	Hippichthys heptagonus	Madura Pipefish	0	N	0	0	1.43	1.07	1.79	N	Low		
945	Hippichthys penicillus	Beady Pipefish, Steep-nosed Pipefish	0	N	0	0	1.43	1.07	1.79	N	Low		
1595	Hippichthys spicifer	[a pipefish]	0	N	0	0	1.43	1.07	1.79	N	Low		
951	Hippocampus planifrons	Flat-face Seahorse	0	N	0	0	1.43	1.07	1.79	N	Low		
1603	Hippocampus zebra	[a pipefish]	0	N	0	0	1.43	1.07	1.79	N	Low		
954	Histiogamphelus cristatus	Rhino Pipefish, Macleay's Crested Pipefish	0	N	0	0	1.43	1.07	1.79	N	Low		
967	Kimblaeus bassensis	Trawl Pipefish, Kimbla Pipefish	0	N	0	0	1.43	1.07	1.79	N	Low		
992	Micrognathus andersonii	Anderson's Pipefish, Shortnose Pipefish	0	N	0	0	1.43	1.07	1.79	N	Low		
1604	Micrognathus pygmaeus	[a pipefish]	0	N	0	0	1.43	1.07	1.79	N	Low		
547	Micrognathus micronotopterus	Tidepool Pipefish	0	N	0	0	1.43	1.07	1.79	N	Low		
1605	Micrognathus natans	[a pipefish]	0	N	0	0	1.43	1.07	1.79	N	Low		
1606	Microphis brachyurus	[a pipefish]	0	N	0	0	1.43	1.07	1.79	N	Low		
798	Microphis manadensis	Manado River Pipefish, Manado Pipefish	0	N	0	0	1.43	1.07	1.79	N	Low		
1607	Nannocampus lindemanensis	[a pipefish]	0	N	0	0	1.43	1.07	1.79	N	Low		

ERA species ID	Scientific name	Common name	Average logbook catch (kg) (2001-04)	Missing > 3 attributes (Y/N)	Missing productivity attributes (out of 7)	Missing susceptibility attributes (out of 5)	Productivity (additive) (1- low, 3-high)	Susceptibility (mult) (1- low, 3-high)	2D vulnerability value (P&S) (low-high range=1.41-4.24)	Susceptibility override used?	2D P&S vulnerability category	High/Med risk category (Refer 2.4.8)	Comments
1001	Notiocampus ruber	Red Pipefish	0	N	0	0	1.43	1.07	1.79	N	Low		
1608	Phoxocampus diacanthus	[a pipefish]	0	N	0	0	1.43	1.07	1.79	N	Low		
1609	Siokunichthys breviceps	[a pipefish]	0	N	0	0	1.43	1.07	1.79	N	Low		
1071	Solegnathus sp. 1 [in Kuiter, 2000]	Pipehorse	0	N	0	0	1.43	1.07	1.79	N	Low		
322	Trachyrhamphus longirostris	Long-nosed Pipefish, Straight Stick Pipefish	0	N	0	0	1.43	1.07	1.79	N	Low		
1093	Vanacampus margaritifer	Mother-of-pearl Pipefish	0	N	0	0	1.43	1.07	1.79	N	Low		
950	Hippocampus minotaur	Bullneck Seahorse	0	N	0	0	1.43	1.07	1.79	N	Low		
1597	Hippocampus bargibanti	Pygmy seahorse	0	N	0	0	1.43	1.07	1.79	N	Low		
948	Hippocampus queenslandicus	Kellogg's Seahorse	0	N	0	0	1.43	1.07	1.79	N	Low		
1598	Hippocampus dahli	[a pipefish]	0	N	0	0	1.43	1.07	1.79	N	Low		
1602	Hippocampus tristis	[a pipefish]	0	N	0	0	1.43	1.07	1.79	N	Low		
1596	Hippocampus alatus	[a pipefish]	0	N	0	0	1.43	1.07	1.79	N	Low		
1664	Hippocampus abdominalis	Big-bellied / southern potbellied seahorse	0	N	0	0	1.43	1.07	1.79	N	Low		
1601	Hippocampus procerus	[a pipefish]	0	N	0	0	1.43	1.07	1.79	N	Low		
1600	Hippocampus multispinus	[a pipefish]	0	N	0	0	1.43	1.07	1.79	N	Low		
1599	Hippocampus hendriki	[a pipefish]	0	N	0	0	1.43	1.07	1.79	N	Low		
1548	Heraldia sp. 1 [in Kuiter, 2000]	Western upsidedown pipefish	0	N	0	0	1.43	1.07	1.79	N	Low		
318	Hippocampus spinosissimus	Hedgehog Seahorse	0	N	0	0	1.43	1.07	1.79	N	Low		
1665	Hippocampus histrix	Spiny Seahorse	0	N	0	0	1.43	1.07	1.79	N	Low		
1666	Hippocampus kelloggi	Kellogg's Seahorse	0	N	0	0	1.43	1.07	1.79	N	Low		

ERA species ID	Scientific name	Common name	Average logbook catch (kg) (2001-04)	Missing > 3 attributes (Y/N)	Missing productivity attributes (out of 7)	Missing susceptibility attributes (out of 5)	Productivity (additive) (1- low, 3-high)	Susceptibility (mult) (1- low, 3-high)	2D vulnerability value (P&S) (low-high range=1.41-4.24)	Susceptibility override used?	2D P&S vulnerability category	High/Med risk category (Refer 2.4.8)	Comments
1094	Vanacampus phillipi	Port Phillip Pipefish	0	N	0	0	1.29	1.07	1.68	N	Low		

Summary of Habitat PSA results

The Habitat component was eliminated at Level 1.

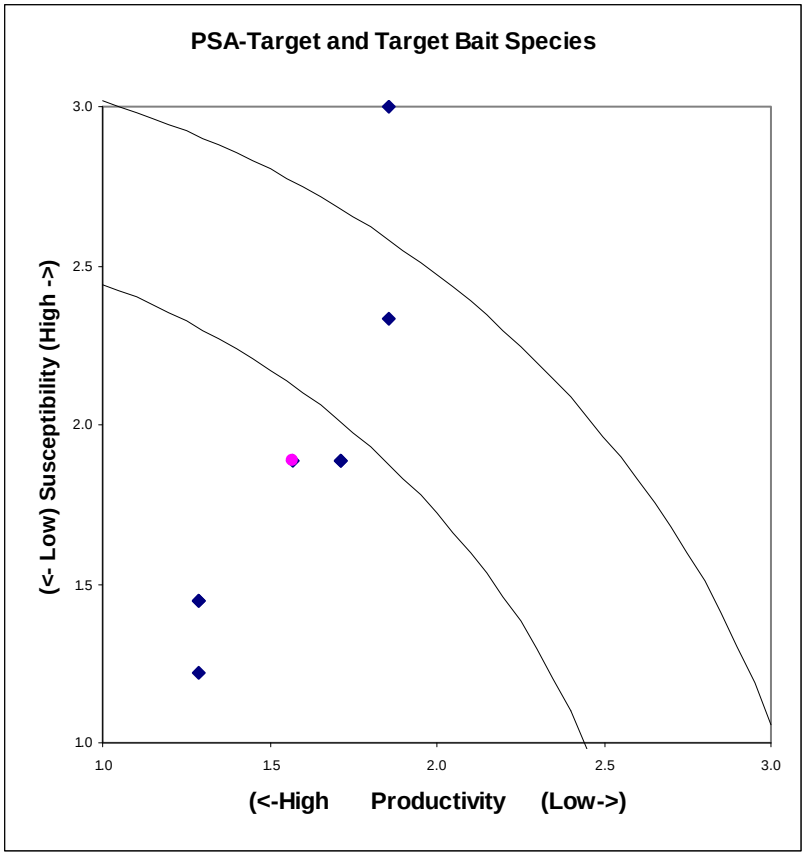
Summary of Community PSA results

The community component was not assessed in this iteration of the ERAEF. It should be included in future.

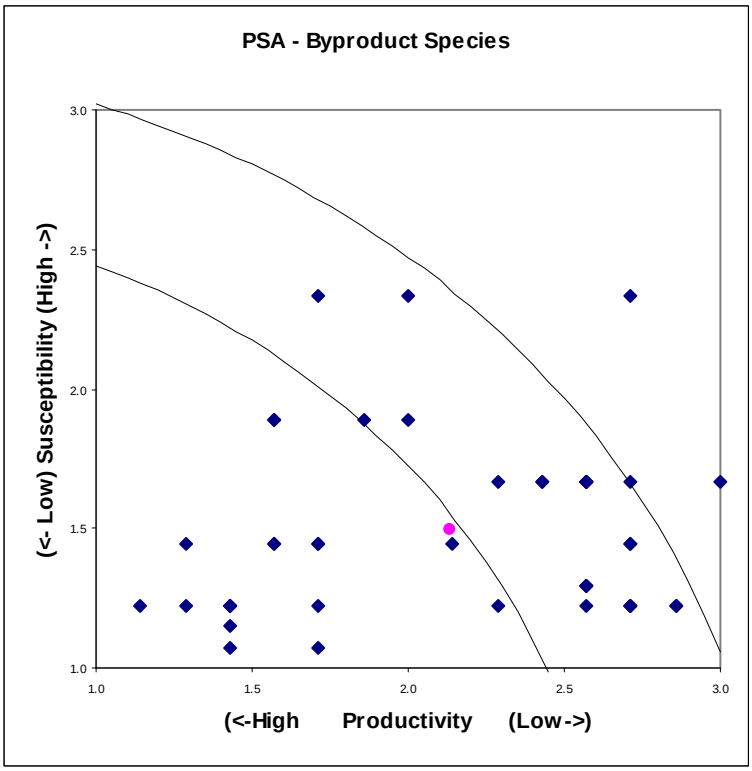
2.4.4 PSA Plot for individual units of analysis (Step 4)

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).

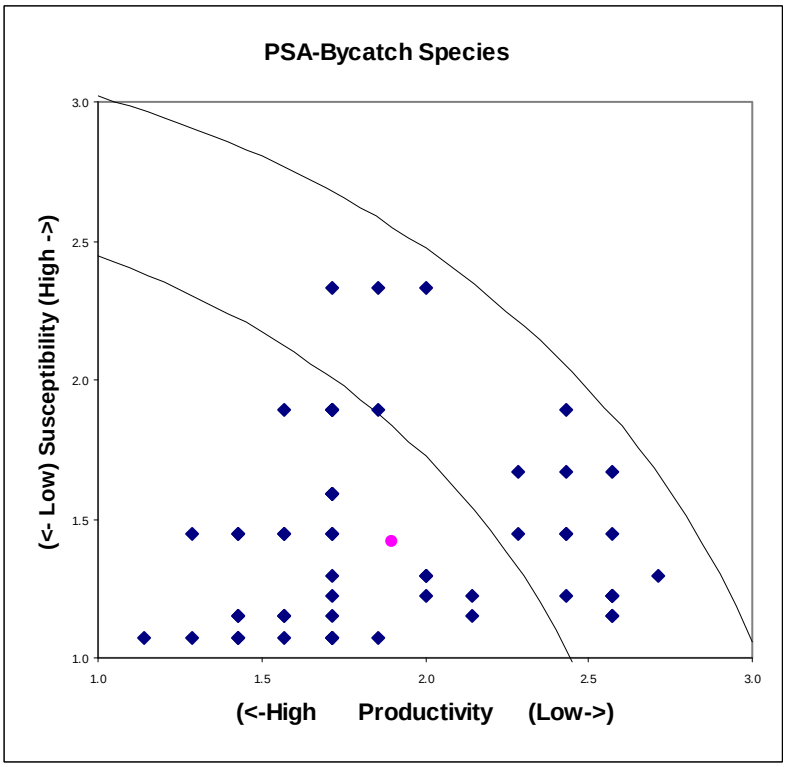
Results of the PSA plot from PSA workbook ranking worksheet



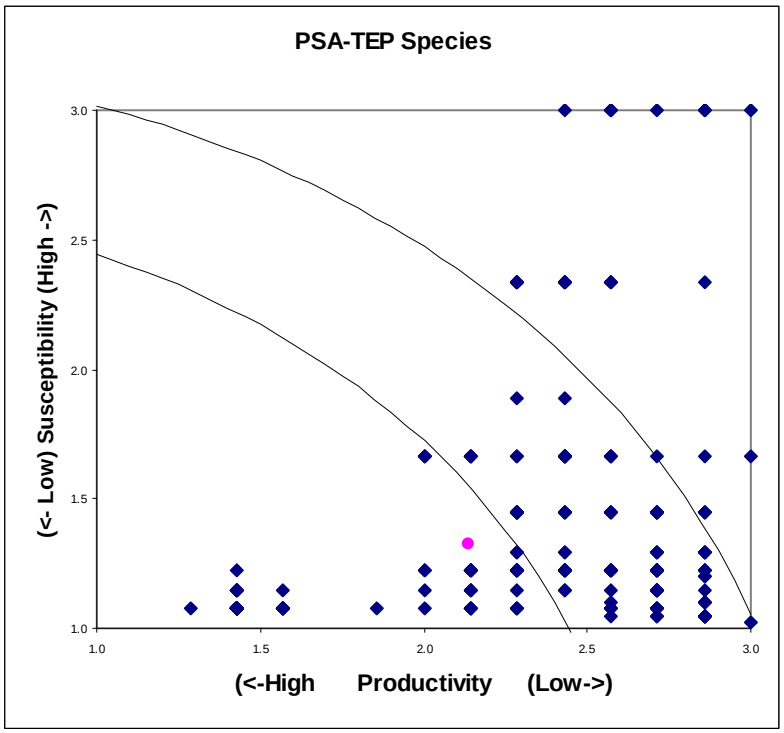
PSA plot for target species and target bait species in the ETBF longline fishery. The magenta dot in the center of the blue diamonds is the average risk for this component.



PSA plot for byproduct species in the ETBF longline fishery. The magenta dot in the center of the blue diamonds is the average risk for this component.



PSA plot for bycatch species in the ETBF longline fishery. The magenta dot in the center of the blue diamonds is the average risk for this component.



PSA plot for TEP species in the ETBF longline fishery. The magenta dot in the center of the blue diamonds is the average risk for this component.

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 (**Figure 17)**. The cut-offs for each category are thirds of the total distribution of all possible risk values (**Figure 17)**.

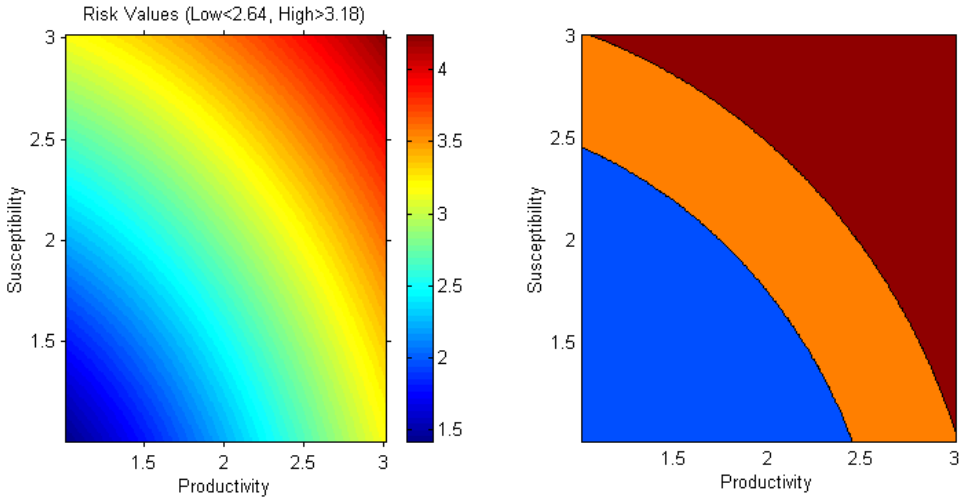


Figure 17. Overall risk values in the PSA plot. Left panel. Colour map of the distribution of the euclidean overall risk values. Right panel. The PSA plot contoured to show the low (blue) risk, medium (orange) risk and high (red) risk values.

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.

2.4.5 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.

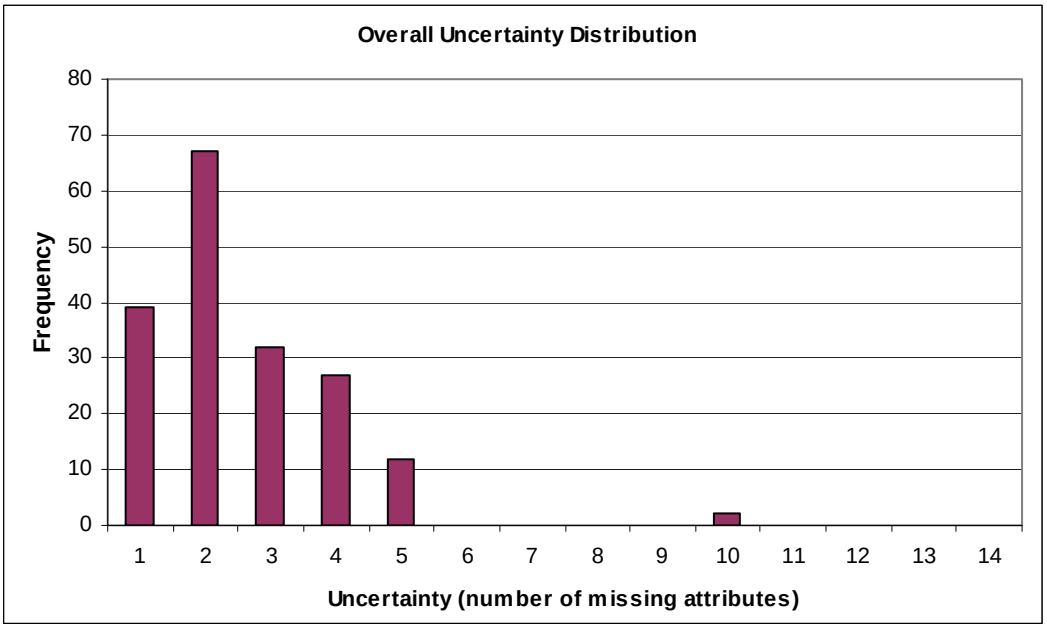
The validity of the ranking can also be examined by comparing the results with those from other data sources or modelling approaches that have already been undertaken in specific fisheries. For example, the PSA results of the individual species (target, byproduct and bycatch and TEP) can be compared 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.

<u>Availability of information</u>
The ability to score each species based on information on each attribute varied between the attributes (as per summary below). With regard to the productivity attributes, Trophic level was missing in 36% of species, and so the most conservative score was used, while information on reproductive strategy could be found or calculated for all of species. The current method of scoring the susceptibility attributes provides a value for each attribute for each species – some of these are based on good information, whereas others are merely sensible default values.

Summary of the success of obtaining information on the set of productivity and susceptibility attributes for the species. Where information on an attribute was missing the highest score was used in the PSA.

Productivity Attributes	Average age at maturity	Average max age	Fecundity	Average max size	Average size at Maturity	Reproductive strategy	Trophic level (fishbase)
Total species scores for attribute	390	390	390	390	390	390	390
n species scores with attribute unknown, (conservative score used)	62	80	40	4	3	3	138
% unknown information	16	21	10	1	1	1	35
Susceptibility Attributes	Availability	Encounterability	Selectivity	PCM			
Total species scores for attribute	390	390	390	390			
n species scores with attribute unknown, (conservative score used)	0	0	0	0			
% unknown information	0	0	0	0			

Each species considered in the analysis had information for an average of 6.10, (87%) productivity attributes and for all susceptibility attributes. Species had missing information for between 0 and 7 (average 1.22) of the combined 12 productivity and susceptibility attributes (note that 4 susceptibility aspects were evaluated from 5 attributes).



Species: Overall uncertainty distribution - frequency of missing information for the combined productivity and susceptibility attributes

Correlation between attributes

Species component:

Species component: The attributes selected for productivity were often strongly correlated (as per correlation matrix below for productivity). The strongest productivity

attribute correlation was between trophic level and maximum age. This is why the attributes for productivity are averaged, as they are all in turn correlated with the intrinsic rate of increase (see *ERAEF: Methodology* document for more details). In contrast the susceptibility attributes were less correlated, which is to be expected as they measure independent aspects of this dimension, and are multiplied to obtain the overall susceptibility score. The strongest susceptibility correlation was between encounterability and availability (0.57), while the rest were very weak (see matrix below).

Correlation matrix for the species productivity attributes. The correlation (r) is based on the scores within each attribute pair. Results from PSA workbook ranking graphs worksheet.

	Age at maturity	Max age	Fecundity	Max size	Min size at maturity	Reproductive strategy	Trophic level
Age at maturity	X						
Max age	0.67	X					
Fecundity	0.49	0.52	X				
Max size	0.27	0.40	0.13	X			
Min size at maturity	0.44	0.61	0.38	0.79	X		
Reproductive strategy	0.39	0.47	0.87	0.10	0.35	X	
Trophic level	0.42	0.67	0.42	0.44	0.59	0.48	X

Correlation matrix for the four species susceptibility attributes. The correlation (r) is based on the scores within each attribute pair. Results from PSA workbook ranking graphs worksheet.

	Availability	Encounterability	Selectivity	Post-capture mortality
Availability	X			
Encounterability	0.27	X		
Selectivity	0.23	0.19	X	
Post-capture mortality	-0.26	0.11	-0.18	X

Habitat Component:
The Habitat component was eliminated at Level 1.

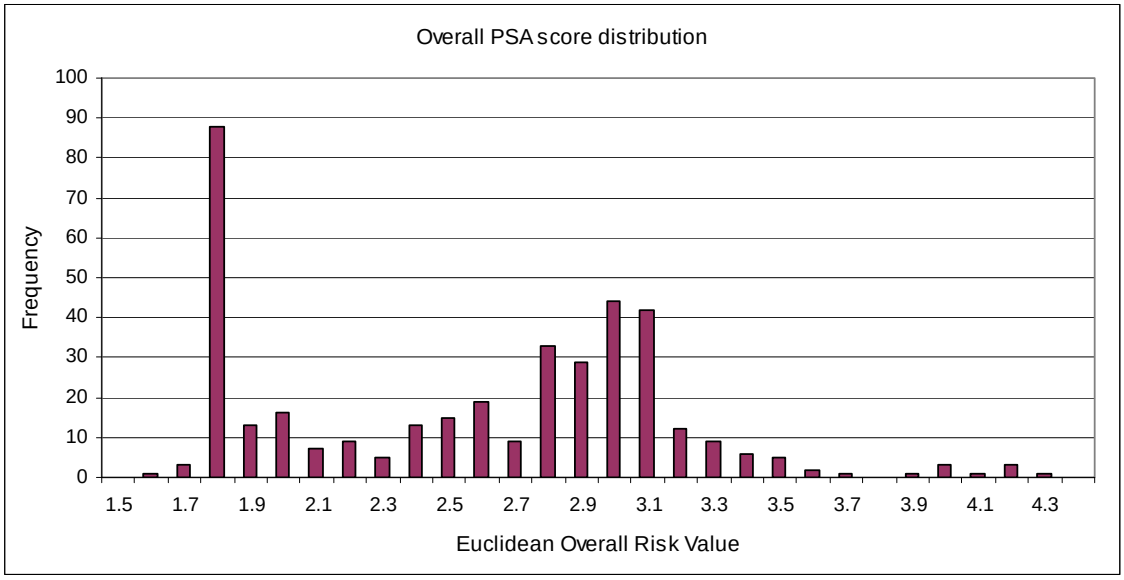
Community Component:
The Community component could not be evaluated at this time.

Productivity and susceptibility values for Species
The average productivity score for all species was 2.09 ± 0.11 (mean ± SD of scores calculated using n-1 attributes) and the mean susceptibility score was 1.37 (as per summary of average productivity and susceptibility scores as below). Individual scores are shown in Section 2.4.2 and 2.4.3: Summary of PSA results. The small variation in the average of the boot-strapped values (using n-1 attributes), indicates the productivity and susceptibility scores are robust to elimination of a single attribute. Information for a single attribute does not have a disproportionately large effect on the productivity and susceptibility scores.

Overall Risk Values for Species

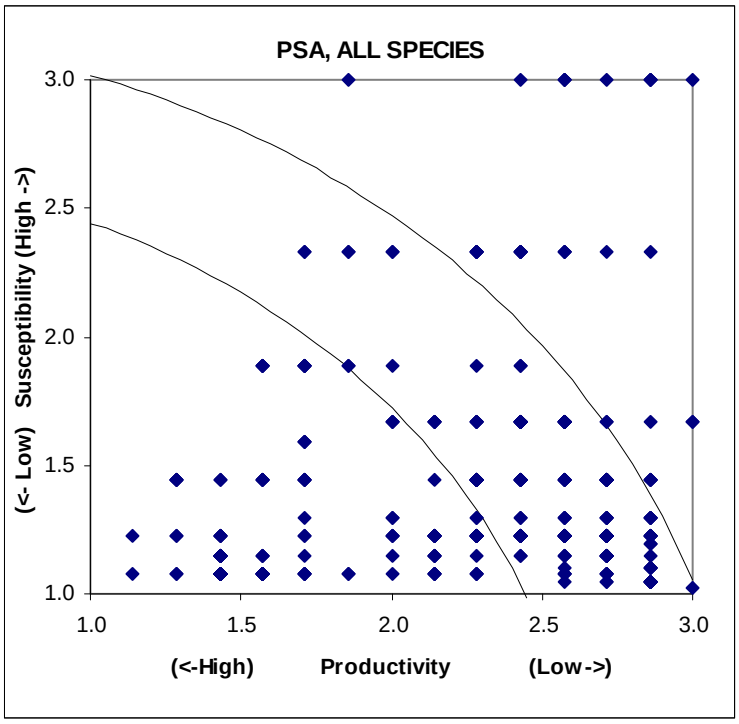
The overall risk values (euclidean distance on the PSA plot) could fall between 1 and 4.24 (scores of 1&1 and 3&3 for both productivity and susceptibility respectively). The mean observed overall risk score was 2.53, with a range of 1.57-3.86**.** The actual values for each species are shown in Summary of PSA results. A total of 34 species, (9%) were classed as high risk, 162 (42%) were in the medium risk category, and 191 (49%) as low risk**.**

Results: Frequency distribution of the overall PSA risk values



Frequency distribution of the overall risk values generated for the species in the ETBF PSA.

The distribution of the overall risk values of all species is shown on the PSA plot below. The species are distributed in all parts of the plot, indicating that both high and low risk units are potentially impacted in the Eastern Tuna and Billfish Fishery.



PSA plot for all species in the Eastern Tuna and Billfish Fishery; Pelagic longline sub-fishery. Species in the upper right of the plot are at highest risk.

2.4.6 Evaluation of the PSA results (Step 6)

Species Components:

The PSA analysis of the Eastern Tuna and Billfish (ETBF) fishery was presented to a stakeholder meeting on 30 March 2005. Changes were made to the analysis on the basis of the feedback provided. The PSA methodology has since been reviewed and revised. The following results reflect the revised methodology (as at 10 April 2006), as well as the changes for individual species.

Overall

A total of 390 species were considered. For most species there was little missing data. The average number of missing attributes was 1.17 out of a possible 12. Of the 390 species assessed, expert over rides were used on 145 species. Of the 34 species assessed to be at high risk, only four species had more than 3 missing attributes.

Summary of average productivity, susceptibility and overall risk scores.

Component	Measure	
All species	Number of species	392
	Average of productivity total	2.09
	Average of susceptibility total	1.36
	Average of overall risk value (2D)	2.52
	Average number of missing attributes	1.14
Target species	Number of species	5
	Average of productivity total	1.74
	Average of susceptibility total	2.22

Component	Measure	
	Average of overall risk value (2D)	2.81
	Average number of missing attributes	0.0
Byproduct species	Number of species	44
	Average of productivity total	2.14
	Average of susceptibility total	1.45
	Average of overall risk value (2D)	2.60
	Average number of missing attributes	0.3
Bycatch species	Number of species	56
	Average of productivity total	1.88
	Average of susceptibility total	1.35
	Average of overall risk value (2D)	2.33
	Average number of missing attributes	0.52
TEP species	Number of species	284
	Average of productivity total	2.14
	Average of susceptibility total	1.34
	Average of overall risk value (2D)	2.54
	Average number of missing attributes	1.41

PSA (productivity and susceptibility) risk categories for each species component**.**

Risk Category	High	Medium	Low	Total
Target species	1	1	3	5
Target/Bait			3	3
Byproduct species	3	23	18	44
Bycatch species		19	35	54
TEP species	30	119	135	284
Total	34	162	194	390

PSA 2D (productivity and susceptibility) risk categories for each taxa.

Risk Category	High	Medium	Low	Total
Chondrichthyan	4	29	1	34
Invertebrate	0	0	0	0
Marine bird	23	39	25	87
Marine mammal	5	46	1	52
Marine reptile	1	32	6	39
Teleost	1	16	161	178
Total	34	162	194	390

Discussion

Target species

Of the 5 target species, one was classified as high risk (broad billed swordfish), 1 as medium risk (striped marlin), and 3 as low risk (yellowfin tuna, bigeye tuna, albacore tuna). All three bait species were classified low risk. There were no missing attributes, but some uncertainty remains. These species are highly migratory with distribution patterns that are not well understood. Therefore availability estimates were classified using general categories only. There was no detailed mapping analysis.

These results are generally consistent with stock assessment information that is available (update from ETBF RAG provided by Campbell Davies, Robert Campbell, and details provided in the Scoping section). Within Australia, none of these species are currently classified as overfished, although several represent international stocks for which overfishing is thought to be occurring across broader scales. This is the case for yellowfin and bigeye, which are assessed by the Secretariat of the Pacific Commission (SPC). The regional assessment for albacore indicates that this species is not being overfished, and biomass is above B_{MSY}. The assessment for Striped Marlin, which is also considered to have an independent distribution in the south-west Pacific, is also uncertain, although overfishing remains a possibility. By contrast, broad billed swordfish are thought to have a more restricted distribution, and recent assessments suggest that overfishing may be occurring within Australian waters, and an interim quota of 1400 t was set for 2006. Broad billed swordfish was at high risk according to the PSA.

Byproduct species

Of the 44 byproduct species, 3 are classified as high risk, 23 as medium risk and 18 as low risk. There were very little missing data. The byproduct species fall into two taxa, chondrichthyans (22) and teleosts (21).

Chondrichthyans:

The three high risk species are chondrichthyans (longfin mako, porbeagle and dusky shark). The longfin mako has very low productivity but is an infrequent visitor to Australian waters; not known here 12 years ago (Last and Stevens 1994). The dusky shark and the bronze whaler have very similar appearance and have been confused in logbook and observer data. The bronze whaler mainly occurs over the inner shelf but the dusky shark occurs from the surf zone to oceanic waters adjacent to the continent. In all likelihood, most of the data recorded against these two whaler shark species represent dusky sharks, which have been overfished in other fisheries (McAuley, 2006). The porbeagle is widely distributed, but has been reduced in some North Atlantic Areas.

The other 30 chondrichthyans are classified as medium (n=29) or low (n=1) risk. The shortfinned mako has the highest catches recorded in logbooks, which is of concern for this low productivity species. The remaining chondrichthyans classified as medium risk with large catches are: blue shark, oceanic whitetip shark, scalloped hammerhead (low productivity), tiger shark (low productivity), thintail and thresher shark (low productivity). The blue sharks and the oceanic white-tips are highly migratory species with broad distributions. Their availability within Australian waters is difficult to assess. There have been high catches of blue shark in the region since the days of the Japanese tuna fleets and potentially the risk for blue shark has been under-represented.

Teleosts:

Of the 21 byproduct teleost species, 6 are classified as medium risk and 15 are low risk. The teleosts classified as medium risk with large catches (by decreasing weight of catch) are: rudderfish and oilfish, both of which have medium productivity.

The dolphin fish (mahi mahi) is classified at low risk, but has significant catches, the third highest of the byproduct species. This is followed by the escolar. All these species

have lower (within medium range) productivity than the other byproduct teleosts classified at low risk.

The southern bluefin tuna is targeted and managed in the SBT and ETBF fisheries. This species is considered overfished, and overfishing has been occurring since 1992 (BRS 2004). The spawning stock is severely depleted and the current catches limit the probability of rebuilding. The reliability of the assessment is high for current status but less robust for future projections. The species is highly migratory and the biology and life-history of this species make it slow to recover from overfishing, contrasting with the tropical tunas such as yellowfin or skipjack (BRS 2004). Particular measures are in place to reduce incidental take of this species in the ETBF, including a (variable) southern limit to the extent of the fishery.

Bycatch species

Of the 54 bycatch species, none were classified as high risk, 19 as medium risk and 35 as low risk. There were some missing data. The bycatch species fall into two taxa, chondrichthyans (9) and teleosts (49).

Chondrichthyans:

All of the 9 bycatch Chondrichthyans were are classified as medium risk. There were no missing data. As examples, the following species were classified as medium risk: black shark (medium productivity), velvet dogfish (border medium to low productivity) and brier shark (low productivity). Two of these species (Black shark -*Dalatias licha* and Brier shark - *Deania calcea*) are demersal bottom feeders from the upper slope. In all likelihood, catches attributed to these species are, in fact catches of velvet dogfish (*Zameus* sp), which occurs through the water column.

The cookie cutter shark (cigar shark) with medium productivity is the other species which is within the range of the fishery at depths from surface to 1000m (Last and Stevens, 1994). The true cookie cutter shark is rarely caught but the common name is also applied to other dogfishes including Lantern sharks - *Etmopterus* spp, black sharks -*Dalatias licha*, and velvet dogfish –*Zameus*. It is not possible to determine from the data what species of 'cookie cutter' are caught regularly.

Teleosts:

Of the 49 bycatch teleosts, none are classified as high risk, 8 as medium risk and 39 as low risk. The species classified as medium risk tended to have medium to low productivity when compared to those species considered to be at low risk. Two such species are the shortbill spearfish and the ocean sunfish. The only species with high catch from the logbook data classified at low risk is the sailfish which has medium-high productivity.

TEP species

Of the 284 TEP species, 30 were classified as high risk, 119 as medium risk and 135as low risk. The TEP species fall into 5 broader taxa: chondrichthyans (3), marine birds (87), marine mammals (52), marine reptiles (39), and teleosts (103). The TEP component had the most missing attributes.

Chondrichthyans:
One of the TEP Chondrichthyans was classified as high risk (white shark); the other two species, whale shark and grey nurse shark were at medium risk, due to low productivity rather than high susceptibility. The AFMA Data Summaries provide information on catches of these species. For the white shark (great white) 1999/00, 1 was observed caught and dead. For the grey nurse shark 2000/01, 5 were caught alive. The other species was the whale shark. All species have low productivity. The whale shark is a plankton feeder and is not likely to be attracted to bait.

Marine birds:
Of the 87 marine birds, 23 were classified at high risk, 39 at medium risk and 25 at low risk. The two groups at high risk were shearwaters and albatross. According to BRS (2004), in the ETBF marine birds such as albatross and shearwaters may be attracted to long line baits when vessels are setting their gear, and some birds are hooked and drown. The 1998 Threat Abatement Plan to reduce incidental bycatch of marine birds requires longline operators to deploy approved bird scaring tori lines, to set only at night when operating south of 30^{o} S, and to not discharge offal during line setting and hauling. Trials are underway regarding mitigation measures such as chutes and line weighting (BRS 2004.)

The AFMA Data Summaries for 03/04 and 04/05 are the only years to list observations of individual species and to record types of interactions, including light or heavy contact with vessel gear; chasing and diving for baits or target and non target species; wildlife hook or entangled; and seabird species around vessels while hauling and setting. A report by Dambacher (2005) also contains information, and should be consulted in the next iteration.

The albatross and shearwaters were generally classed as high risk. Although there are limited observer data on individual species which might have allowed overrides for some species, this approach was not possible as the AFMA Data Summaries for 1999/00 – 2004/05 record undifferentiated species of albatross and shearwaters as caught dead and alive during this period. The AFMA Data Summaries for 03/04 also observed undifferentiated petrels chasing or diving for bait and around vessels while setting and hauling. AFMA Data Summaries for 04/05 observed undifferentiated petrels, prions, shearwaters, and albatross around vessels while setting and hauling.

In general most albatross have low productivity, but there were also missing attributes for this species group. The albatross species observed (apart from the undifferentiated species) by type of interaction are as follows. Most of the marine birds caught in 03/04 and 04/05 were dead. Those dead included 03/04 Black browed, Bullers, Shy, and Yellow nosed albatross; 04/05 Wandering and Black browed albatross. Those cut free or escaped in 03/04 included Black browed and Wandering albatross; 04/05 Shy albatross. Those with light and heavy interaction with the gear, or observed chasing and diving for bait, in descending order of numbers observed in 03/04, included Black browed, and Yellow nosed, Wandering, Shy, Bullers and Indian nose albatross; 04/05 included Black browed, Wandering, Yellow nosed, Shy and Royal (Southern royal) albatross. These species of albatross were also observed around vessels while hauling and setting and represented less than 5% of marine birds seen in the vicinity of the

vessels. The other albatross in this category (apart from undifferentiated albatross) were Campbell, Gibson, and Sooty albatross.

The shearwater species observed (apart from the undifferentiated species) by type of interaction are listed by year. All shearwaters caught in 03/04 and 04/05 were dead. In 03/04 those dead included Flesh footed, Short tailed, and Sooty shearwater; and in 04/05 the Flesh footed shearwater. For those species with light and heavy interaction, or observed chasing and diving for bait, in descending order of numbers observed in 03/04, included the Flesh footed and Short tailed shearwater; and in 04/05 included Sooty, Flesh footed and Short tailed shearwaters. The following species of shearwaters were also observed around vessels while hauling and setting: for 03/04 the Wedge tailed, Flesh footed represented a high proportion with the rest less than 5% of marine bird composition; and in 04/05 the Flesh footed shearwater, representing a high proportion of marine birds, and Sooty shearwaters 6% composition.

Marine mammals:
Of the 52 marine mammals, only 5 were classified as high risk, 46 at medium and 1 at low. This group can be further categorised into main species groups as follows: whales (30), dolphins (15), seals (5), sea lions (1), and dugong (1).

Whales and dolphins:
The AFMA Data Summaries for 1999/00 – 2004/05 observed undifferentiated whales and dolphins caught alive although for 2001/02 1 was caught dead. Of the 30 whales and 15 dolphins, only 2 were classified as high risk and in general there was very little missing data. Nearly all the whales and dolphins scored low productivity. Bob Stanley provided a paper relevant to the ETBF [Bell et al (2006) Marine mammals and Japanese longline fishing vessels in Australian waters: operational interactions and sightings *Pacific Cons Biology* 12:31-39]. The paper analysed observer data from Japanese fleets 1980 -1997 and provided information on whales and dolphins. For killer and false whales, one of each were hooked and cut free alive, and one of each were caught drowned. One undifferentiated whale was caught dead. Killer and false whales were observed taking, damaging, and scaring away target species. Two killer whales were observed taking bycatch or bait fish and took a prolonged interest in the vessel, possibly feeding. A small pod of pilot whales was observed taking a prolonged interest in the vessel, possibly feeding. According to BRS (2004) marine mammals sometimes create problems for fishers by removing or damaging hooked fish before the longline is hauled.

Seals:
All five seals were classed as medium risk (New Zealand, Australian fur, and sub-Antarctic seals, leopard and elephant seal). There were no missing attributes for these species. Bell et al (2006) provides relevant data for this group, for a range of fisheries. They analysed observer data for the Japanese fleets from 1980 -1997 and provided information on leopard seals. Two were observed hooked, one alive but for the other the paper does not provide status alive or dead. A small number of elephant seals have been caught and killed in sub-Antarctic fisheries (Bob Stanley, AFMA pers comm.). Bell et al (2006) also recorded 4 unidentified seals caught with 2 cut free alive but the report does not provide status alive or dead on the other two.

Marine reptiles:
Of the 39 marine reptiles, only 1 was classified as high risk, 32 at medium and 6 at low risk. This group can be further categorised into turtles (6) and sea snakes (33).

Turtles:
Of the 6 turtles, 1 were classified as high risk (leathery turtle) and 5 at medium (loggerhead, hawksbill, green, olive ridley and flatback turtles). There was little missing information. The AFMA Data Summaries for 1999/00 – 2004/05 observed undifferentiated turtles caught dead and alive. Individual species (green, hawksbill, loggerhead, and olive ridley) were all observed caught alive during this period. The leatherback (same as leathery turtle) turtle was observed caught dead and alive during this period. The 03/04 Data Summaries recorded the leatherback (3) and hawksbill turtles (1) as caught but jerked free. The 04/05 Data Summaries recorded the green turtle as 2 caught dead, 1 cut free, 2 jerked free; for the olive ridley (same as pacific ridley) 1 was caught and tagged. According to BRS (2004) the ETBF expansion of shallow line sets targeting swordfish has increased the likelihood of catching sea turtles. A BRS project has examined the extent of ETBF turtle bycatch and possible mitigation measures that the fishery might adopt. The results of the project suggest that turtle interaction rates in the ETBF are low compared to other longline fisheries and that almost all turtles are released alive. Despite this finding, the project also highlights the need for improved data collection on turtle interaction rates.

Sea snakes:
Of the 33 sea snakes, none were classified high risk. Most were low risk. At the Stakeholder meeting 30/3/05 sea snakes were not considered an issue for this fishery.

Teleosts (TEP):
Of the 103 TEP teleosts, all were classified as low risk and 100 were from the syngnathid family. At the stakeholder meeting 30/3/05 pipehorses were not considered an issue for this fishery. This is supported by analysis of detailed mapping data which shows that the fishery does not overlap with the distribution of seahorses, apart from perhaps when collecting bait.

Habitat Component:
The Habitat component was eliminated at Level 1.

Community Component:
The Community component was not able to be assessed at Level 2 at this time.

2.4.7 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. These 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.

Units at low risk, in the lower third (risk value <2.64), will be deemed not at risk from the sub-fishery and the assessment is concluded for these units.

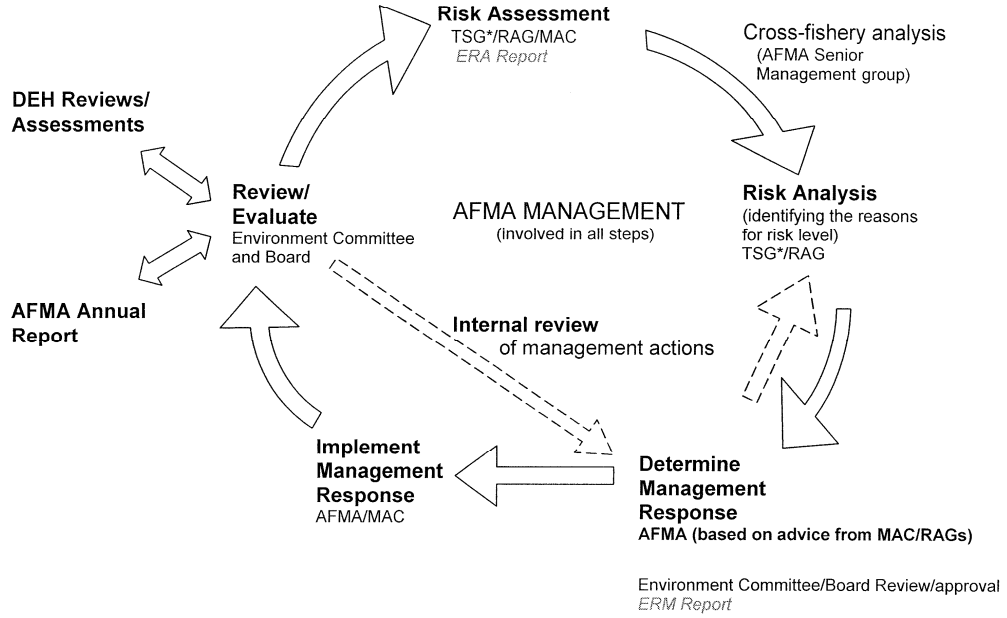
For example, if in a Level 2 analysis of habitat types, two of seven habitat types were determined to have risk from the sub-fishery, only those two habitat types would be considered at Level 3.

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 (see Figure x below) makes use of the existing AFMA management structures to enable the ERAs to become a part of normal fisheries management, including the involvement of fisheries consultative committees. A separate document, the ERM report, will be developed that outlines the reasons why species are at high risk and what actions the fishery will implement to respond to the risks.

Figure x: Ecological Risk Management Framework



*T

SG – Technical Support Group - currently provided by CSIRO.

2.4.8 High risk categorisation (Step 8)

Following the Level 2 PSA scoring of target, bycatch and byproduct, and TEP species, the high risk species can be divided into categories that highlight some potential reasons for the high risk scores. These categories should also assist decisions regarding possible management responses for these species. The categories are exclusive and species are allocated to each category in the order the categories are presented below. Thus, while in principle a species could qualify for both Category 1 and 2, it will only appear in Category 1 because that was scored first. The five categories are programmed into the PSA excel spreadsheets for each fishery according to the following algorithms:

- **Category 1: Missing data** (*>3 missing attributes in either Productivity or Susceptibility estimation)*. Rationale: A total of 3 or more missing attributes (out of 12 possible) could lead to a change in risk score if the information became known (3 identified by sensitivity analysis). Recall missing information is scored as high.
- **Category 2**: Spatial overlap categorization
    - **2A.** *low overlap inside the fishery (<20%).* Refers to the preferred Availability attribute used to calculate Susceptibility. Rationale: This cutoff (20%) has no strong rationale, other than being a low percentage overlap. Additional work to determine what threshold might be applicable is required. However, the categories are to be used as a guide for management, and additional effort deciding on cutoffs may be misplaced if the categories are just used a guide. This category is a direct count of the attribute values below the threshold. The same could be done for the encounterability and selectivity attributes, however, availability (overlap) is seen as more important than the other two attributes. This is because a subtle change in

fishing practice could modify encounterability or selectivity, while to change availability requires some major changes in fleet location, which will be easier to detect.
    - **2B.** *widely distributed outside the fishery (>0.8).* More than 80% of the species range is outside the jurisdictional range of the fishery.
- **Category 3**: *Low Susceptibility- Low Productivity species*. Two alternatives for categorising these species should be considered, and further consideration is required. The first is based on the PSA scores, the second on the attribute scores that led to the susceptibility score.
    - **3A**: *Low Susceptibility (<1.5), Low Productivity (>2.5) species*. Rationale: This category identified where species may be classed high risk because of the inherent low productivity, even when susceptibility is low (e.g. albatross). The scores represent the lower right hand area of the PSA plot. The cutoffs are selected as the lower parts of the distribution for both productivity and susceptibility (recall scores are between 1 and 3). Using this approach, a score of 1 x 3 x 3 x 3 = 1.67, and 2 x 2 x 2 x 2 = 1.40 would be above and below the category threshold, when the converse is preferred. There is no single threshold that avoids this issue. The alternative is to categorize on the basis of the individual attribute scores (see 3B)
    - **3B**. One attribute within the susceptibility calculation is scored as a 1.
- **Category 4**: *Missing spatial overlap data* (Thus, this is a count of the number of species missing less than 3 attributes (i.e. not in Category 1) and missing spatial data). Thus, availability was calculated using the second attribute (Distribution: Global/Southern Hemisphere/Australia, with stock likelihood overrides where necessary). Rationale: the absence of fine scale catch and species distribution data (e.g. TEP species) means that the substitute attribute (precautionary) was used. Spatial data should be sought.
- **Category 5**: *remain high after 1-4 considered* (i.e. not Category 1-4).

In the ETBF longline fishery 35 species were originally classified as high risk, 4 as a result of missing information (Category 1), 3 had low overlap inside the fishery (Category 2A), 2 had low susceptibility and low productivity (Category 3A), and 26 were missing spatial information (Category 4). After considering all these categories, no species remained high (Category 5).

Category	Description	Total
High original		35
Category 1	Missing data	4
Category 2A	Low overlap (inside fishery)	3
Category 2B	Widely distributed outside fishery	0
Category 3A	Low susceptibility, Low productivity	2
Category 3B	One susceptibility attribute =1	0
Category 4	Missing spatial overlap data	26
Category 5	Remaining High	0

These categories do not result in a down-grading of risk. They are intended as a tool to focus the subsequent discussions. Sensitivity analysis to the particular cutoffs has not been undertaken in a formal sense, and may not be required, as these categories are

intended as guides to focus the consideration of the high risk species. These categories may also indicate false positives in the high risk species category.

2.5 Level 3

There are no stock assessments for any of the target species, bycatch, or byproduct species. There are some Level 3 type analyses being undertaken for one of the seabird species, Fleshy foot shearwater, and may provide additional information about the risk.

3. General discussion and research implications

3.1 Level 1

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

- Fishing (direct impacts on all ecological components except habitats),
- Fishing without capture (direct impact on TEP species),
- Translocation of species (impact on all components except habitats)
- On board processing (impact on TEP species), and
- Discarding catch (impact on TEP species).

The direct impacts of fishing hazard was scored as moderate for bycatch and communities components, major for the Target component, and severe for the TEP component. Confidence scoring was high for Target and TEP components, but low for the Bycatch and Communities.

Risks to species components, from Translocation, On-board processing and Discarding, were all assessed with low confidence scores. Translocation was considered to be a major risk (4) to both Target and Communities components.

3.2 Level 2

The PSA species analysis has identified a small number of species at potentially high risk from fishing, particularly TEP species. This section evaluates these results in the light of observer data, direct comments from observers, and the (limited) published literature on bycatch from the Japanese pelagic longline fishery in the same region.

3.2.1 Species at risk

The authors consider that 23 high/medium risk species need further evaluation or management response. This judgment is based on taxonomy/identification, distribution, stock structure, movements, conservation status and overlap with this/other fisheries (sorted by taxa and risk category) as discussed further below.

Species	*Risk category*	*Role*
High risk species		
Teleosts		
• Broadbilled swordfish	Spatial uncertainty	Target
Chondrichthyans:		
• Longfin mako shark	Spatial uncertainty	Byproduct
• Porbeagle shark	Low overlap	Byproduct
• Dusky Shark	Low overlap	Byproduct
Marine birds		
• Buller's Albatross	Spatial uncertainty	TEP
• Shy Albatross	Spatial uncertainty	TEP

- Yellow-nosed Albatross Spatial uncertainty TEP
- Grey-headed Albatross Spatial uncertainty TEP
- Southern Royal Albatross Spatial uncertainty TEP
- Wandering Albatross Spatial uncertainty TEP
- Black-browed Albatross Spatial uncertainty TEP
- Sooty Albatross Spatial uncertainty TEP
- Light-mantled Albatross Spatial uncertainty TEP
- Gibson's Albatross Spatial uncertainty TEP
- Northern Royal Albatross Spatial uncertainty TEP
- Campbell Albatross Spatial uncertainty TEP
- Indian Yellow-nosed Albatross Spatial uncertainty TEP
- Tristan Albatross Spatial uncertainty TEP
- White-capped Albatross Spatial uncertainty TEP
- White-chinned Petrel Spatial uncertainty TEP
- Wedge-tailed Shearwater Spatial uncertainty TEP
-

Marine reptiles

- Leathery turtle Spatial uncertainty TEP

Medium risk species

Chondrichthyans:

- Blue shark Low overlap
  Byproduct

The broad billed swordfish, a target species, is likely to be a local stock, and as such has increased the risk score of this target species to high.

Only three of 98 byproduct and bycatch species, 3 were evaluated to be at high risk from fishing. These were all Chondrichthyan species (longfin mako, porbeagle and dusky shark). The blue shark is a byproduct species that is caught in significant volume and, although scored medium risk, should be given further consideration. Abundance data are limited for these species, so exploitation rates and true risk remain unclear. However domestic and international observer data is available and could be analysed.

The majority of the high risk species are TEP species. Of the 284 TEP species that occur within the range of the fishery, 30 were scored as high risk in the PSA analysis. Of these species, 23 were marine birds, 5 were marine mammals (whales and dolphins), 1 was a chondrichthyan, and 1 was a marine reptile (turtle). No TEP fishes (teleosts) were found to be at high risk from the ETBF fishery. Many of the high risk groups have low productivity, which tends to place them at higher risk in the PSA analysis, but susceptibility to the gear is harder to determine. As discussed in the methods, a precautionary approach is taken regarding assumptions about susceptibility, and will tend to lead to false positives rather than false negatives with regard to identifying high risk species. For this reason, it is useful to verify the high risk species based on more direct observations, particularly the use of species specific observer data and information.

The AFMA observer program has been operating in the fishery since July 2003, and aims to achieve 5% coverage overall (about 3 to 4% has been achieved, but varies seasonally and spatially). Details of the observer program design were not available, nor were electronic copies of data, so analyses relied on the annual Data Summaries prepared by the AFMA Data Group (for 2003/04 and 2004/05). These summaries include common names but not scientific names, and some of the groups are reported as undifferentiated species (e.g. "petrels", "moonfish"). However members of the ERA analysis team did approach at least one observer (Bob Stanley) for direct information and comment on individual species, particularly seabirds.

The Data Summaries show that large numbers of birds interact with the fishing gear or the vessel; considerable numbers of some groups are caught, and a number do not survive. These groups include albatross, petrels, mutton birds and shearwaters, and "unspecified" seabirds. (Information on catch by species (rather than by group) is only available from mid 2003.) All seabirds have low productivity, but of the specified groups, albatross are known to have very low productivity, and to be at risk from pelagic longline fishing. For example, 6 wandering albatross were observed to be discarded (dead) from pelagic-longline observed trips in 2004/05. This would represent a considerable mortality over a year, weighted up by the level of observer coverage.

Trends on captures of seabirds in the Data Summary show that numbers caught have been declining for most groups. The data by groups extends back to 1999/2000, a year after the introduction of a Threat Abatement Plan (TAP) for the incidental catch of seabirds in oceanic longline fishing. This TAP requires that one or more mitigation measures are introduced into fishing operations, including setting at night, weighting of lines, use of thawed bait, use of bird scaring devices, etc. The overall aim is to reduce capture rates (of seabirds generically) to below 0.05 captures per thousand hooks. The decreasing rates of capture recorded in the Data Summaries suggest that the strategy may be working. However in the absence of independent data on trends in abundance, the capture data may simply reflect declining populations of seabirds. A study is currently underway to examine this issue in more detail for captures of fleshy footed shearwaters (Geoff Tuck, CSIRO pers comm.). This study essentially involves doing a Level 3 analysis for this species, and the results, when available, should be considered in relation to implications for this fishery.

Captures of marine mammals appear to be rare events, based on the 2004/05 Data Summary, with only one death recorded over the past six years. However, it is not clear from Table 8 in the Data Summary whether these data have been scaled up by the level of observer coverage to total numbers of animals caught for the whole fishery. If not, then more marine mammals may be captured by the fishery each year. Additional information in Bell *et al* (2006) based on interactions with marine mammals observed in the Japanese longline fishery in Australian waters (1980 to 1997) tends to confirm low levels of capture of marine mammals in this fishery.

The Data Summaries also include trends in captures of 6 species of turtles. Considerable numbers of these are caught, with most apparently being returned alive. There is no apparent downward trend indicated in these capture data.

Specific research and monitoring issues that arise from the above include:

- Observer data need to be compiled in accessible and well structured data bases to facilitate analysis of patterns in the data
- Further observer training in identification of some shark groups would be useful (whalers and dogfish in particular)
- It would be very useful if summary reports listed scientific as well as common names
- Clarify whether TEP data from observers reported in annual Data Summaries are weighted up to whole of fishery level by rates of observer coverage
- More detail is required (to be publicly available) on the design and operation of the observer program, including issues such as program objectives, statistical power, spatial and temporal coverage, experience of observers, taxonomic resolution in data, etc
- More detailed spatial information on high risk migratory species (particularly seabirds, turtles and pelagic sharks) should be sought
- Monitor the outcomes of fleshy footed shearwater Level 3 analysis and consider extending to other high risk species

Residual risk

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

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

CSIRO and AFMA will continue to work together to include the broad set of management arrangements in Level 2 analyses, and these methods will be incorporated in future developments of the ERAEF framework. CSIRO has also undertaken some

preliminary Level 3 analyses for bycatch species for several fisheries, and these or similar methods will also form part of the overall ERAEF framework into the future.

3.2.2 Habitats at risk

Not relevant; eliminated at Level 1

3.2.3 Community assemblages at risk

The community component was not assessed at Level 2 for this sub-fishery, but should be considered in future assessments when the methods to do this are fully developed.

3.3 Key Uncertainties / Recommendations for Research and Monitoring

In assessing risk to byproduct, bycatch and TEP 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 should be sought and examined for the high risk species identified in this analysis.

Specific recommendations arising from this assessment include:

- Further analysis of observer data and attempt to weight up total captures and deaths to whole of fishery level
- Collate finer scale distributional information for high risk species and map
- Possibly extend flesh-footed shearwater interaction rate analysis to other bird species
- Better species identification of pelagic sharks, marine mammals, and birds

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Glossary of Terms

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

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

Appendix A: General summary of stakeholder feedback (added for October 2006 feedback)

Date	Format received	Comment from stakeholder	Action/explanation
October 2006	Consolidated comments received from AFMA end of Sept 2006	1. Striped Marlin, albacore – scores seem low given other known information from assessment 2. Skipjack tuna – medium risk – seems over estimated (is same as SBT). 3. Luvar – operators did not know what it is and have never caught it.	1. Disagree with albacore comment. See words added to text (Rob Campbell). The regional assessment for albacore indicates that this species is not being overfished, and biomass is above B_{MSY}. Striped marlin came out at medium, which is consistent with assessment information. The assessment for Striped Marlin, which is also considered to have an independent distribution in the south-west Pacific, is also uncertain, although overfishing remains a possibility. 2. Skipjack is low in revised PSA 3. This species remained from Stage 1, Japanese data. Has been removed from the list and the report, as not in current AFMA logbook records.
October 2006	Consolidated comments received from AFMA end of Sept 2006	Species ID 210000 (Procellaria parkinsoni) is the same as Species ID 1042.	This error corrected in the PSA and report, species only included once. Updated in database.
October 2006	Consolidated comments received from AFMA end of Sept 2006	Species ID 21000001 (Catharacta maccormicki) is not listed in the Microsoft Access database that should include all species	Correct species number was 2766
October 2006	Consolidated comments received from AFMA end of Sept 2006	Species ID 1673 (Pacific Albatross) occurs twice - listed as same scientific name, but different family?	This error corrected in the PSA and report. Updated in database.

Appendix B: PSA results summary of stakeholder discussions

Level 2 (PSA) Document L2.1. Summary table of stakeholder discussion regarding PSA results.

The following species were discussed at the INSERT FISHERY GROUP NAME meeting on INSERT DATE and LOCATION. ALL or SELECTED high risk species were discussed.

Taxa name	Scientific name	Common name	Role in fishery	PSA risk ranking (H/M/L)	Comments from meeting, and follow-up	Action	Outcome	Possible management response
					e.g. Distribution queried- core depth is mostly shallower than fishery	*Changed depth dsn*	*Reduced risk from high to medium*	
					e.g. extra size information provided by fishers	*Max size added*	*Reduced risk from high to medium*	
					e.g. Confusion re species identification	*none*	*none*	*Improve species identification*
					e.g. more common on outer shelf. Does occur in range of fishery according to literature.	*none*	*none*	*Check depths at which caught in adjacent fishery*

Appendix C: Level 1 Description of consequences for each component

Table 5A. Target 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	2 Minor	3 Moderate	4 Major	5 Severe	6 Intolerable
Population size	**1. Population size** Insignificant change to population size/growth rate (r). Unlikely to be detectable against background variability for this population.	**1. Population size** Possible detectable change in size/growth rate (r) but minimal impact on population size and none on dynamics.	**1. Population size** Full exploitation rate but long-term recruitment dynamics not adversely damaged.	**1. Population size** Affecting recruitment state of stocks and/or their capacity to increase	**1. Population size** Likely to cause local extinctions if continued in longer term	**1. Population size** Local extinctions are imminent/immediate
Geographic range	**2. Geographic range** No detectable change in geographic range. Unlikely to be detectable against background variability for this population.	**2. Geographic range** 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.	**2. Geographic range** Change in geographic range up to 10 % of original.	**2. Geographic range** Change in geographic range up to 25 % of original.	**2. Geographic range** Change in geographic range up to 50 % of original.	**2. Geographic range** Change in geographic range > 50 % of original.
Genetic structure	**3. Genetic structure** No detectable change in genetic structure. Unlikely to be detectable against background variability for this population.	**3. Genetic structure** Possible detectable change in genetic structure. Any change in frequency of genotypes, effective population size or number of spawning units up to	**3. Genetic structure** Change in frequency of genotypes, effective population size or number of spawning units up to 10%.	**3. Genetic structure** Change in frequency of genotypes, effective population size or number of spawning units up to 25%.	**3. Genetic structure** Change in frequency of genotypes, effective population size or number of spawning units, change up to 50%.	**3. Genetic structure** Change in frequency of genotypes, effective population size or number of spawning units > 50%.

Sub-component	Score/level					
	1 Negligible	2 Minor	3 Moderate	4 Major	5 Severe	6 Intolerable
		5%.				
Age/size/sex structure	**4. Age/size/sex structure** No detectable change in age/size/sex structure. Unlikely to be detectable against background variability for this population.	**4. Age/size/sex structure** Possible detectable change in age/size/sex structure but minimal impact on population dynamics.	**4. Age/size/sex structure** Impact on population dynamics at maximum sustainable level, long-term recruitment dynamics not adversely affected.	**4. Age/size/sex structure** Long-term recruitment dynamics adversely affected. Time to recover to original structure up to 5 generations free from impact.	**4. Age/size/sex structure** Long-term recruitment dynamics adversely affected. Time to recover to original structure up to 10 generations free from impact.	**4. Age/size/sex structure** Long-term recruitment dynamics adversely affected. Time to recover to original structure > 100 generations free from impact.
Reproductive capacity	**5. Reproductive capacity** No detectable change in reproductive capacity. Unlikely to be detectable against background variability for this population.	**5. Reproductive capacity** Possible detectable change in reproductive capacity but minimal impact on population dynamics.	**5. Reproductive capacity** Impact on population dynamics at maximum sustainable level, long-term recruitment dynamics not adversely affected.	**5. Reproductive capacity** Change in reproductive capacity adversely affecting long-term recruitment dynamics. Time to recovery up to 5 generations free from impact.	**5. Reproductive capacity** Change in reproductive capacity adversely affecting long-term recruitment dynamics. Time to recovery up to 10 generations free from impact.	**5. Reproductive capacity** Change in reproductive capacity adversely affecting long-term recruitment dynamics. Time to recovery > 100 generations free from impact.
Behaviour/movement	**6. 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.	**6. Behaviour/ movement** 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.	**6. Behaviour/ movement** 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.	**6. Behaviour/ movement** Change in behaviour/ movement with impacts on population dynamics. Time to return to original behaviour/ movement on the scale of months to years.	**6. Behaviour/ movement** Change in behaviour/ movement with impacts on population dynamics. Time to return to original behaviour/ movement on the scale of years to decades.	**6. Behaviour/ movement** Change to behaviour/ movement. Population does not return to original behaviour/ movement.

Table 5B. Bycatch and Byproduct species. Description of consequences for each component and each sub-component. Use table as a guide for scoring the level of consequence for bycatch/byproduct species (Modified from Fletcher et al. 2002).

Sub-component	Score/level					
	1 Negligible	2 Minor	3 Moderate	4 Major	5 Severe	6 Intolerable
Population size	**1. Population size** Insignificant change to population size/growth rate (r). Unlikely to be detectable against background variability for this population.	**1. Population size** Possible detectable change in size/growth rate (r) but minimal impact on population size and none on dynamics.	**1. Population size** 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%.	**1. Population size** Relative state of capture/susceptibility suspected/known to be greater than 50% and species should be examined explicitly.	**1. Population size** Likely to cause local extinctions if continued in longer term	**1. Population size** Local extinctions are imminent/immediate
Geographic range	**2. Geographic range** No detectable change in geographic range. Unlikely to be detectable against background variability for this	**2. Geographic range** Possible detectable change in geographic range but minimal impact on population range and none on dynamics, change in	**2. Geographic range** Change in geographic range up to 10 % of original.	**2. Geographic range** Change in geographic range up to 25 % of original.	**2. Geographic range** Change in geographic range up to 50 % of original.	**2. Geographic range** Change in geographic range > 50 % of original.

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

Sub-component	Score/level					
	1 Negligible	2 Minor	3 Moderate	4 Major	5 Severe	6 Intolerable
			recruitment dynamics not adversely damaged.	impact.	generations free from impact.	
Behaviour/movement	**6. 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.	**6. Behaviour/ movement** 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.	**6. Behaviour/ movement** 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.	**6. Behaviour/ movement** Change in behaviour/ movement with impacts on population dynamics. Time to return to original behaviour/ movement on the scale of months to years	**6. Behaviour/ movement** Change in behaviour/ movement with impacts on population dynamics. Time to return to original behaviour/ movement on the scale of years to decades.	**6. Behaviour/ movement** Change to behaviour/ movement. Population does not return to original behaviour/ movement.

Table 5C. TEP species. Description of consequences for each component and each sub-component. Use table as a guide for scoring the level of consequence for TEP species (Modified from Fletcher et al. 2002).

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

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

Sub-component	Score/level					
	1 Negligible	2 Minor	3 Moderate	4 Major	5 Severe	6 Intolerable
		on the scale of hours.	Time to return to original behaviour/ movement on the scale of days to weeks	Time to return to original behaviour/ movement on the scale of weeks to months	original behaviour/ movement on the scale of months to years.	original behaviour/ movement on the scale of years to decades.
Interaction with fishery	**7. Interactions with fishery** No interactions with fishery.	**7. Interactions with fishery** Few interactions and involving up to 5% of population.	**7. Interactions with fishery** Moderate level of interactions with fishery involving up to10 % of population.	**7. Interactions with fishery** Major interactions with fishery, interactions and involving up to 25% of population.	**7. Interactions with fishery** Frequent interactions involving ~ 50% of population.	**7. Interactions with fishery** Frequent interactions involving the entire known population negatively affecting the viability of the population.

Table 5D. 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	2 Minor	3 Moderate	4 Major	5 Severe	6 Intolerable
Substrate quality	**1. 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.	**1. Substrate quality** 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.	**1. Substrate quality** 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%.	**1. Substrate quality** 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.	**1. Substrate quality** 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.	**1. Substrate quality** The dynamics of the entire habitat is in danger of being changed in a major way, or > 90% of habitat destroyed.
Water quality	**2. Water quality** No direct impact on water quality. Impact unlikely to be detectable. Time taken to recover to pre-disturbed state on	**2. Water quality** Detectable impact on water quality. Time to recover from local impact on the scale of days to weeks, at larger spatial scales	**2. Water quality** Moderate impact on water quality. Time to recover from local impact on the scale of weeks to months, at larger spatial scales	**2. Water quality** Time to recover from local impact on the scale of months to years, at larger spatial scales recovery time of weeks to months.	**2. Water quality** Impact on water quality with 50 - 90% of the habitat affected or removed by the activity which may seriously endanger its	**2. Water quality** The dynamics of the entire habitat is in danger of being changed in a major way, or > 90% of habitat destroyed.

Sub-component	Score/level					
	1 Negligible	2 Minor	3 Moderate	4 Major	5 Severe	6 Intolerable
	the scale of hours.	recovery time of hours to days.	recovery time of days to weeks.		long-term survival and result in changes to ecosystem function. Recovery period measured in years to decades.	
Air quality	**3. 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.	**3. Air quality** 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.	**3. Air quality** Detectable impact on air quality. Time to recover from local impact on the scale of weeks to months, at larger spatial scales recovery time of days to weeks.	**3. Air quality** Time to recover from local impact on the scale of months to years, at larger spatial scales recovery time of weeks to months.	**3. Air quality** 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.	**3. Air quality** The dynamics of the entire habitat is in danger of being changed in a major way, or > 90% of habitat destroyed.
Habitat types	**4. 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.	**4. Habitat types** 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.	**4. Habitat types** 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.	**4. Habitat types** 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.	**4. Habitat types** Impact on relative abundance of habitat types resulting in severe changes to ecosystem function. Recovery period likely to be > decadal	**4. Habitat types** 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

Sub-component	Score/level					
	1 Negligible	2 Minor	3 Moderate	4 Major	5 Severe	6 Intolerable
						to centuries.
Habitat structure and function	**5. 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.	**5. Habitat structure and function** Detectable impact on habitat structure and function. Time to recover from impact on the scale of days to months, regardless of spatial scale	**5. Habitat structure and function** 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.	**5. Habitat structure and function** 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.	**5. Habitat structure and function** Impact on habitat function resulting from severe changes to internal dynamics of habitats. Time to recover from impact likely to be > decadal.	**5. Habitat structure and function** 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 5E. 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	2 Minor	3 Moderate	4 Major	5 Severe	6 Intolerable
Species composition	1. Species composition Interactions may be occurring which affect the internal dynamics of communities leading to change in species composition not detectable against natural variation.	1. Species composition Impacted species do not play a keystone role – only minor changes in relative abundance of other constituents. Changes of species composition up to 5%.	1. Species composition Detectable changes to the community species composition without a major change in function (no loss of function). Changes to species composition up to 10%.	1. Species composition 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.	1. Species composition Change to ecosystem structure and function. Ecosystem dynamics currently shifting as different species appear in fishery. Recovery period measured in years to decades.	1. Species composition Total collapse of ecosystem processes. Long-term recovery period required, on the scale of decades to centuries
Functional group composition	2. Functional group composition Interactions which affect the internal dynamics of communities leading to change in functional group composition not detectable against natural variation.	2. Functional group composition Minor changes in relative abundance of community constituents up to 5%.	2. Functional group composition Changes in relative abundance of community constituents, up to 10% chance of flipping to an alternate state/ trophic cascade.	2. Functional group composition 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.	2. Functional group composition 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.	2. Functional group composition Ecosystem function catastrophically altered with total collapse of ecosystem processes. Recovery period measured in decades to centuries.
Distribution of the community	3. Distribution of the community	3. Distribution of the community	3. Distribution of the community	3. Distribution of the community	3. Distribution of the community	3. Distribution of the community

Sub-component	Score/level					
	1 Negligible	2 Minor	3 Moderate	4 Major	5 Severe	6 Intolerable
	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	4. Trophic/size structure Interactions which affect the internal dynamics unlikely to be detectable against natural variation.	4. Trophic/size structure Change in mean trophic level, biomass/ number in each size class up to 5%.	4. Trophic/size structure Changes in mean trophic level, biomass/ number in each size class up to 10%.	4. Trophic/size structure 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.	4. Trophic/size structure 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.	4. Trophic/size structure 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.
Bio-geochemical cycles	5. Bio- and geochemical cycles Interactions which affect bio- &	5. Bio- and geochemical cycles Only minor changes in relative	5. Bio- and geochemical cycles Changes in relative abundance of other	5. Bio- and geochemical cycles Changes in relative abundance of constituents	5. Bio- and geochemical cycles Changes in relative abundance of	5. Bio- and geochemical cycles Ecosystem function catastrophically

Sub-component	Score/level					
	1 Negligible	2 Minor	3 Moderate	4 Major	5 Severe	6 Intolerable
	geochemical cycling unlikely to be detectable against natural variation.	abundance of other constituents leading to minimal changes to bio- & geochemical cycling up to 5%.	constituents leading to minimal changes to bio- & geochemical cycling, up to 10%.	leading to major changes to bio- & geochemical cycling, up to 25%.	constituents leading to Severe changes to bio- & geochemical cycling. Recovery period measured in years to decades.	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.