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Australian Government
Australian Fisheries Management Authority

Ecological Risk Assessment (ERA) for Effects of Fishing

REPORT FOR THE SKIPJACK TUNA FISHERY

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Helping Communities Helping Australia
An Australian Government Initiative

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This fishery ERA report should be cited as

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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 Skipjack Tuna 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; by-product and by-catch species; threatened, endangered and protected (TEP) species; habitats; and (ecological) communities.

ERAEF proceeds through four stages of analysis: scoping; an expert judgment 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 Skipjack Tuna Fishery includes the following:

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

Fishery Description

Gear:	Purse seine net
Area:	Continental Australian Fishing Zone (AFZ); most recent effort of southern NSW
Depth range:	0 – 30 m from the surface in waters 100 – 500 m deep
Fleet size:	33 PS permits, less than five active in 2004 and again in 2005
Effort:	14 shots in 2004 and 0 shots in 2005
Landings:	810 t in 2003/2004, 1 t in 2004/2005
Discard rate:	Likely to be minimal for target and non-target species (Un-verified)
Main target species:	Skipjack Tuna
Management:	Limited entry
Observer program:	None currently

Ecological Units Assessed

Target species:	1 Target + 7 Bait
By-product species:	6
Discard Species:	10
TEP species:	304
Habitats:	4
Communities:	10

Level 1 Results

Three ecological components were eliminated at Level 1: Habitats, Communities, Target species. There was at least one risk score of 3 (moderate) or above for two components: Byproduct/bycatch species and TEP species.

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

- Direct impact of fishing on byproduct/bycatch and TEP components.

These remaining hazards were assessed in more detail at Level 2 based on the precautionary approach.

Significant external hazards included International fisheries and coastal development. Risks rated as major (risk scores 4) were related to International fisheries for skipjack.

Level 2 Results

Species

Of the 320 species assessed at Level 2 using the PSA analysis, expert/observer over-rides were used on 12 species. A total of 124 species were found to be at high risk. Of these, 31 species had more than 3 missing attributes.

The high risk species included 0 by-product species, 3 by-catch species, and 121 TEP species. By taxa, the high risk species comprised 5 chondrichthyans (sharks and rays), 0 teleosts, 85 marine birds, 25 marine mammals and 9 reptiles.

Most of the high risk species are in all likelihood false positives. It is unlikely that the gear interacts with birds. There are no warp wires or hooks. Fishers report that there are few interactions with sharks or marine mammals, but this is un-verified. A small number of shark interactions are known to occur, primarily with dusky sharks/ bronze whalers. More data is needed on the number of whaler sharks caught across a range of Commonwealth fisheries. There are concerns for captures of dolphins in International and SA State purse seine fisheries.

Communities
Habitats were eliminated at the end of Level 1.

Communities
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.

Summary
The key issues that emerge from the ERAEF analysis of the Skipjack Fishery are the lack of verified independent field observations of interactions with bycatch and TEP species.

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.

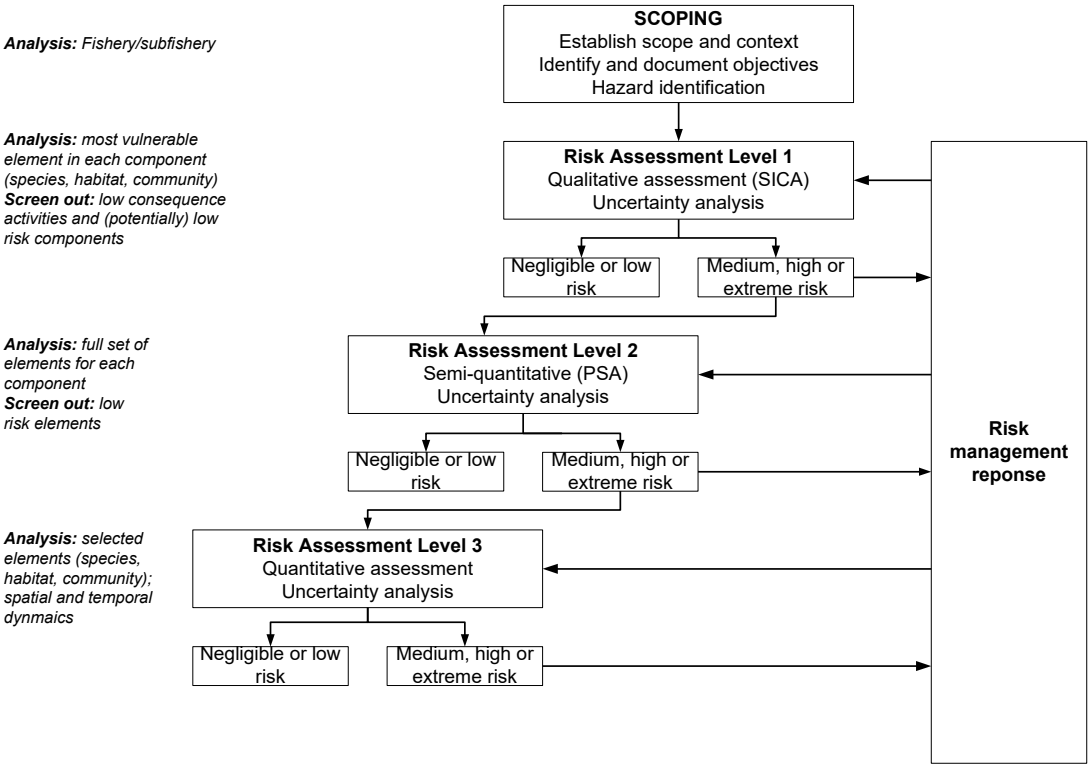


Figure 1. Overview of ERAEF showing focus of analysis for each level at the left in italics.

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 components 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
- By-product and by-catch 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.

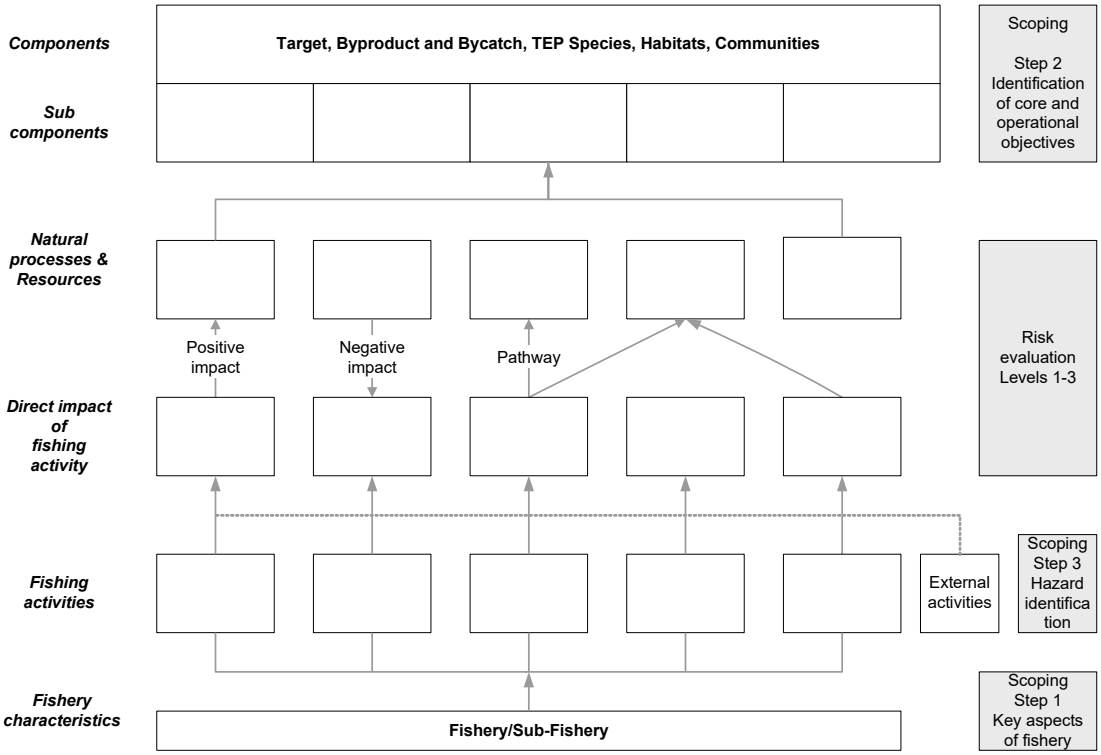


Figure 2. Generic conceptual model used in ERAEF.

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).

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.

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 Document 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 re-evaluated, and documented as before. The fishery management group or AFMA may take ownership of this process, or scientific consultants may be engaged. In any case the ERAEF should again be based on the input of the full set of stakeholders and reviewed by independent experts familiar with the process.

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 re-evaluated.

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 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, is 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 Skipjack Tuna Fishery

2.1 Stakeholder Engagement

2.1 Summary Document SD1. Summary of stakeholder involvement for fishery

SKIPJACK TUNA FISHERY

Fishery ERA report stage	Type of stakeholder interaction	Date of stakeholder interaction	Composition of stakeholder group (names or roles)	Summary of outcome
Scoping	E-mail	13 October 2005	Christian Pyke, AFE	Contacts provided, Port Lincoln Cannery
Scoping	Phone	13 Oct 2005	Port Lincoln Cannery	No Reply
Scoping	E-mail	21 October 2005	Andrew Townley/Melissa Schubert	Information provided on management arrangements and observer coverage.
Scoping	E-mails	27 October 2005	Christian Pyke - AFE	Details of bait capture methods provided
Scoping-	E-mails and phone calls regarding jurisdiction	24 February 2006	Andrew Townley	AFZ used as geographic boundary for assessment
Scoping-	Update on jurisdictional arrangements e-mail	May 2006	Andrew Townley, Tim Smith	AFZ used as geographic boundary for assessment
Level 1 and 2	Workshop	15 – 16 November	AFMA managers, Brian Jefferies representing Tuna fisheries, Other industry reps	Feedback reviewed and distributed out of session
Level 1 and 2	phone calls	May 2006	Denis Brown	Update on effort and catch in the Fishery for Summer 2005/2006

2.2 Scoping

The aim in the Scoping stage is to develop a profile of the fishery being assessed. This provides information needed to complete Levels 1 and 2 and at stakeholder meetings. 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.

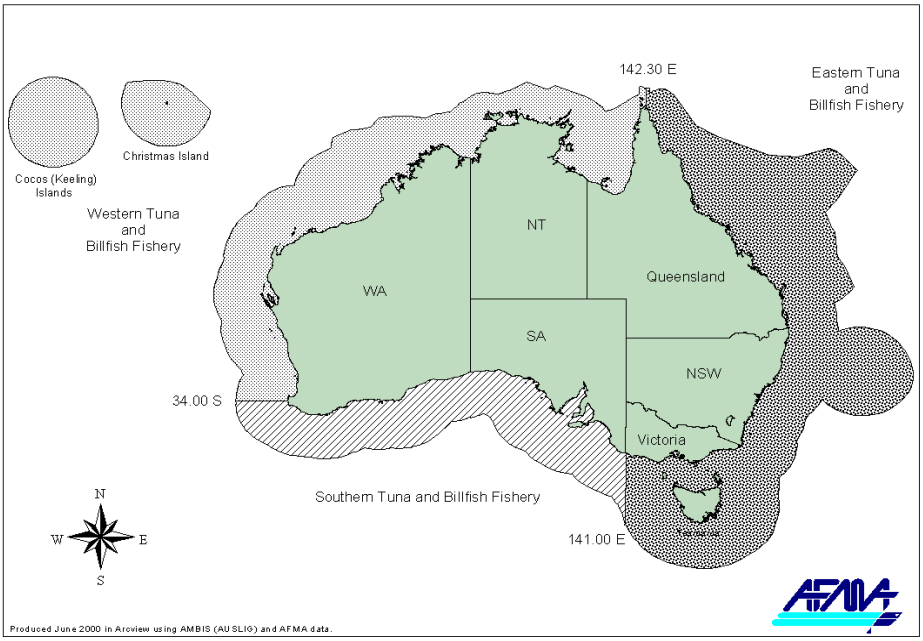
Scoping Document S1 General Fishery Characteristics

Fishery Name: Skipjack Tuna
Date of assessment: 8/6/2006
Assessor: Ross Daley

General Fishery Characteristics	
Fishery Name	Skipjack Tuna
Sub-fisheries	*Identify sub-fisheries on the basis of fishing method/area* The Australian Skipjack Tuna Fishery is composed of three sub-fisheries: Purse seine, pole-and-line and minor line (AFMA 2003a). An estimated 98% of the current skipjack catch is taken using purse seine methods (AFMA 2003a). The principle fishing method used to take skipjack tuna has changed over time from 1998 when purse seining accounted for around 85% of the total catch, pole and line for 14%, and pelagic longline and minor line methods for the remainder. From 1999 onwards, the use of poling to catch skipjack tuna has decreased and now represents less than 1% of the total catch.
Sub-fisheries assessed	*The sub-fisheries to be assessed on the basis of fishing method/area in this report.* This assessment considers only the Skipjack purse seine sub-fishery
Start date/history	*Provide an indication of the length of time the fishery has been operating.* The fishery developed in the 1950's, as an offshoot from the Southern Bluefin Tuna (SBT) Fishery off southern New South Wales. Skipjack were still abundant later in the year than SBT and fishing for both species allowed the fishing season to be extended. This continued until the mid-1980's when the SBT fishery off

	NSW collapsed. In the early days of the fishery, both skipjack and SBT were used for canning. In the mid-1980's, a number of restrictions were placed on SBT catches including international agreements to manage stocks. The CCSBT was formed and SBT catches were reduced by quota management. This left a gap in the market for canned tuna and skipjack replaced SBT as the main tuna species for domestic canning (BRS 1999). From the mid 1980's until 1999, skipjack caught off NSW were canned locally at Eden. In the late 1990's, the worldwide price for skipjack fell, and as a result, the cannery at Eden closed in 1999. Since 1999 only a small amount of skipjack has been caught in Australia. Most of it has been supplied to a cannery in Port Lincoln. The cannery also imports product for canning and supplies most of its product to Unilever (a canning company). In 2001 there was an upturn in prices paid for skipjack. In part this was due to action by members of the World Tuna Purse Seine Organization to reduce and control the supply of skipjack to the market (AFMA 2003a). The improved market suggested an opportunity to develop the Australian Fishery and improvements to management and marketing were subsequently considered. In May 2003 the skipjack fishery was removed from the ETBF and SWTBF. This had the potential to distance the market for canned skipjack from adverse publicity linked to fisheries for larger tuna species. Internationally, purse seine fisheries for larger tuna species have been associated with dolphin mortality. Similarly long-line fishing has been associated with seabird mortality. In 2005 Australia began developing international agreements to manage skipjack. There are concerns among fishers that these agreements need to be negotiated carefully with input from the Australian Industry. It is hoped this will ensure that previous domestic efforts to restructure the fishery and improve markets are not undermined. Into the future, the main challenge for the fishery is likely to remain the inter-annual variability in catches. Skipjack tuna is a highly migratory, highly productive species. Variation in abundance is thought to be heavily influenced by inter-annual variability in environmental conditions. These natural variations stand in stark contrast to market requirements for a steady supply. Internationally, most of the catch is taken between 20°N and 20°S. In Australia, skipjack are caught outside the core range of the species, potentially increasing the variability in annual catches.

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.* Skipjack stocks fished off Australia are widely distributed in the western Central Pacific and Indian Oceans. They are concentrated in tropical waters from 20°N and 20°S but extend seasonally into subtropical waters to the north and south. Skipjack are widely distributed within the AFZ. On the east coast, the coastal distribution extends from far north Queensland to Tasmania, excluding the Great Barrier Reef. Skipjack are found off southern Australia from Kangaroo Island in the Great Australian Bight and up the west coast as far north as Broome. *Jurisdictional boundaries* The Australian Skipjack Tuna Fishery extends throughout almost all of the area of the AFZ off mainland Australia, excluding the Torres Strait Protected Zone (as described in the Torres Strait Fisheries Regulations, 1985) and Area E (Cairns/Townsville Restricted Area) of the ETBF. The fishery has the potential to extend to high seas areas of the Indian Ocean and western and central Pacific Ocean (AFMA 2003a). It is likely that international agreements to manage the target species will be put in place to mange stocks through the WCPFC. Even if the skipjack stock is managed internationally, the AFMA will almost certainly be required to administer regulations limiting the catch of skipjack by Australian vessels and continue to manage broader ecological impacts of the fishery within the AFZ. *Distribution of catch effort* The bulk of Australia's catch has traditionally been taken on the Pacific coast of Australia in sub-tropical/temperate waters at the fringe of the distribution of the target species. The main fishing grounds are between Ulladulla (New South Wales) to just south of Gabo Island (Victoria) (AFMA 2003a). Effort has been focused on two areas. In recent years, most of the effort has been on the east coast off Eden (off the Victoria/New South Wales border) but effort has occurred as far North as Coffs Harbour and as far South as Hobart. Previously there has been effort in the Great Australian Bight off South Australia.
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.* Previously skipjack tuna catches were managed within the Eastern Tunas and Billfish Fishery (ETBF) and the Southern and Western Tuna and Billfish Fishery (ETBF). The distribution of these fisheries is thought to reflect the distribution of separate skipjack stocks in the Indian Ocean (ETBF) and the western Central Pacific Ocean (SWTBF).

	
Fishing season	*Species targeted and where known, stock status.* Fishing occurs from November to June (AFMA 2003a).
Target species and stock status	*Species targeted and where known, stock status.* Skipjack tuna (*Katsuwonus pelamis*) is the only target species in the Australian Skipjack Tuna Fishery. A stock assessment for skipjack tuna in the WCPO was carried out for the period 1999-2004. The stock assessment indicated that for the broader WCPO skipjack is not overfished and there remains scope for expansion of skipjack catches. The Indian Ocean Tuna Commission (IOTC) Working Party on Tropical Tunas has not made any specific management recommendations for the skipjack stock. Information suggests that there is no need for immediate concern about the status of skipjack tuna (AFMA web site).
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.* Although the fishery uses nets, not hooks, bait is still used as 'chum' to aggregate and direct schools of skipjack. The preferred bait species are anchovy, when available, and pilchards. In order to capture bait, the main vessel is anchored in sheltered waters and a dinghy with a small net is deployed. While bait collection is permitted in commonwealth waters, it is not practical to fish in these exposed waters using a dinghy. Therefore bait collection is essentially restricted to state waters and operates under state permits or informally managed permits.
Current entitlements	*The number of current entitlements in the fishery. Note latent entitlements. Licences/ permits/ boats and number active* There are 13 Fishing Permits granted in the western sector and 20 Fishing Permits granted in the east, with 8 operators granted access to both sectors.

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.

Not applicable - this fishery is not currently managed by TAC.

Current and recent fishery effort trends by method

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

This assessment considers only the purse seine method. There has been very little effort in the fishery since 2002.

Year	Number of shots
1998	5
1999	25
2000	194
2001	54
2002	43
2003	27
2004	14

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).

The table below shows the total catch figures, separate by sectors of skipjack tuna (taken by all methods; pelagic longline, minor line, purse seine and pole and line) from 1994/95 to 2004/05. Note the Eden, New South Wales cannery closed in 1999 and this has had a direct impact on operator's recent fishing behaviour in the eastern sector.

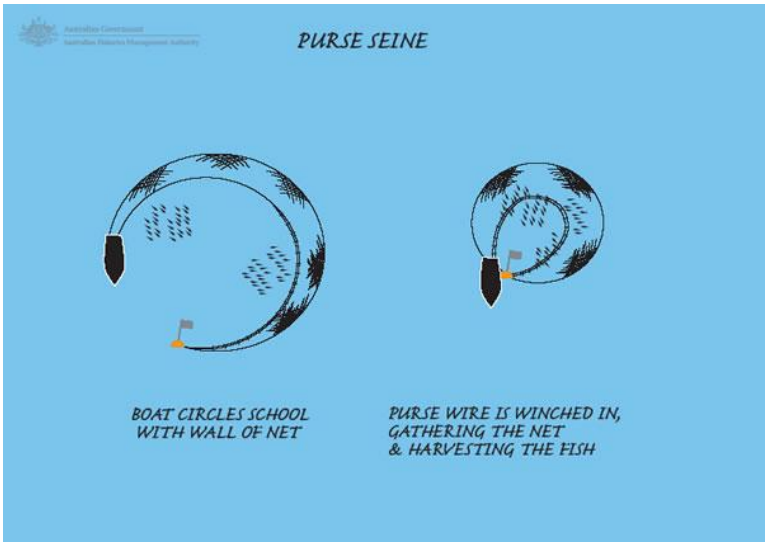
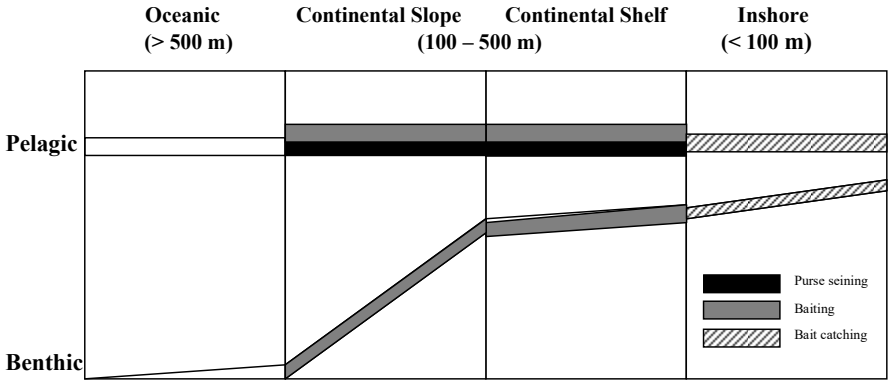
Skipjack tuna catch from 1994/95 to 2004/05

Year	East Sector tonnes	West Sector tonnes	Total tonnes
1994/95	1253	467	1720
1995/96	2767	210	2977
1996/97	5086	152	5239
1997/98	849	1402	2251
1998/99	4668	827	5495
1999/00	4497	401	4899
2000/01	1556	972	2529
2001/02	202	1154	1356
2002/03	17	0	17
2003/04	780	30	810
2004/05	1	0	1

Current and recent value

Summary of the most recent value of the fishery (sub-fishery).

of fishery ($)	The value of the fishery is affected by the price per kg and the volume harvested. The price per kg ranged from $0.63 - $1.78 between 1994 – 2001 The total annual value of the fishery ranged from $1.2m to $8.1m over the same period. The value of the Skipjack Tuna Fishery is low and variable. Value for 2000 – 01 was $3.45 m.
Relationship with other fisheries	*Commercial and recreational, state, national and international fisheries. List other fisheries operating in the same region any interactions* *International fisheries* International catches of skipjack tuna increased steadily from 1950 – 1999 reaching a peak in 1999 at nearly 2million tons. In 2000 over 70% of the reported catch was taken in the Pacific Ocean and a further 17% in the Indian Ocean.). The major catching countries in 2000 were Japan and Indonesia taking 18% and 14% of the reported world catch respectively. The Philippines, Taiwan and the USA also took significant catches in that year *Overview of domestic fisheries* Purse seine vessels are generally specialized for the method of fishing, rather than for a particular target species. Fishing for skipjack generally forms only part of a 'package' of fishing activities for these vessels, due to both the seasonality and inter-annual variability of skipjack catches. Other components of a purse-seine vessels package may include the purse seining for SBT for farming or small pelagics and most permit holders also participate in the longline fisheries for other tuna species (AFMA 2003a). T he number of state operators and recreational anglers that capture skipjack is unknown. However, the annual catch of skipjack by Australian anglers (recreational catch), and catch taken by other commercial methods (including Australian state operators) e.g. trolling and hand-lining, is probably less than 150 t per year (BRS 1999). *Commonwealth Fisheries* In Australia, skipjack tuna is caught as bycatch in the Eastern Tuna (ETBF) and the Southern and Western Tuna and Billfish Fishery (SWTBF) (see **above figure**). All permit holders (430 across both fisheries) may land skipjack tuna. However, the volume taken by these long-line vessels is much smaller than that captured by purse seiners in the SKJ. *State Fisheries* Skipjack are caught as bycatch in a number of state fisheries. NSW operators take skipjack inside 3 nm as do other state operators (subject to trip limits, usually in combination with other tuna/albacore/pomfrets). However, the annual catch of skipjack by including Australian state operators), is probably less than 150 t per year (BRS 1999). *Amateur fisheries* Recreational anglers catch skipjack by trolling and casting lures. Skipjack is also used as bait large pelagic fish such as marlins.
Gear	

Fishing gear and methods	*Description of the methods and gear in the fishery, average number days at sea per trip.* In a purse seine, the top of the net is floated at the ocean's surface and the bottom of the net is held under the water by lead weights. A wire that is threaded through the bottom of the net can be tightened to close the bottom of the net trapping the fish inside. The net is then pulled in toward the boat and the catch is either pumped or lifted out with small nets or the whole net is brought aboard. 
Fishing gear restrictions	*Any restrictions on gear* None documented
Selectivity of gear and fishing methods	*Description of the selectivity of the sub-fishery methods* Because uniform schools of fish are targeted, the purse seine method is considered to be a highly size and species selective method. Furthermore, although purse seining is an 'active' fishing method, minimal habitat impacts occurs as no contact is made with the substrate.
Spatial gear zone set	*Description where gear set i.e. continental shelf, shelf break, continental slope (range nautical miles from shore)* 
Depth range gear set	*Depth range gear set at in metres*

	Oceanic surface waters, 0 – 130 m from the surface in waters where the surface is typically 100 – 500 m above the ocean floor
How gear set	*Description how set, pelagic in water column, benthic set (weighted) on seabed* Two boats usually work in conjunction – The Chum / Pole Boat and the purse seiner. Live bait is captured using berley at night by the chum boat with a small seine or lift net deployed from a dinghy in sheltered waters – 15 – 20 m. The fish are brailed onboard and stored live. Fishing starts at first light. A plane flies out to locate schools of fish. The chum boat and the seiner steam out to a 'patch' where a school has been located. The chum boat releases bait to attract and aggregate the school and then the seine boat moves in to shoot the net. (From Christian Pyke, AFE and Denis Brown). A purse seine operation begins by shooting the bunt end of the net from the stern of the vessel by either attaching a large dan buoy or by using a skiff. The vessel then encircles the school of fish and recovers the first end of the net. The purse line that runs through purse rings attached to the footrope of the net is winched in, enclosing the bottom of the net. A proportion of the net is hauled back onto the vessel with the use of a power block to congregate the fish into a smaller area beside the vessel. In the domestic Skipjack Tuna Fishery the fish are then brailed aboard the vessel and put into refrigerated seawater (a brine hold) (AFMA 2001).
Area of gear impact per set or shot	*Description of area impacted by gear per set (square metres)* The nets are typically about 1000 meters for the commercial sets, and 100 m nets for bait fishing. Thus the area surrounded by the net is 0.1 square km. The immediate area of impact is that water column surrounded by the net. If the net does not contact the bottom, there is no lasting impact on the habitat.
Capacity of gear	*Description number hooks per set, net size weight per trawl shot* A single shot may contain up to 200 t.
Effort per annum all boats	*Description effort per annum of all boats in fishery by shots or sets and hooks, for all boats* See trends in effort, 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.* The gear is deployed at the surface and not prone to snagging. The top of net is buoyed by floats and even if it became detached from the vessel it would be straight forward to retrieve. The gear is expensive and economics and career prospects for skippers provide powerful incentives to recover any lost gear.
Issues	
Target species issues	*List any issues, including biological information such as spawning season and spawning location, major uncertainties about biology or management, interactions etc* A stock assessment for skipjack tuna in the Western and Central Pacific Ocean (WCPO) was carried out for the period 1972-1999 (Hampton & Fournier 2001). The stock assessment indicated that for the broader WCPO skipjack is under fished and there remains scope for expansion of skipjack catches. The potential for increasing skipjack catches in the WCPO may not necessarily extend to the ETBF, the south of which is at

	the extreme of the species' range. The Bureau of Rural Sciences, however, has concluded that "Currently there seems to be no biological reason for capping the ETBF catch of skipjack at current levels. There is scope for expanding skipjack catches off New South Wales and north eastern Queensland." The stock status of skipjack tuna in the Indian Ocean, and hence in the SWTBF, is uncertain. The Indian Ocean Tuna Commission (IOTC) has not developed a formal stock assessment for skipjack tuna but the Scientific Committee of the IOTC intends to do so in 2003 (AFMA 2003a).
Byproduct and bycatch issues and interactions	*List any issues, as for the target species above* Incidental catch includes bigeye and yellowfin tuna, frigate mackerel, sharks, mahi mahi, rays and marlins. The landings of species other than skipjack are believed to be much less than 2% of the total landings (AFMA 2003a).
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.* There is potential for capture and or entanglement of TEP species in purse seining gear / vessels. Potential TEP species include marine mammals e.g. seals, dolphins and whales, and the white pointer shark. TEP species of seabird e.g. albatross also potentially interact with skipjack purse seine operations.
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* *None identified*
Community issues and interactions	*List any issues for any of the community units identified in **Scoping Document S1.2**.* None Identified
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 (AFMA 2001).
Management: planned and those implemented	
Management Objectives	*The management objectives from the most recent management plan* The Skipjack Tuna Purse Seine Fishery (STPSF) is currently informally managed utilising a limited entry regime under Fishing Permits. In the past fishing for skipjack tuna (*Katsuwonus pelamis*) by the purse seine fishing method was managed as part of the Eastern Tuna and Billfish Fishery (ETBF) and the Southern and Western Tuna and Billfish Fishery (SWBTF). In 2000 AFMA announced that the skipjack tuna purse seine and pole and line fishery would be managed separate to the ETBF and the SWTBF. In July 2003 AFMA granted those operators who had previously held a purse seine endorsement under either the ETBF or SWTBF Fishing Permit to take skipjack tuna. While the Eastern Skipjack Tuna Fishery (ESTF) and the Western Skipjack Tuna Fishery (WSTF) are defined separately in the Fisheries Management Regulations

	their Fishing Permit conditions are very similar and as such they are considered and managed as two sectors: the east and west sector that replicate the area of waters of the ETBF and the SWTBF. Internationally, skipjack tuna is listed as a highly migratory species under the United Nations Fish Stocks Agreement (UNFSA). It's management in the Indian Ocean falls under the Indian Ocean Tuna Commission (IOTC) of which Australia is a member and in the east under the regional fisheries management organization for tuna in the Western Central Pacific Ocean (WCPO) of which Australian is again a signatory.
Fishery management plan	*Is there a fisheries management plan is it in the planning stage or implemented what are the key features* None in place currently The AFMA Board has decided to implement a Plan of Management under the Fisheries Management Act 1991. A discussion paper will be released for stakeholder comment in the next few weeks. Individually transferable quotas are likely to be the key management tool for skipjack
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.* Limited entry to holders of thirty three 12 month, transferable permits; area restrictions - operations limited to fishing zones as specified on permits; operations limited to fishing methods as specified on permits; operations limited to target species as specified on permits and incidental catch restrictions as specified on permits; no splitting of license; All ETBF and SWTBF permit holders may take bait in waters under state jurisdiction, except in NSW waters where bait may only be taken if a NSW fishing entitlement is held (AFMA 2002a).
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.* Currently there is no quota set for skipjack tuna (AFMA 2002a). A quota may be applied in the future under a Plan of Management.
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.* Currently there are no technical measures to control catch of skipjack tuna (AFMA 2002a).
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.* Purse seine operations are limited to maximum seasonal incidental catch of 2% (of skipjack catch) of yellowfin and bigeye (combined live weight), and a trip limit of 50% of these species; blue and black marlin must be returned to the sea dead or alive; there is a maximum trip limit of 20 sharks (shark carcasses must be landed with fins attached) (AFMA 2002a).
Initiatives and	*BAPs;TEDs;Industry codes of conduct*

strategies	A Bycatch Action Plan for purse seine tuna fisheries was first published in 2005, which sets out strategies and actions to address bycatch issues in the skipjack and SBT purse seine fisheries.
Enabling processes	*Monitoring, logbooks, observer data, scientific surveys); assessment stock assessments); performance indicators (decision rules, processes, compliance; education; consultation process.* No additional processes Identified
Other initiatives or agreements	*State, national or international conventions or agreements that impact on the management of the fishery/sub-fishery being evaluated.* Australia has been an active participant in the development of a regional fisheries management organization for tuna in the Western Central Pacific Ocean (WCPO), the convention of which came into force on 19 June 2004, and in the Indian Ocean Tuna Commission (IOTC).
Data	
Logbook data	*Verified logbook data; data summaries describe programme* All skipjack data is entered in a multi fishery purse seine logbook (PS01).
Observer data	There are currently no observer programs in place for purse seine fisheries in Australia. Current effort is low– see table above.
Other data	*None Identified*

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]

The number of units of analysis examined in this report is shown by component in the following Table.

Target	By-product	By-catch	TEP	Habitats	Communities
8	6	10	304	4	10

Scoping Document S2A Species list

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

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.

ERAEF species ID	Taxa	Family name	Scientific name	Common Name	CAAB code	Role in fishery	Reference
825	Teleost	Clupeidae	Sardinops neopilchardus	pilchard	37085002	TA/Bait	log data
1088	Teleost	Carangidae	Trachurus declivis	Jack Mackerel	37337002	TA/Bait	log data
540	Teleost	Carangidae	Trachurus novaezelandiae	Yellow tail scad	37337003	TA/Bait	log data
807	Teleost	Carangidae	Trachurus murphyi	Peruvian Jack Mackerel	37337077	TA/Bait	log data
511	Teleost	Arripidae	Arripis georgianus	Tommy rough	37344001	TA/Bait	log data
155	Teleost	Emmelichthyidae	Emmelichthys nitidus	redbait	37345001	TA/Bait	log data
210	Teleost	Scombridae	Scomber australasicus	Blue Mackerel	37441001	TA/Bait	log data
64	Teleost	Scombridae	Katsuwonus pelamis	Skipjack Tuna	37441003	TA	log data

Byproduct species

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.

ERAEF species ID	Taxa	Family name	Scientific name	Common Name	CAAB code	Role in fishery	Reference
814	Teleost	Coryphaenidae	Coryphaena hippurus	Dolphin Fish (mahi mahi)	37338001	BP	log data
212	Teleost	Scombridae	Thunnus albacares	Yellowfin Tuna	37441002	BP	log data
255	Teleost	Scombridae	Thunnus maccoyii	Southern Bluefin Tuna	37441004	BP	log data
895	Teleost	Scombridae	Thunnus alalunga	Albacore	37441005	BP	log data
62	Teleost	Scombridae	Thunnus obesus	Bigeye Tuna	37441011	BP	log data
211	Teleost	Scombridae	Sarda australis	Australian bonito	37441020	BP	log data

Discard species

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.

ERAEF species ID	Taxa	Family name	Scientific name	Common Name	CAAB code	Role in fishery	Reference
964	Chondrichthyan	Lamnidae	Isurus oxyrinchus	Shortfinned Mako or Blue Pointer	37010001	DI	log data
972	Chondrichthyan	Lamnidae	Lamna nasus	Porbeagle shark	37010004	DI	log data
808	Chondrichthyan	Carcharhinidae	Carcharhinus obscurus	Dusky Shark	37018003	DI	log data
1039	Chondrichthyan	Carcharhinidae	Prionace glauca	Blue Shark	37018004	DI	log data
853	Chondrichthyan	Myliobatidae	Manta birostris	Manta Ray	37041004	DI	log data

ERAEF species ID	Taxa	Family name	Scientific name	Common Name	CAAB code	Role in fishery	Reference
908	Teleost	Scombridae	Auxis thazard	Frigate mackerel	37441009	DI	log data
213	Teleost	Xiphiidae	Xiphias gladius	Broad Billed Swordfish	37442001	DI	log data
884	Teleost	Istiophoridae	Tetrapturus audax	Striped marlin	37444002	DI	log data
852	Teleost	Istiophoridae	Makaira mazara	Blue Marlin	37444003	DI	log data
851	Teleost	Istiophoridae	Makaira indica	Black Marlin	37444006	DI	log data

TEP species

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.

ERAEF species ID	Taxa	Family name	Scientific name	Common Name	CAAB code	Role in fishery	Reference
313	Chondrichthyan	Odontaspididae	Carcharias taurus	grey nurse shark	37008001	TEP	DEH
315	Chondrichthyan	Lamnidae	Carcharodon carcharias	white shark	37010003	TEP	DEH
1067	Chondrichthyan	Rhincodontidae	Rhincodon typus	whale shark	37014001	TEP	DEH
898	Marine bird	Spheniscidae	Eudyptula minor	Little Penguin	40001008	TEP	DEH
1032	Marine bird	Diomedeidae	Thalassarche bulleri	Buller's Albatross	40040001	TEP	DEH
1033	Marine bird	Diomedeidae	Thalassarche cauta	Shy Albatross	40040002	TEP	DEH
1034	Marine bird	Diomedeidae	Thalassarche chlororhynchos	Yellow-nosed Albatross, Atlantic Yellow-	40040003	TEP	DEH
1035	Marine bird	Diomedeidae	Thalassarche chrysostoma	Grey-headed Albatross	40040004	TEP	DEH

ERAEF species ID	Taxa	Family name	Scientific name	Common Name	CAAB code	Role in fishery	Reference
753	Marine bird	Diomedeidae	Diomedea epomophora	Southern Royal Albatross	40040005	TEP	DEH
451	Marine bird	Diomedeidae	Diomedea exulans	Wandering Albatross	40040006	TEP	DEH
1085	Marine bird	Diomedeidae	Thalassarche melanophrys	Black-browed Albatross	40040007	TEP	DEH
1008	Marine bird	Diomedeidae	Phoebetria fusca	Sooty Albatross	40040008	TEP	DEH
1009	Marine bird	Diomedeidae	Phoebetria palpebrata	Light-mantled Albatross	40040009	TEP	DEH
755	Marine bird	Diomedeidae	Diomedea gibsoni	Gibson's Albatross	40040010	TEP	DEH
628	Marine bird	Diomedeidae	Diomedea antipodensis	Antipodean Albatross	40040011	TEP	DEH
799	Marine bird	Diomedeidae	Diomedea sanfordi	Northern Royal Albatross	40040012	TEP	DEH
1084	Marine bird	Diomedeidae	Thalassarche impavida	Campbell Albatross	40040013	TEP	DEH
1031	Marine bird	Diomedeidae	Thalassarche carteri	Indian Yellow-nosed Albatross	40040014	TEP	DEH
894	Marine bird	Diomedeidae	Thalassarche salvini	Salvin's albatross	40040016	TEP	DEH
889	Marine bird	Diomedeidae	Thalassarche eremita	Chatham albatross	40040017	TEP	DEH
1428	Marine bird	Diomedeidae	Diomedea amsterdamensis	Amsterdam Albatross	40040018	TEP	DEH
1429	Marine bird	Diomedeidae	Diomedea dabbenena	Tristan Albatross	40040019	TEP	DEH
1580	Marine bird	Procellariidae	Calonectris leucomelas	streaked shearwater	40041002	TEP	DEH
595	Marine bird	Procellariidae	Daption capense	Cape Petrel	40041003	TEP	DEH
314	Marine bird	Procellariidae	Fulmarus glacialoides	Southern fulmar	40041004	TEP	DEH
939	Marine bird	Procellariidae	Halobaena caerulea	Blue Petrel	40041005	TEP	DEH
1052	Marine bird	Procellariidae	Lugensa brevirostris	Kerguelen Petrel	40041006	TEP	DEH
73	Marine bird	Procellariidae	Macronectes giganteus	Southern Giant-Petrel	40041007	TEP	DEH
981	Marine bird	Procellariidae	Macronectes halli	Northern Giant-Petrel	40041008	TEP	DEH
1003	Marine bird	Procellariidae	Pachyptila turtur	Fairy Prion	40041013	TEP	DEH
1006	Marine bird	Procellariidae	Pelecanoides urinatrix	Common Diving-Petrel	40041017	TEP	DEH
1041	Marine bird	Procellariidae	Procellaria aequinoctialis	White-chinned Petrel	40041018	TEP	DEH
494	Marine bird	Procellariidae	Procellaria cinerea	Grey petrel	40041019	TEP	DEH
1042	Marine bird	Procellariidae	Procellaria parkinsoni	Black Petrel	40041020	TEP	DEH
1043	Marine bird	Procellariidae	Procellaria westlandica	Westland Petrel	40041021	TEP	DEH
1691	Marine bird	Procellariidae	Pseudobulweria rostrata	Tahiti Petrel	40041022	TEP	DEH
1693	Marine bird	Procellariidae	Pterodroma baraui	Barau's Petrel	40041024	TEP	DEH
1045	Marine bird	Procellariidae	Pterodroma cervicalis	White-necked Petrel	40041025	TEP	DEH
504	Marine bird	Procellariidae	Pterodroma lessoni	White-headed petrel	40041029	TEP	DEH

ERAEF species ID	Taxa	Family name	Scientific name	Common Name	CAAB code	Role in fishery	Reference
1046	Marine bird	Procellariidae	Pterodroma leucoptera	Gould's Petrel	40041030	TEP	DEH
1047	Marine bird	Procellariidae	Pterodroma macroptera	Great-winged Petrel	40041031	TEP	DEH
1048	Marine bird	Procellariidae	Pterodroma mollis	Soft-plumaged Petrel	40041032	TEP	DEH
1049	Marine bird	Procellariidae	Pterodroma neglecta	Kermadec Petrel (western)	40041033	TEP	DEH
1050	Marine bird	Procellariidae	Pterodroma nigripennis	Black-winged Petrel	40041034	TEP	DEH
1051	Marine bird	Procellariidae	Pterodroma solandri	Providence Petrel	40041035	TEP	DEH
1053	Marine bird	Procellariidae	Puffinus assimilis	Little Shearwater (Tasman Sea)	40041036	TEP	DEH
1054	Marine bird	Procellariidae	Puffinus bulleri	Buller's Shearwater	40041037	TEP	DEH
1055	Marine bird	Procellariidae	Puffinus carneipes	Flesh-footed Shearwater	40041038	TEP	DEH
1694	Marine bird	Procellariidae	Puffinus creatopus	Pink-footed Shearwater	40041039	TEP	DEH
1056	Marine bird	Procellariidae	Puffinus gavia	Fluttering Shearwater	40041040	TEP	DEH
1057	Marine bird	Procellariidae	Puffinus griseus	Sooty Shearwater	40041042	TEP	DEH
1058	Marine bird	Procellariidae	Puffinus huttoni	Hutton's Shearwater	40041043	TEP	DEH
1059	Marine bird	Procellariidae	Puffinus pacificus	Wedge-tailed Shearwater	40041045	TEP	DEH
1060	Marine bird	Procellariidae	Puffinus tenuirostris	Short-tailed Shearwater	40041047	TEP	DEH
918	Marine bird	Hydrobatidae	Fregetta grallaria	White-bellied Storm-Petrel (Tasman Sea),	40042001	TEP	DEH
917	Marine bird	Hydrobatidae	Fregetta tropica	Black-bellied Storm-Petrel	40042002	TEP	DEH
555	Marine bird	Hydrobatidae	Garrodia nereis	Grey-backed storm petrel	40042003	TEP	DEH
556	Marine bird	Hydrobatidae	Oceanites oceanicus	Wilson's storm petrel (subantarctic)	40042004	TEP	DEH
1004	Marine bird	Hydrobatidae	Pelagodroma marina	White-faced Storm-Petrel	40042007	TEP	DEH
1432	Marine bird	Phaethontidae	Phaethon rubricauda	Red-tailed Tropicbird	40045002	TEP	DEH
1549	Marine bird	Sulidae	Morus capensis	Cape gannet	40047001	TEP	DEH
998	Marine bird	Sulidae	Morus serrator	Australasian Gannet	40047002	TEP	DEH
861	Marine bird	Sulidae	Papasula abbotti	Abbots booby	40047003	TEP	DEH
1433	Marine bird	Sulidae	Sula dactylatra	Masked Booby	40047004	TEP	DEH
881	Marine bird	Sulidae	Sula leucogaster	Brown boobies	40047005	TEP	DEH
1434	Marine bird	Sulidae	Sula sula	Red-footed Booby	40047006	TEP	DEH
912	Marine bird	Phalacrocoracidae	Phalacrocorax fuscescens	Black faced cormorant	40048003	TEP	DEH
827	Marine bird	Fregatidae	Fregata andrewsi	Christmas frigatebird	40050001	TEP	DEH
829	Marine bird	Fregatidae	Fregata ariel	Lesser frigatebird	40050002	TEP	DEH

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1435	Marine bird	Fregatidae	Fregata minor	Great Frigatebird, Greater Frigatebird	40050003	TEP	DEH
1438	Marine bird	Laridae	Anous minutus	Black Noddy	40128001	TEP	DEH
203	Marine bird	Laridae	Anous stolidus	Common noddy	40128002	TEP	DEH
67	Marine bird	Laridae	Anous tenuirostris	Lesser noddy	40128003	TEP	DEH
325	Marine bird	Laridae	Catharacta skua	Great Skua	40128005	TEP	DEH
973	Marine bird	Laridae	Larus dominicanus	Kelp Gull	40128012	TEP	DEH
974	Marine bird	Laridae	Larus novaehollandiae	Silver Gull	40128013	TEP	DEH
975	Marine bird	Laridae	Larus pacificus	Pacific Gull	40128014	TEP	DEH
1582	Marine bird	Laridae	Procelsterna cerulea	grey ternlet	40128018	TEP	DEH
1014	Marine bird	Laridae	Sterna albifrons	Little tern	40128022	TEP	DEH
1015	Marine bird	Laridae	Sterna anaethetus	Bridled Tern	40128023	TEP	DEH
1016	Marine bird	Laridae	Sterna bengalensis	Lesser crested tern	40128024	TEP	DEH
1017	Marine bird	Laridae	Sterna bergii	Crested Tern	40128025	TEP	DEH
1018	Marine bird	Laridae	Sterna caspia	Caspian Tern	40128026	TEP	DEH
1019	Marine bird	Laridae	Sterna dougallii	Roseate tern	40128027	TEP	DEH
1020	Marine bird	Laridae	Sterna fuscata	Sooty tern	40128028	TEP	DEH
1021	Marine bird	Laridae	Sterna hirundo	Common tern	40128029	TEP	DEH
1023	Marine bird	Laridae	Sterna paradisaea	Arctic tern	40128032	TEP	DEH
1024	Marine bird	Laridae	Sterna striata	White-fronted Tern	40128033	TEP	DEH
1025	Marine bird	Laridae	Sterna sumatrana	Black-naped tern	40128034	TEP	DEH
1086	Marine bird	Diomedeidae	Thalassarche steadi	White-capped Albatross	NA	TEP	DEH
1610	Marine bird	0	Pterodroma heraldica	Herald Petrel	NA	TEP	DEH
1673	Marine bird	Thalassarche	Thalassarche nov. sp.	Pacific Albatross	NA	TEP	DEH
896	Marine mammal	Balaenidae	Eubalaena australis	Southern Right Whale	41110001	TEP	DEH
289	Marine mammal	Balaenidae	Caperea marginata	Pygmy Right Whale	41110002	TEP	DEH
256	Marine mammal	Balaenopteridae	Balaenoptera acutorostrata	Minke Whale	41112001	TEP	DEH
261	Marine mammal	Balaenopteridae	Balaenoptera borealis	Sei Whale	41112002	TEP	DEH
262	Marine mammal	Balaenopteridae	Balaenoptera edeni	Bryde's Whale	41112003	TEP	DEH

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265	Marine mammal	Balaenopteridae	Balaenoptera musculus	Blue Whale	41112004	TEP	DEH
268	Marine mammal	Balaenopteridae	Balaenoptera physalus	Fin Whale	41112005	TEP	DEH
984	Marine mammal	Balaenopteridae	Megaptera novaeangliae	Humpback Whale	41112006	TEP	DEH
1439	Marine mammal	Balaenidae	Balaenoptera bonaerensis	Antarctic Minke Whale	41112007	TEP	DEH
612	Marine mammal	Delphinidae	Delphinus delphis	Common Dolphin	41116001	TEP	DEH
902	Marine mammal	Delphinidae	Feresa attenuata	Pygmy Killer Whale	41116002	TEP	DEH
934	Marine mammal	Delphinidae	Globicephala macrorhynchus	Short-finned Pilot Whale	41116003	TEP	DEH
935	Marine mammal	Delphinidae	Globicephala melas	Long-finned Pilot Whale	41116004	TEP	DEH
937	Marine mammal	Delphinidae	Grampus griseus	Risso's Dolphin	41116005	TEP	DEH
970	Marine mammal	Delphinidae	Lagenodelphis hosei	Fraser's Dolphin	41116006	TEP	DEH
832	Marine mammal	Delphinidae	Lagenorhynchus cruciger	Hourglass dolphin	41116007	TEP	DEH
971	Marine mammal	Delphinidae	Lagenorhynchus obscurus	Dusky Dolphin	41116008	TEP	DEH
61	Marine mammal	Delphinidae	Lissodelphis peronii	Southern Right Whale Dolphin	41116009	TEP	DEH
860	Marine mammal	Delphinidae	Orcaella brevirostris	Irrawaddy dolphin	41116010	TEP	DEH
1002	Marine mammal	Delphinidae	Orcinus orca	Killer Whale	41116011	TEP	DEH
1007	Marine mammal	Delphinidae	Peponocephala electra	Melon-headed Whale	41116012	TEP	DEH
1044	Marine mammal	Delphinidae	Pseudorca crassidens	False Killer Whale	41116013	TEP	DEH
1076	Marine mammal	Delphinidae	Sousa chinensis	Indo-Pacific Humpback Dolphin	41116014	TEP	DEH
1080	Marine mammal	Delphinidae	Stenella attenuata	Spotted Dolphin	41116015	TEP	DEH
1081	Marine mammal	Delphinidae	Stenella coeruleoalba	Striped Dolphin	41116016	TEP	DEH
1082	Marine mammal	Delphinidae	Stenella longirostris	Long-snouted Spinner Dolphin	41116017	TEP	DEH

ERAEF species ID	Taxa	Family name	Scientific name	Common Name	CAAB code	Role in fishery	Reference
1083	Marine mammal	Delphinidae	Steno bredanensis	Rough-toothed Dolphin	41116018	TEP	DEH
1091	Marine mammal	Delphinidae	Tursiops truncatus	Bottlenose Dolphin	41116019	TEP	DEH
1494	Marine mammal	Delphinidae	Tursiops aduncus	Indian Ocean bottlenose dolphin	41116020	TEP	DEH
968	Marine mammal	Physeteridae	Kogia breviceps	Pygmy Sperm Whale	41119001	TEP	DEH
969	Marine mammal	Physeteridae	Kogia simus	Dwarf Sperm Whale	41119002	TEP	DEH
1036	Marine mammal	Physeteridae	Physeter catodon	Sperm Whale	41119003	TEP	DEH
269	Marine mammal	Ziphiidae	Berardius arnuxii	Arnoux's Beaked Whale	41120001	TEP	DEH
959	Marine mammal	Ziphiidae	Hyperoodon planifrons	Southern Bottlenose Whale	41120002	TEP	DEH
1440	Marine mammal	Ziphiidae	*Indopacetus pacificus*	Longman's Beaked Whale	41120003	TEP	DEH
985	Marine mammal	Ziphiidae	*Mesoplodon bowdoini*	Andrew's Beaked Whale	41120004	TEP	DEH
986	Marine mammal	Ziphiidae	*Mesoplodon densirostris*	Blainville's Beaked Whale	41120005	TEP	DEH
987	Marine mammal	Ziphiidae	*Mesoplodon gingkodens*	Gingko Beaked Whale	41120006	TEP	DEH
988	Marine mammal	Ziphiidae	*Mesoplodon grayi*	Gray's Beaked Whale	41120007	TEP	DEH
989	Marine mammal	Ziphiidae	*Mesoplodon hectori*	Hector's Beaked Whale	41120008	TEP	DEH
990	Marine mammal	Ziphiidae	*Mesoplodon layardii*	Strap-toothed Beaked Whale	41120009	TEP	DEH
991	Marine mammal	Ziphiidae	*Mesoplodon mirus*	True's Beaked Whale	41120010	TEP	DEH
1030	Marine mammal	Ziphiidae	*Tasmacetus shepherdi*	Tasman Beaked Whale	41120011	TEP	DEH
1098	Marine mammal	Ziphiidae	*Ziphius cavirostris*	Cuvier's Beaked Whale	41120012	TEP	DEH
216	Marine mammal	Otariidae	*Arctocephalus forsteri*	New Zealand Fur-seal	41131001	TEP	DEH
253	Marine mammal	Otariidae	*Arctocephalus pusillus doriferus*	Australian Fur Seal	41131003	TEP	DEH
263	Marine mammal	Otariidae	*Arctocephalus tropicalis*	Subantarctic fur seal	41131004	TEP	DEH

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1000	Marine mammal	Otariidae	*Neophoca cinerea*	Australian Sea-lion	41131005	TEP	DEH
295	Marine mammal	Phocidae	*Hydrurga leptonyx*	Leopard seal	41136001	TEP	DEH
993	Marine mammal	Phocidae	*Mirounga leonina*	Elephant seal	41136004	TEP	DEH
813	Marine mammal	Dugongidae	*Dugong dugon*	Dugong	41206001	TEP	DEH
864	Marine mammal	Delphinidae	*Delphinus capensis*	Common dolphin, long-beaked	NA	TEP	DEH
324	Marine reptile	Cheloniidae	*Caretta caretta*	Loggerhead	39020001	TEP	DEH
541	Marine reptile	Cheloniidae	*Chelonia mydas*	Green turtle	39020002	TEP	DEH
822	Marine reptile	Cheloniidae	*Eretmochelys imbricata*	Hawksbill turtle	39020003	TEP	DEH
844	Marine reptile	Cheloniidae	*Lepidochelys olivacea*	Olive Ridley turtle	39020004	TEP	DEH
857	Marine reptile	Cheloniidae	*Natator depressus*	Flatback turtle	39020005	TEP	DEH
613	Marine reptile	Dermochelyidae	*Dermochelys coriacea*	Leathery turtle	39021001	TEP	DEH
1679	Marine reptile	Laticaudidae	*Laticauda colubrina*	Banded wide faced Sea krait	39124001	TEP	DEH
1680	Marine reptile	Laticaudidae	*Laticauda laticaudata*	Large scaled sea krait	39124002	TEP	DEH
1408	Marine reptile	Hydrophiidae	*Acalyptophis peronii*	Horned Seasnake	39125001	TEP	DEH
1409	Marine reptile	Hydrophiidae	*Aipysurus apraefrontalis*	Short-nosed Seasnake	39125002	TEP	DEH
1410	Marine reptile	Hydrophiidae	*Aipysurus duboisii*	Dubois' Seasnake	39125003	TEP	DEH
1411	Marine reptile	Hydrophiidae	*Aipysurus eydouxii*	Spine-tailed Seasnake	39125004	TEP	DEH
1413	Marine reptile	Hydrophiidae	*Aipysurus fuscus*	Dusky Seasnake	39125006	TEP	DEH
1414	Marine reptile	Hydrophiidae	*Aipysurus laevis*	Olive Seasnake, Golden Seasnake	39125007	TEP	DEH
1415	Marine reptile	Hydrophiidae	*Aipysurus tenuis*	Brown-lined Seasnake	39125008	TEP	DEH
254	Marine reptile	Hydrophiidae	*Astrotia stokesii*	Stokes' seasnake	39125009	TEP	DEH
1530	Marine reptile	Hydrophiidae	*Disteira kingii*	spectacled seasnake	39125010	TEP	DEH
1416	Marine reptile	Hydrophiidae	*Disteira major*	Olive-headed Seasnake	39125011	TEP	DEH
1417	Marine reptile	Hydrophiidae	*Emydocephalus annulatus*	Turtle-headed Seasnake	39125012	TEP	DEH
1418	Marine reptile	Hydrophiidae	*Enhydrina schistosa*	Beaked Seasnake	39125013	TEP	DEH
1420	Marine reptile	Hydrophiidae	*Hydrelaps darwiniensis*	Black-ringed Seasnake	39125015	TEP	DEH
1681	Marine reptile	Hydrophiidae	*Hydrophis atriceps*	Black-headed seasnake	39125016	TEP	DEH
1683	Marine reptile	Hydrophiidae	*Hydrophis caerulescens*	Dwarf seasnake	39125018	TEP	DEH

ERAEF species ID	Taxa	Family name	Scientific name	Common Name	CAAB code	Role in fishery	Reference
1421	Marine reptile	Hydrophiidae	*Hydrophis coggeri*	Slender-necked Seasnake	39125019	TEP	DEH
1531	Marine reptile	Hydrophiidae	*Hydrophis czeblukovi*	fine-spined seasnake	39125020	TEP	DEH
957	Marine reptile	Hydrophiidae	*Hydrophis elegans*	Elegant seasnake	39125021	TEP	DEH
1684	Marine reptile	Hydrophiidae	*Hydrophis gracilis*	Slender seasnake	39125023	TEP	DEH
1422	Marine reptile	Hydrophiidae	*Hydrophis mcdowelli*	seasnake	39125025	TEP	DEH
1686	Marine reptile	Hydrophiidae	*Hydrophis melanosoma*	Black-banded robust seasnake	39125027	TEP	DEH
1423	Marine reptile	Hydrophiidae	*Hydrophis ornatus*	seasnake	39125028	TEP	DEH
1687	Marine reptile	Hydrophiidae	*Hydrophis pacificus*	Large-headed Seasnake	39125029	TEP	DEH
1688	Marine reptile	Hydrophiidae	*Hydrophis vorisi*	A seasnake	39125030	TEP	DEH
1424	Marine reptile	Hydrophiidae	*Lapemis hardwickii*	Spine-bellied Seasnake	39125031	TEP	DEH
1689	Marine reptile	Hydrophiidae	*Parahydrophis mertoni*	Northern mangrove seasnake	39125032	TEP	DEH
1005	Marine reptile	Hydrophiidae	*Pelamis platurus*	yellow-bellied seasnake	39125033	TEP	DEH
1074	Teleost	Solenostomidae	*Solenostomus cyanopterus*	Blue-finned Ghost Pipefish, Robust Ghost	37281001	TEP	DEH
1075	Teleost	Solenostomidae	*Solenostomus paradoxus*	Harlequin Ghost Pipefish, Ornate Ghost Pipefish	37281002	TEP	DEH
1010	Teleost	Syngnathidae	*Phycodurus eques*	Leafy Seadragon	37282001	TEP	DEH
1011	Teleost	Syngnathidae	*Phyllopteryx taeniolatus*	Weedy Seadragon, Common Seadragon	37282002	TEP	DEH
320	Teleost	Syngnathidae	*Solegnathus guentheri*	Indonesian Pipefish, Gunther's Pipehorse	37282003	TEP	DEH
1072	Teleost	Syngnathidae	*Solegnathus robustus*	Robust Spiny Pipehorse, Robust Pipehorse	37282004	TEP	DEH
549	Teleost	Syngnathidae	*Hippocampus angustus*	Western Spiny Seahorse	37282005	TEP	DEH
1089	Teleost	Syngnathidae	*Trachyrhamphus bicoarctatus*	Bend Stick Pipefish, Short-tailed Pipefish	37282006	TEP	DEH
360	Teleost	Syngnathidae	*Haliichthys taeniophorus*	Ribboned Seadragon, Ribboned Pipefish	37282007	TEP	DEH
1092	Teleost	Syngnathidae	*Urocampus carinirostris*	Hairy Pipefish	37282008	TEP	DEH
980	Teleost	Syngnathidae	*Lissocampus runa*	Javelin Pipefish	37282009	TEP	DEH
946	Teleost	Syngnathidae	*Hippocampus bleekeri*	pot bellied seahorse	37282010	TEP	DEH
953	Teleost	Syngnathidae	*Histiogamphelus briggsii*	Briggs' Crested Pipefish, Briggs' Pipefish	37282011	TEP	DEH
961	Teleost	Syngnathidae	*Hypselognathus rostratus*	Knife-snouted Pipefish	37282012	TEP	DEH

ERAEF species ID	Taxa	Family name	Scientific name	Common Name	CAAB code	Role in fishery	Reference
978	Teleost	Syngnathidae	*Leptoichthys fistularius*	Brushtail Pipefish	37282013	TEP	DEH
966	Teleost	Syngnathidae	*Kaupus costatus*	Deep-bodied Pipefish	37282014	TEP	DEH
995	Teleost	Syngnathidae	*Mitotichthys semistriatus*	Half-banded Pipefish	37282015	TEP	DEH
979	Teleost	Syngnathidae	*Lissocampus caudalis*	Australian Smooth Pipefish, Smooth Pipefish	37282016	TEP	DEH
1026	Teleost	Syngnathidae	*Stigmatopora argus*	Spotted Pipefish	37282017	TEP	DEH
1027	Teleost	Syngnathidae	*Stigmatopora nigra*	Wide-bodied Pipefish, Black Pipefish	37282018	TEP	DEH
1028	Teleost	Syngnathidae	*Stipecampus cristatus*	Ring-backed Pipefish	37282019	TEP	DEH
1061	Teleost	Syngnathidae	*Pugnaso curtirostris*	Pug-nosed Pipefish	37282021	TEP	DEH
994	Teleost	Syngnathidae	*Mitotichthys mollisoni*	Mollison's Pipefish	37282022	TEP	DEH
1094	Teleost	Syngnathidae	*Vanacampus phillipi*	Port Phillip Pipefish	37282023	TEP	DEH
1095	Teleost	Syngnathidae	*Vanacampus poecilolaemus*	Australian Long-snout Pipefish, Long-snouted Pipefish	37282024	TEP	DEH
996	Teleost	Syngnathidae	*Mitotichthys tuckeri*	Tucker's Pipefish	37282025	TEP	DEH
947	Teleost	Syngnathidae	*Hippocampus breviceps*	Short-head Seahorse, Short-snouted Seahorse	37282026	TEP	DEH
952	Teleost	Syngnathidae	*Hippocampus whitei*	white's seahorse	37282027	TEP	DEH
1073	Teleost	Syngnathidae	*Solegnathus spinosissimus*	spiny pipehorse	37282029	TEP	DEH
938	Teleost	Syngnathidae	*Halicampus grayi*	Mud Pipefish, Gray's Pipefish	37282030	TEP	DEH
566	Teleost	Syngnathidae	*Corythoichthys conspicillatus*	Yellow-banded Pipefish, Network Pipefish	37282032	TEP	DEH
949	Teleost	Syngnathidae	*Hippocampus taeniopterus*	Spotted Seahorse, Yellow Seahorse	37282033	TEP	DEH
105	Teleost	Syngnathidae	*Acentronura australe*	Southern Pygmy Pipehorse	37282034	TEP	DEH
114	Teleost	Syngnathidae	*Acentronura breviperula*	Hairy Pygmy Pipehorse	37282035	TEP	DEH
53	Teleost	Syngnathidae	*Bulbonaricus brauni*	Braun's Pughead Pipefish, Pug-headed Pipefish	37282037	TEP	DEH
1583	Teleost	Syngnathidae	*Bulbonaricus davaoensis*	[a pipefish]	37282038	TEP	DEH
287	Teleost	Syngnathidae	*Campichthys galei*	Gale's Pipefish	37282039	TEP	DEH
546	Teleost	Syngnathidae	*Campichthys tricarinatus*	Three-keel Pipefish	37282040	TEP	DEH
288	Teleost	Syngnathidae	*Campichthys tryoni*	Tryon's Pipefish	37282041	TEP	DEH
388	Teleost	Syngnathidae	*Choeroichthys brachysoma*	Pacific Short-bodied	37282042	TEP	DEH

ERAEF species ID	Taxa	Family name	Scientific name	Common Name	CAAB code	Role in fishery	Reference
				Pipefish, Short-bodied pipefish			
1584	Teleost	Syngnathidae	*Choeroichthys cinctus*	[a pipefish]	37282043	TEP	DEH
387	Teleost	Syngnathidae	*Choeroichthys latispinosus*	Muiron Island Pipefish	37282044	TEP	DEH
1585	Teleost	Syngnathidae	*Choeroichthys sculptus*	[a pipefish]	37282045	TEP	DEH
389	Teleost	Syngnathidae	*Choeroichthys suillus*	Pig-snouted Pipefish	37282046	TEP	DEH
563	Teleost	Syngnathidae	*Corythoichthys amplexus*	Fijian Banded Pipefish, Brown-banded Pipefish	37282047	TEP	DEH
1586	Teleost	Syngnathidae	*Corythoichthys haematopterus*	[a pipefish]	37282048	TEP	DEH
52	Teleost	Syngnathidae	*Corythoichthys intestinalis*	Australian Messmate Pipefish, Banded Pipefish	37282049	TEP	DEH
578	Teleost	Syngnathidae	*Corythoichthys ocellatus*	Orange-spotted Pipefish, Ocellated Pipefish	37282050	TEP	DEH
1587	Teleost	Syngnathidae	*Corythoichthys paxtoni*	[a pipefish]	37282051	TEP	DEH
452	Teleost	Syngnathidae	*Corythoichthys schultzi*	Schultz's Pipefish	37282052	TEP	DEH
401	Teleost	Syngnathidae	*Cosmocampus banneri*	Roughridge Pipefish	37282053	TEP	DEH
1588	Teleost	Syngnathidae	*Cosmocampus darrosanus*	[a pipefish]	37282054	TEP	DEH
580	Teleost	Syngnathidae	*Cosmocampus howensis*	Lord Howe Pipefish	37282055	TEP	DEH
1589	Teleost	Syngnathidae	*Cosmocampus maxweberi*	[a pipefish]	37282056	TEP	DEH
361	Teleost	Syngnathidae	*Dunckerocampus dactyliophorus*	Ringed Pipefish	37282057	TEP	DEH
569	Teleost	Syngnathidae	*Doryrhamphus melanopleura*	Bluestripe Pipefish	37282058	TEP	DEH
55	Teleost	Syngnathidae	*Doryrhamphus janssi*	Cleaner Pipefish, Janss' Pipefish	37282059	TEP	DEH
568	Teleost	Syngnathidae	*Doryrhamphus malus*	Flagtail Pipefish, Negros Pipefish	37282060	TEP	DEH
904	Teleost	Syngnathidae	*Festucalex cinctus*	Girdled Pipefish	37282061	TEP	DEH
1590	Teleost	Syngnathidae	*Festucalex gibbsi*	[a pipefish]	37282062	TEP	DEH
321	Teleost	Syngnathidae	*Festucalex scalaris*	Ladder Pipefish	37282063	TEP	DEH
914	Teleost	Syngnathidae	*Filicampus tigris*	Tiger Pipefish	37282064	TEP	DEH
54	Teleost	Syngnathidae	*Halicampus brocki*	Brock's Pipefish	37282065	TEP	DEH
359	Teleost	Syngnathidae	*Halicampus dunckeri*	Red-hair Pipefish, Duncker's Pipefish	37282066	TEP	DEH
1592	Teleost	Syngnathidae	*Halicampus macrorhynchus*	[a pipefish]	37282067	TEP	DEH

ERAEF species ID	Taxa	Family name	Scientific name	Common Name	CAAB code	Role in fishery	Reference
1593	Teleost	Syngnathidae	*Halicampus mataafae*	[a pipefish]	37282068	TEP	DEH
57	Teleost	Syngnathidae	*Halicampus nitidus*	Glittering Pipefish	37282069	TEP	DEH
454	Teleost	Syngnathidae	*Halicampus spinirostris*	Spiny-snout Pipefish	37282070	TEP	DEH
942	Teleost	Syngnathidae	*Heraldia nocturna*	Upside-down Pipefish	37282071	TEP	DEH
943	Teleost	Syngnathidae	*Hippichthys cyanospilos*	Blue-speckled Pipefish, Blue-spotted Pipefish	37282072	TEP	DEH
944	Teleost	Syngnathidae	*Hippichthys heptagonus*	Madura Pipefish	37282073	TEP	DEH
1675	Teleost	Syngnathidae	*Hippichthys parvicarinatus*	Short-keeled Pipefish	37282074	TEP	DEH
945	Teleost	Syngnathidae	*Hippichthys penicillus*	Beady Pipefish, Steep-nosed Pipefish	37282075	TEP	DEH
1595	Teleost	Syngnathidae	*Hippichthys spicifer*	[a pipefish]	37282076	TEP	DEH
951	Teleost	Syngnathidae	*Hippocampus planifrons*	Flat-face Seahorse	37282078	TEP	DEH
1603	Teleost	Syngnathidae	*Hippocampus zebra*	[a pipefish]	37282080	TEP	DEH
954	Teleost	Syngnathidae	*Histiogamphelus cristatus*	Rhino Pipefish, Macleay's Crested Pipefish	37282081	TEP	DEH
960	Teleost	Syngnathidae	*Hypselognathus horridus*	Shaggy Pipefish, Prickly Pipefish	37282082	TEP	DEH
967	Teleost	Syngnathidae	*Kimblaeus bassensis*	Trawl Pipefish, Kimbla Pipefish	37282083	TEP	DEH
390	Teleost	Syngnathidae	*Lissocampus fatiloquus*	Prophet's Pipefish	37282084	TEP	DEH
983	Teleost	Syngnathidae	*Maroubra perserrata*	Sawtooth Pipefish	37282085	TEP	DEH
992	Teleost	Syngnathidae	*Micrognathus andersonii*	Anderson's Pipefish, Shortnose Pipefish	37282086	TEP	DEH
1604	Teleost	Syngnathidae	*Micrognathus pygmaeus*	[a pipefish]	37282087	TEP	DEH
547	Teleost	Syngnathidae	*Micrognathus micronotopterus*	Tidepool Pipefish	37282088	TEP	DEH
1605	Teleost	Syngnathidae	*Micrognathus natans*	[a pipefish]	37282089	TEP	DEH
1606	Teleost	Syngnathidae	*Microphis brachyurus*	[a pipefish]	37282090	TEP	DEH
798	Teleost	Syngnathidae	*Microphis manadensis*	Manado River Pipefish, Manado Pipefish	37282091	TEP	DEH
1243	Teleost	Syngnathidae	*Mitotichthys meraculus*	Western Crested Pipefish	37282092	TEP	DEH
1607	Teleost	Syngnathidae	*Nannocampus lindemanensis*	[a pipefish]	37282093	TEP	DEH
1242	Teleost	Syngnathidae	*Nannocampus subosseus*	Bony-headed Pipefish	37282094	TEP	DEH
1001	Teleost	Syngnathidae	*Notiocampus ruber*	Red Pipefish	37282095	TEP	DEH
1608	Teleost	Syngnathidae	*Phoxocampus diacanthus*	[a pipefish]	37282096	TEP	DEH

ERAEF species ID	Taxa	Family name	Scientific name	Common Name	CAAB code	Role in fishery	Reference
1609	Teleost	Syngnathidae	*Siokunichthys breviceps*	[a pipefish]	37282097	TEP	DEH
1070	Teleost	Syngnathidae	*Solegnathus dunckeri*	Duncker's Pipehorse	37282098	TEP	DEH
1071	Teleost	Syngnathidae	*Solegnathus sp. 1 [in Kuiter, 2000]*	Pipehorse	37282099	TEP	DEH
1029	Teleost	Syngnathidae	*Syngnathoides biaculeatus*	Double-ended Pipehorse, Alligator Pipefish	37282100	TEP	DEH
322	Teleost	Syngnathidae	*Trachyrhamphus longirostris*	Long-nosed Pipefish, Straight Stick Pipefish	37282101	TEP	DEH
1093	Teleost	Syngnathidae	*Vanacampus margaritifer*	Mother-of-pearl Pipefish	37282102	TEP	DEH
1096	Teleost	Syngnathidae	*Vanacampus vercoi*	Verco's Pipefish	37282103	TEP	DEH
56	Teleost	Syngnathidae	*Bhanotia fasciolata*	Corrugated Pipefish, Barbed Pipefish	37282104	TEP	DEH
950	Teleost	Syngnathidae	*Hippocampus minotaur*	Bullneck Seahorse	37282105	TEP	DEH
1597	Teleost	Syngnathidae	*Hippocampus bargibanti*	pygmy seahorse	37282106	TEP	DEH
1591	Teleost	Syngnathidae	*Halicampus boothae*	[a pipefish]	37282107	TEP	DEH
362	Teleost	Syngnathidae	*Phoxocampus belcheri*	Rock Pipefish	37282109	TEP	DEH
948	Teleost	Syngnathidae	*Hippocampus queenslandicus*	Kellogg's Seahorse	37282110	TEP	DEH
1598	Teleost	Syngnathidae	*Hippocampus dahli*	[a pipefish]	37282114	TEP	DEH
1676	Teleost	Syngnathidae	*Hippocampus biocellatus*	False-eyed seahorse	37282115	TEP	DEH
1677	Teleost	Syngnathidae	*Hippocampus tuberculatus*	Knobby Seahorse	37282116	TEP	DEH
1602	Teleost	Syngnathidae	*Hippocampus tristis*	[a pipefish]	37282117	TEP	DEH
1596	Teleost	Syngnathidae	*Hippocampus alatus*	[a pipefish]	37282118	TEP	DEH
1664	Teleost	Syngnathidae	*Hippocampus abdominalis*	Big-bellied / southern potbellied seahorse	37282120	TEP	DEH
1601	Teleost	Syngnathidae	*Hippocampus procerus*	[a pipefish]	37282122	TEP	DEH
548	Teleost	Syngnathidae	*Hippocampus subelongatus*	West Australian Seahorse	37282123	TEP	DEH
1600	Teleost	Syngnathidae	*Hippocampus multispinus*	[a pipefish]	37282124	TEP	DEH
1599	Teleost	Syngnathidae	*Hippocampus hendriki*	[a pipefish]	37282125	TEP	DEH
1678	Teleost	Syngnathidae	*Hippocampus grandiceps*	Bighead Seahorse	37282126	TEP	DEH
1548	Teleost	Syngnathidae	*Heraldia sp. 1 [in Kuiter, 2000]*	Western upsidedown pipefish	37282130	TEP	DEH
308	Teleost	Clinidae	*Heteroclinus perspicillatus*	Common weedfish	37416013	TEP	DEH
318	Teleost	Syngnathidae	*Hippocampus spinosissimus*	Hedgehog Seahorse	NA	TEP	DEH
1665	Teleost	Syngnathidae	*Hippocampus histrix*	Spiny Seahorse	NA	TEP	DEH

ERAEF species ID	Taxa	Family name	Scientific name	Common Name	CAAB code	Role in fishery	Reference
1666	Teleost	Syngnathidae	*Hippocampus kelloggi*	Kellogg's Seahorse	NA	TEP	DEH
1667	Teleost	Syngnathidae	*Hippocampus kuda*	Spotted Seahorse, Yellow Seahorse	NA	TEP	DEH
1668	Teleost	Syngnathidae	*Hippocampus subelongatus*	West Australian Seahorse	NA	TEP	DEH
1669	Teleost	Syngnathidae	*Idiotropiscis larsonae*	Helen's Pygmy Pipehorse	NA	TEP	DEH
1699	Teleost	Syngnathidae	*Idiotropiscis australe*	Southern Pygmy Pipehorse	NA	TEP	DEH

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 bioregionalisation 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 for the Skipjack Tuna Fishery. Shading denotes habitats occurring within the jurisdictional boundary of the sub-fishery that are not subject to effort from purse seine nets. As a pelagic fishery, frequency of contact with the bottom is likely to be minimal

ERAEF record No.	ERAEF Habitat Number	Sub-biome	Feature	Habitat type	SGF Score	Depth (m)	Image available	Reference image location
2116	203	inner shelf	shelf	Fine sediments, Unrippled, Small encrustors	106	25- 100	Y	GAB (ECL) Image Collection
0932	096	inner shelf	shelf	fine sediments, wave rippled, small sponges	122	25- 100	N	
2093	201	inner shelf	shelf	fine sediments, wave rippled, encrustors	126	25- 100	N	
2117	204	inner shelf	shelf	Fine sediments, Subcrop, Mixed faunal community	153	25- 100	Y	GAB (ECL) Image Collection
2118	205	inner shelf	shelf	Coarse sediments, Unrippled, Small encrustors	206	25- 100	Y	GAB (ECL) Image Collection
0994	010	inner shelf	shelf	Coarse sediments, Current rippled, no fauna	210	25- 100	Y	GAB (ECL) Image Collection
2119	206	inner shelf	shelf	Coarse sediments, directed scour, large sponges	211	25- 100	Y	GAB (ECL) Image Collection
0111	011	inner shelf	shelf	coarse sediments, wave rippled, large sponges	221	25- 100	Y	GAB (ECL) Image Collection
2000	191	inner shelf	shelf	coarse sediments, wave rippled, small sponges	222	25- 100	N	
1993	191	inner shelf	shelf	coarse sediments, wave rippled, small sponges	222	25- 100	N	
2089	200	inner shelf	shelf	coarse sediments, wave rippled, encrustors	226	25- 100	N	

ERAEF record No.	ERAEF Habitat Number	Sub-biome	Feature	Habitat type	SGF Score	Depth (m)	Image available	Reference image location
2082	200	inner shelf	shelf	coarse sediments, wave rippled, encrustors	226	25- 100	N	
2076	199	inner shelf	shelf	cobble, wave rippled, low/ encrusting mixed fauna	426	25- 100	N	
2069	199	inner shelf	shelf	cobble, wave rippled, low/ encrusting mixed fauna	426	25- 100	N	
0130	012	inner shelf	shelf	fine sediments, unrippled, large sponges	101	25- 100	Y	SE and GAB Image Collection
0914	094	inner shelf	shelf	fine sediments, unrippled, small sponges	102	25- 100	N	
0166	016	inner shelf	shelf	fine sediments, unrippled, mixed faunal community	103	25- 100	Y	SE and GAB Image Collection
0902	093	inner shelf	shelf	fine sediments, unrippled, bioturbators	109	25- 100	N	
0154	014	inner shelf	shelf	fine sediments, wave rippled, large sponges	111	25- 100	Y	SE and GAB Image Collection
0926	095	inner shelf	shelf	fine sediments, wave rippled, no fauna	120	25- 100	N	
0939	096	inner shelf	shelf	fine sediments, wave rippled, small sponges	122	25- 100	N	
2098	201	inner shelf	shelf	fine sediments, wave rippled, encrustors	126	25- 100	N	
0878	091	inner shelf	shelf	fine sediments, irregular, large sponges	131	25- 100	N	
0890	092	inner shelf	shelf	fine sediments, irregular, small sponges	132	25- 100	N	
0142	013	inner shelf	shelf	coarse sediments, unrippled, large sponges	201	25- 100	Y	SE and GAB Image Collection
0105	010	inner shelf	shelf	coarse sediments, current rippled, no fauna	210	25- 100	Y	SE and GAB Image Collection
0866	090	inner shelf	shelf	coarse sediments, current rippled, bioturbators	219	25- 100	N	
0118	011	inner shelf	shelf	coarse sediments, wave rippled, large sponges	221	25- 100	Y	SE and GAB Image Collection
0093	009	inner shelf	shelf	coarse sediments, wave rippled, sedentary	227	25- 100	Y	SE and GAB Image Collection
0854	089	inner shelf	shelf	coarse sediments, irregular, encrustors	236	25- 100	N	
0069	006	inner shelf	shelf	coarse sediments, subcrop, large sponges	251	25- 100	Y	SE and GAB Image Collection
0009	001	inner shelf	shelf	gravel, current rippled, mixed faunal community	313	25- 100	Y	SE and GAB Image Collection

ERAEF record No.	ERAEF Habitat Number	Sub-biome	Feature	Habitat type	SGF Score	Depth (m)	Image available	Reference image location
0963	098	inner shelf	shelf	gravel, wave rippled, no fauna	320	25- 100	Y	SE and GAB Image Collection
0951	097	inner shelf	shelf	gravel, wave rippled, bioturbators	329	25- 100	Y	SE and GAB Image Collection
0081	007	inner shelf	shelf	gravel, debris flow, mixed faunal community	343	25- 100	Y	SE and GAB Image Collection
0057	005	inner shelf	shelf	cobble, debris flow, large sponges	441	25- 100	Y	SE and GAB Image Collection
0975	099	inner shelf	shelf	Igneous rock, high outcrop, large sponges	591	25- 100	N	
0045	004	inner shelf	shelf	Sedimentary rock, outcrop, large sponges	671	25- 100	Y	SE and GAB Image Collection
0021	002	inner shelf	shelf	Sedimentary rock, outcrop, large sponges	691	25- 100	Y	SE and GAB Image Collection
0033	003	inner shelf	shelf	Sedimentary rock, outcrop, mixed faunal community	693	25- 100	Y	SE and GAB Image Collection
1699	161	mid-slope	slope	mud, unrippled, small sponges	002	700- 1500	N	
1663	158	mid-slope	slope	mud, current rippled, bioturbators	019	700- 1500	N	
1687	160	mid-slope	slope	mud, irregular, sedentary	037	700- 1500	N	
1675	159	mid-slope	slope	mud, irregular, bioturbators	039	700- 1500	N	
1639	156	mid-slope	slope	fine sediments, unrippled, no fauna	100	700- 1500	N	
2113	156	mid-slope	Slope	Fine sediments, Unrippled, No fauna	100	700-1500	Y	GAB (ECL) Image Collection
0650	063	mid-slope	slope	fine sediments, unrippled, octocorals	105	700- 1500	Y	SE and GAB Image Collection
0626	061	mid-slope	slope	fine sediments, irregular, bioturbators	139	700- 1500	Y	SE and GAB Image Collection
0578	057	mid-slope	slope	fine sediments, subcrop, bioturbators	150	700- 1500	Y	SE and GAB Image Collection
1603	153	mid-slope	slope	coarse sediments, unrippled, no fauna	200	700- 1500	N	
0638	062	mid-slope	slope	coarse sediments, unrippled, octocorals	205	700- 1500	Y	SE and GAB Image Collection
1567	150	mid-slope	slope	coarse sediments, current rippled, no fauna	210	700- 1500	N	
1579	151	mid-slope	slope	coarse sediments, current rippled, octocorals	215	700- 1500	N	

ERAEF record No.	ERAEF Habitat Number	Sub-biome	Feature	Habitat type	SGF Score	Depth (m)	Image available	Reference image location
2120	207	mid-slope	Slope	Coarse sediments, Current rippled / directed scour, Small encrustors	216	700-1500	Y	GAB (ECL) Image Collection
1591	152	mid-slope	slope	coarse sediments, current rippled, sedentary	217	700- 1500	N	
2112	152	mid-slope	Slope	Coarse sediments, Current rippled, Sedentary	217	700-1500	Y	GAB (ECL) Image Collection
2121	208	mid-slope	Slope	Coarse sediments, Highly irregular, Mixed faunal community	233	700-1500	Y	GAB (ECL) Image Collection
0602	059	mid-slope	slope	coarse sediments, irregular, low encrusting	236	700- 1500	Y	SE and GAB Image Collection
2103	059	mid-slope	Slope	Coarse sediments, Highly irregular, Small encrustors	236	700-1500	Y	GAB (ECL) Image Collection
0590	058	mid-slope	slope	cobble, unrippled, small sponges	402	700- 1500	Y	SE and GAB Image Collection
1615	154	mid-slope	slope	cobble, debris flow, crinoids	444	700- 1500	N	
1627	155	mid-slope	slope	slabs/ boulders, debris flow, octocorals	445	700- 1500	Y	SE and GAB Image Collection
0494	050	mid-slope	slope	cobble, debris flow, encrustors	446	700- 1500	Y	SE and GAB Image Collection
2123	210	mid-slope	Slope	Cobble/ boulder, Debris flow / rubble banks, Sedentary	447	700-1500	Y	GAB (ECL) Image Collection
0506	051	mid-slope	slope	cobble, outcrop, no fauna	460	700- 1500	Y	SE and GAB Image Collection
0614	060	mid-slope	slope	cobble, outcrop, crinoids	464	700- 1500	Y	SE and GAB Image Collection
0662	064	mid-slope	slope	Sedimentary slab and mud boulders, outcrop, crinoids	464	700- 1500	Y	SE and GAB Image Collection
2124	211	mid-slope	Slope	Igneous / metamorphic rock, Subcrop, Small encrustors	556	700-1500	Y	GAB (ECL) Image Collection
2125	212	mid-slope	Slope	Igneous / metamorphic rock, Subcrop, Sedentary	557	700-1500	Y	GAB (ECL) Image Collection
0530	053	mid-slope	slope	Igneous rock, low outcrop, sedentary	567	700- 1500	Y	SE and GAB Image Collection
2126	213	mid-slope	Slope	Igneous / metamorphic rock, Low Outcrop, Octocorals	575	700-1500	Y	GAB (ECL) Image Collection
2127	214	mid-slope	Slope	Igneous / metamorphic rock, Low Outcrop, Small encrustors	576	700-1500	Y	GAB (ECL) Image Collection
2128	215	mid-slope	Slope	Igneous / metamorphic rock, Low Outcrop, Sedentary	577	700-1500	Y	GAB (ECL) Image Collection
0482	049	mid-slope	slope	Igneous rock, high outcrop, bioturbators	594	700- 1500	Y	SE and GAB Image Collection

ERAEF record No.	ERAEF Habitat Number	Sub-biome	Feature	Habitat type	SGF Score	Depth (m)	Image available	Reference image location
1651	157	mid-slope	slope	Igneous rock, high outcrop, octocorals	595	700- 1500	N	
0554	055	mid-slope	slope	Sedimentary rock, unrippled, sedentary	607	700- 1500	Y	SE and GAB Image Collection
1711	162	mid-slope	slope	Sedimentary rock, debris flow, crinoids	644	700- 1500	N	
1735	164	mid-slope	slope	Sedimentary rock, subcrop, crinoids	654	700- 1500	Y	SE and GAB Image Collection
1747	165	mid-slope	slope	Sedimentary rock, subcrop, octocorals	655	700- 1500	Y	SE and GAB Image Collection
0566	056	mid-slope	slope, canyons, seamounts	Sedimentary rock, outcrop, mixed faunal community	673	700- 1500	Y	SE and GAB Image Collection
0518	052	mid-slope	slope	Sedimentary rock, outcrop, octocorals	675	700- 1500	Y	SE and GAB Image Collection
2107	080	mid-slope	Slope	Sedimentary rock, Low Outcrop, Small encrustors	676	700-1500	Y	GAB (ECL) Image Collection
0830	084	mid-slope	seamount	Sedimentary rock, outcrop, sedentary	677	700- 1500	Y	SE and GAB Image Collection
2108	084	mid-slope	Slope	Sedimentary rock, Low Outcrop, Sedentary: e.g. seapens	677	700-1500	Y	GAB (ECL) Image Collection
0542	054	mid-slope	slope	Sedimentary rock, outcrop, crinoids	694	700- 1500	Y	SE and GAB Image Collection
1723	163	mid-slope	slope	Sedimentary rock, high outcrop, octocorals	695	700- 1500	Y	SE and GAB Image Collection
2114	163	mid-slope	Slope	Sedimentary rock, High Outcrop, Octocorals (gold corals / seawhips)	695	700-1500	Y	GAB (ECL) Image Collection
1888	177	outer shelf	shelf	mud, unrippled, low encrusting sponges	002	100- 200	N	
1883	177	outer shelf	shelf	mud, unrippled, low encrusting sponges	002	100- 200	N	
1897	178	outer shelf	shelf	mud, unrippled, bioturbators	009	100- 200	N	
1892	178	outer shelf	shelf	mud, unrippled, bioturbators	009	100- 200	N	
1906	179	outer shelf	shelf	mud, subcrop, erect sponges	051	100- 200	N	
1901	179	outer shelf	shelf	mud, subcrop, erect sponges	051	100- 200	N	
1295	125	outer shelf	shelf	mud, subcrop, small sponges	052	100- 200	Y	GAB (ECL) Image Collection
1915	180	outer shelf	shelf	mud, subcrop, low encrusting mixed fauna	056	100- 200	N	

ERAEF record No.	ERAEF Habitat Number	Sub-biome	Feature	Habitat type	SGF Score	Depth (m)	Image available	Reference image location
1910	180	outer shelf	shelf	mud, subcrop, low encrusting mixed fauna	056	100- 200	N	
1131	112	outer shelf	shelf	fine sediments, unrippled, no fauna	100	100- 200	Y	GAB (ECL) Image Collection
1144	113	outer shelf	shelf	fine sediments, unrippled, small sponges	102	100- 200	Y	GAB (ECL) Image Collection
1924	181	outer shelf	shelf	fine sediments, unrippled, encrustors	106	100- 200	N	
1919	181	outer shelf	shelf	fine sediments, unrippled, encrustors	106	100- 200	N	
1106	110	outer shelf	shelf	fine sediments, unrippled, bioturbators	109	100- 200	Y	GAB (ECL) Image Collection
1933	183	outer shelf	shelf	fine sediments, current rippled, no fauna	110	100- 200	N	
1928	183	outer shelf	shelf	fine sediments, current rippled, no fauna	110	100- 200	N	
1942	184	outer shelf	shelf	fine sediments, current rippled, low/ encrusting sponges	112	100- 200	N	
1937	184	outer shelf	shelf	fine sediments, current rippled, low/ encrusting sponges	112	100- 200	N	
1194	117	outer shelf	shelf	fine sediments, wave rippled, no fauna	120	100- 200	N	
1157	114	outer shelf	shelf	fine sediments, wave rippled, bioturbators	129	100- 200	Y	GAB (ECL) Image Collection
1055	106	outer shelf	shelf	fine sediments, irregular, no fauna	130	100- 200	N	
1068	107	outer shelf	shelf	fine sediments, irregular, small sponges	132	100- 200	N	
1951	185	outer shelf	shelf	fine sediments, irregular, low encrusting mixed fauna	136	100- 200	N	
1946	185	outer shelf	shelf	fine sediments, irregular, low encrusting mixed fauna	136	100- 200	N	
1960	187	outer shelf	shelf	fine sediments, irregular, bioturbators	139	100- 200	N	
1955	187	outer shelf	shelf	fine sediments, irregular, bioturbators	139	100- 200	N	
1969	188	outer shelf	shelf	fine sediments, rubble banks, low encrusting sponges	142	100- 200	N	
1964	188	outer shelf	shelf	fine sediments, rubble banks, low encrusting sponges	142	100- 200	N	
0172	017	outer shelf	shelf	fine sediments, subcrop, large sponges	151	100- 200	Y	GAB (ECL) Image Collection

ERAEF record No.	ERAEF Habitat Number	Sub-biome	Feature	Habitat type	SGF Score	Depth (m)	Image available	Reference image location
1093	109	outer shelf	shelf	fine sediments, subcrop, small sponges	152	100- 200	Y	GAB (ECL) Image Collection
1978	189	outer shelf	shelf	fine sediments, subcrop, mixed low fauna	156	100- 200	N	
1973	189	outer shelf	shelf	fine sediments, subcrop, mixed low fauna	156	100- 200	N	
1987	190	outer shelf	shelf	coarse sediments, unrippled, no fauna	200	100- 200	N	
1982	190	outer shelf	shelf	coarse sediments, unrippled, no fauna	200	100- 200	N	
0283	027	outer shelf	shelf	coarse sediments, current rippled, no fauna	210	100- 200	Y	GAB (ECL) Image Collection
0258	025	outer shelf	shelf	coarse sediments, wave rippled, no fauna	220	100- 200	Y	GAB (ECL) Image Collection
0197	019	outer shelf	shelf	coarse sediments, subcrop, large sponges	251	100- 200	Y	GAB (ECL) Image Collection
0993	101	outer shelf	shelf	coarse sediments, subcrop, small sponges	252	100- 200	N	
2122	209	Outer shelf	shelf	Coarse sediments, Subcrop, Mixed faunal community	253	100- 200	Y	GAB (ECL) Image Collection
2009	192	outer shelf	shelf	gravel/ pebble, current rippled, large sponges	311	100- 200	N	
2004	192	outer shelf	shelf	gravel/ pebble, current rippled, large sponges	311	100- 200	N	
2018	193	outer shelf	shelf	gravel/ pebble, current rippled, mixed low fauna	316	100- 200	N	
2013	193	outer shelf	shelf	gravel/ pebble, current rippled, mixed low fauna	316	100- 200	N	
1231	120	outer shelf	shelf	gravel, current rippled, bioturbators	319	100- 200	N	
1282	124	outer shelf	shelf	gravel, wave rippled, no fauna	320	100- 200	N	
1269	123	outer shelf	shelf	gravel, wave rippled, large sponges	321	100- 200	N	
2027	194	outer shelf	shelf	gravel/ pebble, wave rippled, low encrusting sponges	322	100- 200	N	
2022	194	outer shelf	shelf	gravel/ pebble, wave rippled, low encrusting sponges	322	100- 200	N	
2036	195	outer shelf	shelf	gravel, wave rippled, encrustors	326	100- 200	N	
2031	195	outer shelf	shelf	gravel, wave rippled, encrustors	326	100- 200	N	

ERAEF record No.	ERAEF Habitat Number	Sub-biome	Feature	Habitat type	SGF Score	Depth (m)	Image available	Reference image location
1244	121	outer shelf	shelf	gravel, wave rippled, bioturbators	329	100- 200	Y	GAB (ECL) Image Collection
2045	196	outer shelf	shelf	gravel, wave rippled, encrustors	346	100- 200	N	
2040	196	outer shelf	shelf	gravel, wave rippled, encrustors	346	100- 200	N	
2054	197	outer shelf	shelf	cobble, unrippled, low/ encrusting mixed fauna	406	100- 200	N	
2049	197	outer shelf	shelf	cobble, unrippled, low/ encrusting mixed fauna	406	100- 200	N	
2063	198	outer shelf	shelf	cobble, current rippled, low/ encrusting mixed fauna	416	100- 200	N	
2058	198	outer shelf	shelf	cobble, current rippled, low/ encrusting mixed fauna	416	100- 200	N	
2109	126	Outer shelf	shelf	Sedimentary rock, Subcrop, large sponges	651	100- 200	Y	GAB (ECL) Image Collection
1320	127	outer shelf	shelf	Sedimentary rock, subcrop, small sponges	652	100- 200	Y	GAB (ECL) Image Collection
1843	173	outer shelf	shelf-break	mud, unrippled, no fauna	000	100- 200, 200-700	N	
0987	100	outer shelf	shelf	mud, unrippled, sedentary	007	100- 200	Y	SE and GAB Image Collection
1855	174	outer shelf	shelf-break	mud, unrippled, sedentary	007	100- 200, 200-700	N	
1302	125	outer shelf	shelf	mud, subcrop, small sponges	052	100- 200	Y	SE and GAB Image Collection
1138	112	outer shelf	shelf	fine sediments, unrippled, no fauna	100	100- 200	Y	SE and GAB Image Collection
1807	170	outer shelf	shelf-break	fine sediments, unrippled, no fauna	100	100- 200, 200-700	N	
1125	111	outer shelf	shelf	fine sediments, unrippled, large sponges	101	100- 200	Y	SE and GAB Image Collection
1151	113	outer shelf	shelf	fine sediments, unrippled, small sponges	102	100- 200	Y	SE and GAB Image Collection
1819	171	outer shelf	shelf-break	fine sediments, unrippled, octocorals	105	100- 200, 200-700	N	
1113	110	outer shelf	shelf	fine sediments, unrippled, bioturbators	109	100- 200	Y	SE and GAB Image Collection
1795	169	outer shelf	shelf-break	fine sediments, unrippled, bioturbators	109	100- 200, 200-700	N	
1037	104	outer shelf	shelf	fine sediments, current rippled, bioturbators	119	100- 200	Y	SE and GAB Image Collection

ERAEF record No.	ERAEF Habitat Number	Sub-biome	Feature	Habitat type	SGF Score	Depth (m)	Image available	Reference image location
1201	117	outer shelf	shelf	fine sediments, wave rippled, no fauna	120	100- 200	N	
1188	116	outer shelf	shelf	fine sediments, wave rippled, large sponges	121	100- 200	N	
1225	119	outer shelf	shelf	fine sediments, wave rippled, small sponges	122	100- 200	N	
1176	115	outer shelf	shelf	fine sediments, wave rippled, encrustors	126	100- 200	N	
1213	118	outer shelf	shelf	fine sediments, wave rippled, sedentary	127	100- 200	N	
1164	114	outer shelf	shelf	fine sediments, wave rippled, bioturbators	129	100- 200	Y	SE and GAB Image Collection
1062	106	outer shelf	shelf	fine sediments, irregular, no fauna	130	100- 200	N	
1049	105	outer shelf	shelf	fine sediments, irregular, large sponges	131	100- 200	N	
1075	107	outer shelf	shelf	fine sediments, irregular, small sponges	132	100- 200	N	
1783	168	outer shelf	shelf-break	fine sediments, irregular, small sponges	132	100- 200, 200-700	N	
1771	167	outer shelf	shelf-break	fine sediments, irregular, bioturbators	139	100- 200, 200-700	N	
0179	017	outer shelf	shelf	fine sediments, subcrop, large sponges	151	100- 200	Y	SE and GAB Image Collection
1100	109	outer shelf	shelf	fine sediments, subcrop, small sponges	152	100- 200	Y	SE and GAB Image Collection
1087	108	outer shelf	shelf	fine sediments, subcrop, mixed faunal community	153	100- 200	N	
0326	030	outer shelf	shelf	coarse sediments, unrippled, mixed faunal community	203	100- 200	Y	SE and GAB Image Collection
0277	026	outer shelf	shelf	coarse sediments, unrippled, encrustors	206	100- 200	Y	SE and GAB Image Collection
0290	027	outer shelf	shelf	coarse sediments, current rippled, no fauna	210	100- 200	Y	SE and GAB Image Collection
0265	025	outer shelf	shelf	coarse sediments, wave rippled, no fauna	220	100- 200	Y	SE and GAB Image Collection
1025	103	outer shelf	shelf	coarse sediments, wave rippled, small sponges	222	100- 200	N	
1013	102	outer shelf	shelf	coarse sediments, wave rippled, encrustors	226	100- 200	N	
0314	029	outer shelf	shelf	coarse sediments, irregular, large sponges	231	100- 200	Y	SE and GAB Image Collection

ERAEF record No.	ERAEF Habitat Number	Sub-biome	Feature	Habitat type	SGF Score	Depth (m)	Image available	Reference image location
0204	019	outer shelf	shelf	coarse sediments, subcrop, large sponges	251	100- 200	Y	SE and GAB Image Collection
1001	101	outer shelf	shelf	coarse sediments, subcrop, small sponges	252	100- 200	N	
1238	120	outer shelf	shelf	gravel, current rippled, bioturbators	319	100- 200	N	
1289	124	outer shelf	shelf	gravel, wave rippled, no fauna	320	100- 200	N	
1276	123	outer shelf	shelf	gravel, wave rippled, large sponges	321	100- 200	N	
1263	122	outer shelf	shelf	gravel, wave rippled, encrustors	326	100- 200	N	
1251	121	outer shelf	shelf	gravel, wave rippled, bioturbators	329	100- 200	Y	SE and GAB Image Collection
0252	024	outer shelf	shelf	gravel, irregular, encrustors	336	100- 200	Y	SE and GAB Image Collection
0302	028	outer shelf	shelf	cobble, unrippled, large sponges	401	100- 200	Y	SE and GAB Image Collection
0338	032	outer shelf	shelf	cobble, subcrop, crinoids	454	100- 200	Y	SE and GAB Image Collection
0216	020	outer shelf	shelf	cobble, outcrop, crinoids	464	100- 200	Y	SE and GAB Image Collection
1831	172	outer shelf	shelf-break	Igneous rock, high outcrop, no fauna	590	100- 200, 200-700	N	
1314	126	outer shelf	shelf	Sedimentary rock, subcrop, large sponges	651	100- 200	Y	SE and GAB Image Collection
1327	127	outer shelf	shelf	Sedimentary rock, subcrop, small sponges	652	100- 200	Y	SE and GAB Image Collection
1879	176	outer shelf	shelf-break	Sedimentary rock, subcrop, small sponges	652	100- 200, 200-700	N	
0228	022	outer shelf	shelf	Sedimentary rock, subcrop, mixed faunal community	653	100- 200	Y	SE and GAB Image Collection
1867	175	outer shelf	shelf-break	Sedimentary rock, subcrop, crinoids	654	100- 200, 200-700	N	
0240	023	outer shelf	shelf	Sedimentary rock, outcrop, large sponges	671	100- 200	Y	SE and GAB Image Collection
0674	065	outer shelf	canyon	Sedimentary rock, outcrop, small sponges	672	100- 200	Y	SE and GAB Image Collection
0191	018	outer shelf	shelf	Sedimentary rock, outcrop, encrustors	696	100- 200	Y	SE and GAB Image Collection
1759	166	outer shelf	shelf-break	Bryozoan based communities	xx6	100- 200, 200-700	N	

ERAEF record No.	ERAEF Habitat Number	Sub-biome	Feature	Habitat type	SGF Score	Depth (m)	Image available	Reference image location
2115	202	upper slope	Slope	Mud, Unrippled, No fauna	000	200-700	Y	GAB (ECL) Image Collection
2110	144	upper slope	Slope	Mud, Unrippled, Sedentary	007	200-700	Y	GAB (ECL) Image Collection
2106	078	upper slope	Slope	Fine sediments, Unrippled, Sedentary	107	200-700	Y	GAB (ECL) Image Collection
2102	044	upper slope	Slope	Fine sediments, Unrippled, bioturbators	109	200-700	Y	GAB (ECL) Image Collection
2105	073	upper slope	Slope	Fine sediments, irregular, Small encrustors	136	200-700	Y	GAB (ECL) Image Collection
2111	148	upper slope	Slope	Sedimentary rock, Subcrop, Octocorals (gold corals / seawhips)	655	200-700	Y	GAB (ECL) Image Collection
2129	216	upper slope	Slope	Sedimentary rock, low outcrop, Octocorals	675	200-700	Y	GAB (ECL) Image Collection
2104	071	upper slope	Slope	Sedimentary rock, Low Outcrop, Small encrustors	676	200-700	Y	GAB (ECL) Image Collection
2130	217	upper slope	Slope	Sedimentary rock, High Outcrop, Small encrustors	686	200-700	Y	GAB (ECL) Image Collection
2131	218	upper slope	Slope	Sedimentary rock, High Outcrop, Sedentary: e.g. seapens	687	200-700	Y	GAB (ECL) Image Collection
1507	143	upper slope	slope	mud, unrippled, large sponges	001	200- 700	N	
1495	142	upper slope	slope	mud, unrippled, encrustors	006	200- 700	Y	SE and GAB Image Collection
1519	144	upper slope	slope	mud, unrippled, sedentary	007	200- 700	Y	SE and GAB Image Collection
1483	141	upper slope	slope	mud, unrippled, bioturbators	009	200- 700	Y	SE and GAB Image Collection
1471	140	upper slope	slope	mud, irregular, bioturbators	039	200- 700	Y	SE and GAB Image Collection
0470	046	upper slope	slope	fine sediments, unrippled, no fauna	100	200- 700	Y	SE and GAB Image Collection
1435	137	upper slope	slope	fine sediments, unrippled, small sponges	102	200- 700	N	
1423	136	upper slope	slope	fine sediments, unrippled, encrustors	106	200- 700	Y	SE and GAB Image Collection
0794	078	upper slope	canyon	fine sediments, unrippled, sedentary	107	200- 700	Y	SE and GAB Image Collection
0446	044	upper slope	slope, canyon	fine sediments, unrippled, bioturbators	109	200- 700	Y	SE and GAB Image Collection
1399	133	upper slope	slope	fine sediments, current rippled, no fauna	110	200- 700	N	

ERAEF record No.	ERAEF Habitat Number	Sub-biome	Feature	Habitat type	SGF Score	Depth (m)	Image available	Reference image location
0758	073	upper slope	canyon	fine sediments, irregular, encrustors	136	200- 700	Y	SE and GAB Image Collection
0422	041	upper slope	slope	fine sediments, irregular, bioturbators	139	200- 700	Y	SE and GAB Image Collection
1411	134	upper slope	slope	fine sediments, subcrop, large sponges	151	200- 700	N	
0782	077	upper slope	canyon, slope	fine sediments, subcrop, small sponges	152	200- 700	Y	SE and GAB Image Collection
0410	040	upper slope	slope	fine sediments, subcrop, sedentary	157	200- 700	Y	SE and GAB Image Collection
0434	043	upper slope	slope	coarse sediments, unrippled, low mixed encrustors	206	200- 700	Y	SE and GAB Image Collection
0458	045	upper slope	slope	coarse sediments, unrippled, sedentary	207	200- 700	Y	SE and GAB Image Collection
0770	076	upper slope	canyon, slope	coarse sediments, irregular, low mixed encrustors	236	200- 700	Y	SE and GAB Image Collection
0746	072	upper slope	canyon	coarse sediments, irregular, bioturbators	239	200- 700	Y	SE and GAB Image Collection
1459	139	upper slope	slope	gravel, debris flow, no fauna	340	200- 700	N	
1447	138	upper slope	slope	gravel, debris flow, encrustors	346	200- 700	Y	SE and GAB Image Collection
1363	130	upper slope	slope	cobble, debris flow, no fauna	440	200- 700	Y	SE and GAB Image Collection
1387	132	upper slope	slope	cobble, debris flow, small sponges	442	200- 700	Y	SE and GAB Image Collection
1375	131	upper slope	slope	cobble, debris flow, octocorals	445	200- 700	N	
1351	129	upper slope	slope	cobble, debris flow, encrustors	446	200- 700	Y	SE and GAB Image Collection
0710	069	upper slope	canyon	cobble, outcrop, crinoids	464	200- 700	Y	SE and GAB Image Collection
0818	081	upper slope	seamount	Sedimentary rock, unrippled, no fauna	600	200- 700	Y	SE and GAB Image Collection
0842	085	upper slope	seamount	Sedimentary rock, unrippled, encrustors	606	200- 700	Y	SE and GAB Image Collection
0698	067	upper slope	canyon, slope	Sedimentary rock, subcrop, large sponges	651	200- 700	Y	SE and GAB Image Collection
0722	070	upper slope	canyon	Sedimentary rock, subcrop, small sponges	652	200- 700	Y	SE and GAB Image Collection
0350	033	upper slope	slope	Sedimentary rock, subcrop, mixed faunal community	653	200- 700	Y	SE and GAB Image Collection

ERAEF record No.	ERAEF Habitat Number	Sub-biome	Feature	Habitat type	SGF Score	Depth (m)	Image available	Reference image location
1555	148	upper slope	slope	Sedimentary rock, subcrop, octocorals	655	200- 700	N	
0386	036	upper slope	slope	Sedimentary rock, subcrop, encrustors	656	200- 700	Y	SE and GAB Image Collection
0374	035	upper slope	slope	Sedimentary rock, outcrop, encrustors	666	200- 700	Y	SE and GAB Image Collection
1531	145	upper slope	slope	Sedimentary rock, low outcrop, large sponges	671	200- 700	N	
1543	146	upper slope	slope	Sedimentary rock, low outcrop, small sponges	672	200- 700	Y	SE and GAB Image Collection
0734	071	upper slope	canyon	Sedimentary rock, outcrop, encrustors	676	200- 700	Y	SE and GAB Image Collection
0806	080	upper slope	seamount	Sedimentary rock, outcrop, encrustors	676	200- 700	Y	SE and GAB Image Collection
0398	039	upper slope	slope	Sedimentary rock, outcrop, crinoids	684	200- 700	Y	SE and GAB Image Collection
0686	066	upper slope	canyon	Sedimentary rock, outcrop, crinoids	694	200- 700	Y	SE and GAB Image Collection
0362	034	upper slope	slope	Sedimentary rock, outcrop, encrustors	696	200- 700	Y	SE and GAB Image Collection
1339	128	upper slope	slope	Bryozoan based communities	xx6	200- 700	N	

Scoping Document S2B2. Pelagic Habitats

A list of the pelagic habitats for the Skipjack Tuna Fishery Shading denotes habitats occurring within the jurisdictional boundary of the sub-fishery that are not subject to effort from purse seine nets

ERAEF Habitat Number	Pelagic Habitat type	Depth (m)	Comments	Reference
P1	Eastern Pelagic Province - Coastal	0 – 200		dow167A3
P2	Eastern Pelagic Province - Oceanic	0 – > 600	this is a compilation of the range covered by Oceanic Community (1) and (2)	dow167A3
P4	North Eastern Pelagic Province - Oceanic	0 – > 400	this is a compilation of the range covered by Oceanic Community (1) and (2)	dow167A3
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		dow167A3
P5	Northern Pelagic Province - Coastal	0- 200	this is a compilation of NWS, Bonaparte, Arafura, Gulf, and east Cape York	dow167A1, A2, A4
P6	North Western Pelagic Province - Oceanic	0 – > 800	this is a compilation of the range covered by Oceanic Community (1) and (2)	dow167A3
P7	Southern Pelagic Province - Coastal	0 – 200	this is a compilation of the range covered by Coastal pelagic Tas and GAB	dow167A3
P8	Southern Pelagic Province - Oceanic	0 – > 600	this is a compilation of the range covered by Oceanic Communities (1), (2), and (3)	dow167A3
P9	Southern Pelagic Province - Seamount Oceanic	0 – > 600	this is a compilation of the range covered by Seamount Oceanic Communities (1), (2), and (3)	dow167A3
P10	Western Pelagic Province - Coastal	0 – 200		dow167A3
P11	Western Pelagic Province - Oceanic	0 – > 400	this is a compilation of the range covered by Oceanic Community (1) and (2)	dow167A3
P12	Eastern Pelagic Province - Seamount Oceanic	0 – > 600	this is a compilation of the range covered by Seamount Oceanic Communities (1) and (2)	dow167A3
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	this is a compilation of the range covered by the Seamount Oceanic Community (1) and (2)	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 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													
Outer Shelf 110 – 250m [1,2,]						x				x									
Upper Slope 250 – 565m [3]						x				x									
Mid–Upper Slope 565 – 820m[3]						x													
Mid Slope 820 – 1100m[3]																			
Lower slope/ Abyssal > 1100m[6]																			
Reef 0 -110m[7, 8]																			
Reef 110-250m[8]																			
Seamount 0 – 110m																			
Seamount 110- 250m																			
Seamount 250 – 565m																			
Seamount 565 – 820m																			
Seamount 820 – 1100m																			
Seamount 1100 – 3000m																			
Plateau 0 – 110m																			

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
Plateau 110- 250m[4]																			
Plateau 250 – 565m[4]																			
Plateau 565 – 820m[5]																			
Plateau 820 – 1100m[5]																			

Demersal communities underlying fishing activity in the Skipjack fishery (x). Shaded cells indicate all communities within the province. [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 (250-1000m). 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, 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 Skipjack fishery (x). Shaded cells indicate all communities that exist in the province

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

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

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 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

Table (Note: Operational objectives that are eliminated should be shaded out and a rationale provided as for the retained operational 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).*
Target Species	Avoid recruitment failure of the target species Avoid negative consequences for species or population sub-components	1. Population size	1.1 Maintain catch at specified level 1.2 Species do not approach extinction or become extinct 1.3 No trend in biomass 1.4 Maintain biomass above a specified level	Biomass, numbers, density, CPUE, yield	1.1 EMO – to maximise economic efficiency in the exploitation of fisheries resources (AFMA 2002a). EMO – Ensuring, through proper conservation management measures, that the living resources of the Australian Fishing Zone (AFZ) are not endangered by over-exploitation (AFMA 2002a). 1.3 Operational objective too general and covered by (1.3 & 1.4). 1.4 Covered by Operational Objective 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 the GAB	2.1 Economic penalty to fishery if skipjack shift further from away from fishing port, i.e. need to satisfy EMO – to maximise economic efficiency in the exploitation of fisheries resources (AFMA 2002a).
		3. Genetic structure	3.1 Genetic diversity does not change outside acceptable bounds	Frequency of genotypes in the population, effective population size (N_e), number of spawning units	3.1 Not currently monitored. No reference levels established.

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 There is an optimal skipjack tuna size range for the cannery that is to satisfy the EMO – to maximise economic efficiency in the exploitation of fisheries resources (AFMA 2002a). 2) Skipjack reach maturity within first year, plus AFZ believed to largely be southern extent of the species range.
		5. Reproductive Capacity	5.1 Fecundity of the population does not change outside acceptable bounds (e.g. more than X% of reference population fecundity) 5.2 Recruitment to the population does not change outside acceptable bounds	Egg production of population Abundance of recruits	5.1 Ability of skipjack population to sustain fishing depends on ability to repopulate i.e. the level of fecundity of the population. 5.2 Sustainability of population determined by recruitment of new individuals into the fished population.
		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 Need to maintain integrity and functioning of skipjack shoal units. Plus, there would be a penalty to the fishery if changes in shoaling or surfacing behaviour occur, i.e. fish may be difficult to locate and capture with seine gear. Need to satisfy the EMO – to maximise economic efficiency in the exploitation of fisheries resources (AFMA 2002a) ‡.

‡ Note that skipjack tuna taken off southern Australia are considered to be at the fringe of the species' generally equatorial distribution. Since skipjack do not spawn in waters cooler than 25°C skipjack off southern New South Wales and Tasmania must have recruited from lower latitudes. Its abundance in Australian waters is extremely variable believed strongly linked to sea surface temperature and abundance of prey species.

Component	Core Objective	Sub-component	Example Operational Objectives	Example Indicators	Rationale
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 AMO - Fishing is conducted in a manner that does not threaten stocks of byproduct / bycatch species (AFMA 2002b). 1.2 EMO – To ensure, through proper conservation management measures, that the living resources of the Australian Fishing Zone (AFZ) are not endangered by over-exploitation (AFMA 2002a). 1.3 Not desirable to maintain biomass of by-catch/by-product above certain level, i.e. need to satisfy EMO - to maximise economic efficiency in the exploitation of fisheries resources (AFMA 2002a). 1.4 EMO - Purse seine operations are limited to maximum seasonal incidental catch of 2% of yellowfin and bigeye (combined live weight), and a trip limit of 50% of these species.
		2. Geographic range	2.1 Geographic range of the population, in terms of size and continuity does not change outside acceptable bounds	Presence of population across space	2.1 Not currently monitored. No specific management objective based on the geographic range of by-catch/by-product species.
		3. Genetic structure	3.1 Genetic diversity does not change outside acceptable bounds	Frequency of genotypes in the population, effective population size (N_e), number of s[2] pawning units	3.1 Not currently monitored. No reference levels established. No specific management objective based on the genetic structure of by-catch species.

[2†] AFMA must pursue the objectives of ensuring that the exploitation of fisheries resources and the carrying on of any related activities are conducted in a manner consistent with the principles of ecologically sustainable development (ESD) and the exercise of the precautionary principle, in particular the need to have regard to the impact of fishing activities on non-target species and the long-term sustainability of the marine environment (AFMA 2002).

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 Beyond the generality of the EMO †[3], there is no specific objectives relating to age/size/structure of skipjack bycatch/byproduct species. Size structure may be very important in defining the functional groups of bycatch/byproduct species.
		5 Reproductive Capacity	5.1 Fecundity of the population does not change outside acceptable bounds (e.g. more than X% of reference population fecundity) Recruitment to the population does not change outside acceptable bounds	Egg production of population Abundance of recruits	5.1 Beyond the generality of the EMO †, there is no specific objectives relating to reproductive capacity of bycatch/byproduct species.
		6. Behaviour /Movement	6.1 Behaviour and movement patterns of the population do not change outside acceptable bounds	Presence of population across space, movement patterns within the population (e.g. attraction to bait, lights)	6.1 Not currently considered an important objective, however purse seine methods may attract bycatch/byproduct species and alter behaviour and or movement patterns.

[3] AFMA must pursue the objectives of ensuring that the exploitation of fisheries resources and the carrying on of any related activities are conducted in a manner consistent with the principles of ecologically sustainable development (ESD) and the exercise of the precautionary principle, in particular the need to have regard to the impact of fishing activities on non-target species and the long-term sustainability of the marine environment (AFMA 2002).

Component	Core Objective	Sub-component	Example Operational Objectives	Example Indicators	Rationale
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 EMO – To ensure, through proper conservation management measures, that the living resources of the Australian Fishing Zone (AFZ) are not endangered by over-exploitation (AFMA 2002a). AMO - The fishery is conducted in a manner that avoids mortality of, or injuries to, endangered, threatened or protected species (AFMA 2002b). 1.2 A positive trend in biomass is desirable for TEP species. 1.3 Maintenance of TEP biomass above specified level not currently a fishery operational objective. 1.4 Not desirable to catch TEP species at any level, if caught then it is desirable to decrease catch levels.
		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 Change in geographic range of TEP species may have serious consequences e.g. population fragmentation and/or forcing species into sub-optimal areas.
		3. Genetic structure	3.1 Genetic diversity does not change outside acceptable bounds	Frequency of genotypes in the population, effective population size (N_e), number of spawning units	3.1 Because population size of TEP species is often small, TEP's are sensitive to loss of genetic diversity. Genetic monitoring may be an effective approach to measure possible fishery impacts.
		4. Age/size/sex structure	4.1 Age/size/sex structure does not change outside acceptable bounds (e.g. more than X% from reference structure)	Biomass, numbers or relative proportion in age/size/sex classes Biomass of spawners Mean size, sex ratio	4.1 Monitoring the age/size/sex structure of TEP populations may be a useful management tool allowing the identification of possible fishery impacts and that cross-section of the population most at risk.

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) Recruitment to the population does not change outside acceptable bounds	Egg production of population Abundance of recruits	5.1 The reproductive capacity of TEP species is of concern to the Skipjack Tuna Fishery because potential fishery induced changes in reproductive ability (e.g. reduction in bait fish leading to reduction in seabird brooding success) may have immediate impact on the population size of TEP species.
		6. Behaviour /Movement	6.1 Behaviour and movement patterns of the population do not change outside acceptable bounds	Presence of population across space, movement patterns within the population (e.g. attraction to bait, lights)	6.1 Purse seine baiting and capture methods may attract TEP species and alter behaviour and movement patterns. Fishing operations may also influence the behaviour of whales by visual/sound stimuli.
		7. Interactions with fishery	7.1 Survival after interactions is maximised 7.2 Interactions do not affect the viability of the population or its ability to recover	Survival rate of species after interactions Number of interactions, biomass or numbers in population	7.1, 7.2 EMO – To ensure, through proper conservation management measures, that the living resources of the Australian Fishing Zone (AFZ) are not endangered by over-exploitation (AFMA 2002a). AMO - The fishery is conducted in a manner that avoids mortality of, or injuries to, endangered, threatened or protected species (AFMA 2002b).
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 AMO – The fishery shall be conducted in a manner that minimises the impact of fishing operations on the ecosystem generally (AFMA 2002b).
		2. Air quality	2.1 Air quality does not change outside acceptable bounds	Air chemistry, noise levels, visual pollution, pollutant concentrations, light pollution from artificial light	2.1 Not currently perceived as an important habitat sub-component, purse seine operations not believed to strongly influence air quality.

Component	Core Objective	Sub-component	Example Operational Objectives	Example Indicators	Rationale
		3. Substrate quality	3.1 Sediment quality does not change outside acceptable bounds	Sediment chemistry, stability, particle size, debris, pollutant concentrations	3.1 AMO – The fishery shall be conducted in a manner that minimises the impact of fishing operations on the ecosystem generally (AFMA 2002b).
		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 Purse seine operations not perceived to result in change of habitat frequency.
		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 Purse seining activities may result in local disruption to pelagic processes, and perhaps benthic processes. AMO – The fishery shall be conducted in a manner that minimises the impact of fishing operations on the ecosystem generally (AFMA 2002b).
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 AMO – The fishery shall be conducted in a manner that minimises the impact of fishing operations on the ecosystem generally (AFMA 2002b).
		2. Functional group composition	2.1 Functional group composition does not change outside acceptable bounds	Number of functional groups, species per functional group (e.g. autotrophs, filter feeders, herbivores, omnivores, carnivores)	2.1 The presence/abundance of 'functional group' members may fluctuate widely, however in terms of maintenance of ecosystem processes it is important that the aggregate effect of a functional group is maintained.

Component	Core Objective	Sub-component	Example Operational Objectives	Example Indicators	Rationale
		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 The community may be forced from fishing grounds, or only remain functional outside fishing grounds, need to satisfy the AMO – The fishery shall be conducted in a manner that minimises the impact of fishing operations on the ecosystem generally (AFMA 2002b).
		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 Bait extraction activities may reduce the 'tuna prey' functional group potentially resulting in migratory or behavioural shifts of skipjack away from the fishing grounds rendering the purse seine fishery inefficient. Inversely, if purse seine operations interact strongly with the functional group of 'tuna predators', i.e. direct impact entanglement/death or indirect impact via a significant reduction in prey, then the function of this group may be lost from the system. The 'tuna predator' functional group includes TEP species, e.g. sharks, toothed whales.
		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 Purse seine operations not perceived to have a measurable effect on bio and geochemical cycles.

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: SJJ
Sub-fishery Name: NA
Date completed: 1 June 2006

Direct impact of Fishing	Fishing Activity	Score (0/1)	Documentation of Rationale
Capture	Bait collection	0	'Chum' Bait is used aggregate schools of skipjack for targeting. Bait collection is permitted within the jurisdictional boundary of the fishery. However, bait is captured using a dinghy and a small net, which is only possible in sheltered (state) waters i.e. an external activity (Denis Brown).
	Fishing	1	Actual fishing, i.e. capture of skipjack due to deployment and retrieval of purse seine net and poling on the chum boat
	Incidental behaviour	1	Crew may fish with hand lines during down time.
Direct impact without capture	Bait collection	0	
	Fishing	1	Disorientation/injury/mortality as a result of momentary entanglement in seine net but animal able to free itself, e.g. marlin/shark.
	Incidental behaviour	1	Crew may fish with hand lines during down time.
	Gear loss	1	Purse seine nets are large, expensive and float. If ever a net became detached from the boat, it could be retrieved. Potential lost items known includes netting scraps, ropes, buoys, etc.
	Anchoring/ mooring	0	Anchoring to capture bait only occurs in state waters
	Navigation/steaming	1	Steaming/navigation (including spotter planes) to find aggregations of skipjack may result in collisions (e.g. seabird collides with navigation lights on vessel at night).
Addition/ movement of biological material	Translocation of species (boat launching, re-ballasting)	0	Live anchovies, pilchards and mackerels are caught in state waters, mainly around Eden and released in waters as far away as Hobart. There is currently no use of frozen imported pilchards (Denis Brown). Mainly an external activity.
	On board processing	0	Not applicable to the skipjack purse seine fishery, fish are held in chilled brine tank and transported to cannery for processing.
	Discarding catch	1	Discards may include juvenile or damaged target and non-target species, which are often discarded back into the sea during fishing operations (AFMA 2001).
	Stock enhancement	0	Stock enhancement not currently used in the Skipjack Tuna Fishery.
	Provisioning	1	A chum boat is used to release bait and berley. This is used to attract and direct shoals of skipjack but may be scavenged by other animals.
	Organic waste disposal	1	Disposal of organic wastes (food scraps, flushing toilet) as a result of general fishing vessel operations.

Direct impact of Fishing	Fishing Activity	Score (0/1)	Documentation of Rationale
Addition of non-biological material	Debris	1	Cardboard boxes or food packaging could be lost over the sides. No use of frozen bait or bait boxes or strapping
	Chemical pollution	1	No major discharge of chemicals or chemical pollution known to occur during purse seining fishing. Small amount of oil leaking in the bilge. Chemicals are used for cleaning and in toilet
	Exhaust	1	Exhaust as a result of diesel and other engines during general fishing operations.
	Gear loss	1	Potential lost items includes netting scraps, ropes, buoys etc.
	Navigation/ steaming	1	Purse seine operations may involve several vessels navigating to and from fishing grounds that introduce noise and visual stimuli into the environment, e.g. attraction of foraging/scavenging birds to boats.
	Activity/ presence on water	1	Purse seine operations involve the presence of several vessels on the fishing grounds –introducing noise and visual stimuli into the environment, e.g. attraction of foraging/scavenging animals.
Disturb physical processes	Bait collection	1	Inshore bait collection using seine net may disturb physical processes related to water movement or sediment and hard substrate processes if net contacts benthos.
	Fishing	1	Purse seine fishing activities may disturb/disrupt local physical water flow patterns, e.g. vertical mixing.
	Boat launching	0	Not applicable. Vessels in Skipjack Tuna Fishery come from designated ports.
	Anchoring/ mooring	0	There are no anchors on the net. The purse seine vessel does not anchor offshore when fishing. The mother ship may anchor inshore when the dinghy is deployed to catch bait but only state waters (an external activity)
	Navigation/ steaming	1	Purse seine operations involve several vessels navigating to and from fishing grounds including towing transport cages, may disturb physical pelagic processes e.g. mixed layer depth.
External Hazards (specify the particular example within each activity area)	Other capture fishery methods	1	The stock targeted is distributed throughout the western Central Pacific Ocean. Most of the catch from the stock is taken by International fisheries.
	Aquaculture	1	Pilchards are targeted for skipjack bait and aquaculture feed. Demand for aquaculture feed could impact on the amount of pilchards available for skipjack chum.
	Coastal development	1	Deep sewerage outfalls extend to 2.8 nm from coast. The effluent plumes plume extends out into Commonwealth waters. From the air, aerial spotter planes can see skipjack schools disperse as the schools approach outfall plumes near Sydney (Denis Brown).
	Other extractive activities	1	Oil and gas exploration occurs in the area and skipjack are known to aggregate around oil platforms
	Other non-extractive activities	0	The extensive range of the Skipjack Tuna Fishery encompasses a significant number of sea floor cables, however, as a pelagic species, interaction with cables is anticipated to be minimal (AFMA 2002a).

Direct impact of Fishing	Fishing Activity	Score (0/1)	Documentation of Rationale
	Other anthropogenic activities	0	A number of major shipping routes pass through the area of the Skipjack Tuna Fishery and may potentially interact with the fish population. Tourism, fishing and whale watching, occur in the coastal communities near the Skipjack Tuna Fishery or in adjacent fisheries (AFMA 2002a).

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, re-	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
	ballasting)	
	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.
	Fishing	Fishing activities may disturb physical processes if the gear contacts seafloor-disturbing sediment, or if the gear disrupts water

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

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, 19 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 23 activity-component scenarios will be considered at Level 1. This results in 115 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
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 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 Disagreement between experts
High	2	Data exists and is considered sound Consensus between experts Consequence is constrained by logical consideration

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

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

2.3.1 Level 1 (SICA) Documents L1.1 - Target Species Component

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)

Direct impact of fishing	Fishing activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
Capture	Bait collection	0									
	Fishing	1	4	3	Population size	Skipjack	1.1	3	1	1	Within AFZ, fishing over the last five years has been restricted, across 500 nm, to less than 100 days per year. Population size of the stock could be affected by capture fishing. Intensity moderate at broader scales. Consequence negligible - fishing within the AFZ unlikely to have a measurable effect on the fished stock which is distributed throughout the western Central Pacific Ocean. Confidence low - harvest strategy under development but no formal stock assessment of the WCPO stock.
	Incidental behaviour	1	4	3	Population size	Skipjack	1.1	2	1	2	Within AFZ, fishing over the last five years has been restricted, across 500 nm, less than 100 days per year. Population size of the stock could be affected by recreational fishing during down time. Intensity minor because down time is limited Consequence negligible - fishing within the AFZ unlikely to have a measurable effect on the fished stock which is distributed throughout the western Central Pacific Ocean. Confidence high can be evaluated without data
Direct impact without capture	Bait collection	0									
	Fishing	1	4	3	Population size	Skipjack	1.1	3	1	2	Within AFZ, fishing over the last five years has been restricted, across 500 nm, to less than 100 days per year. Impact without capture most likely to affect population size skipjack, resulting in mortality of escaped fish. Fishing intensity moderate at broader scales. Consequence minor - unlikely to reduce the size of the WCPO stock. Confidence high - can be evaluated without data.
	Incidental behaviour	1	4	3	Behaviour/movement	Skipjack	6.1	2	1	2	Within AFZ, fishing over the last five years has been restricted, across 500 nm, to less than 100 days per year. Recreational fishing without capture most likely to affect skipjack resulting in attraction to bait. Unlikely to have a measurable impact at the scale of the stock. Consequence negligible -Time taken to return to normal behaviour on the scale of hours. Confidence high can be evaluated without 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
	Gear loss	1	4	3	Population size	Skipjack	1.1	3	1	2	Within AFZ, fishing over the last five years has been restricted, across 500 nm, to less than 100 days per year. Major gear loss is extremely rare. Loss of net, rope scraps or broken floats more common. Mostly likely to affect population size of skipjack - pelagic species may be injured or entangled in floating objects. Fishing intensity moderate at broader scales. Consequence negligible -insignificant change to population size. Confidence high - can be evaluated without data
	Anchoring/ mooring	0									
	Navigation/ steaming	1	4	3	Behaviour/movement	Skipjack	6.1	3	1	2	Within AFZ, fishing over the last five years has been restricted, across 500 nm, to less than 100 days per year. Navigation/ steaming most likely to affect skipjack resulting in changing the direction of moving schools. Steaming intensity moderate at broader scales. Consequence negligible -Time taken to return to normal behaviour on the scale of hours. Confidence high can be evaluated without data
Addition/ movement of biological material	Translocation of species	0	0	0	Population size	Pilchard					Risks are present but occur within the bait collection sector in state waters - See external impacts/other fisheries.
	On board processing	0									
	Discarding catch	0									
	Stock enhancement	0									
	Provisioning	1	4	3	Behaviour/movement	Skipjack	6.1	3	1	2	Within AFZ, fishing over the last five years has been restricted, across 500 nm, to less than 100 days per year. A chum boat is used during most operations to release bait and berley to attract and direct shoals of skipjack - alters behaviour. Intensity moderate at broader scale. Consequence negligible - Time taken to return to normal behaviour on the scale of hours (as soon as chum is gone). Confidence high can be evaluated without 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
	Organic waste disposal	1	4	3	Behaviour/movement	Skipjack	6.1	2	1	2	Toilet is flushed every day that normal fishing operations occur: less than 100 days per year across 500 nm. May affect behaviour of skipjack - repulsion. Intensity minor because the volume of discharge is small. Consequence negligible -Time taken to return to normal behaviour on the scale of hours (as soon as chum is gone). Confidence high - can be evaluated without data
Addition of non-biological material	Debris	1	4	3	Behaviour/movement	Skipjack	6.1	2	1	2	Within AFZ, fishing over the last five years has been restricted, across 500 nm, to less than 100 days per year. Loss of food packaging may occur. Mostly likely to affect behaviour/movement of skipjack - pelagic species may aggregate around floating objects. Intensity minor - only a very small among lost over the side. Consequence negligible -Time taken to return to normal behaviour on the scale of hours. Confidence high - can be evaluated without data
	Chemical pollution	1	4	3	Behaviour/movement	Skipjack	6.1	2	1	2	Within AFZ, fishing over the last five years has been restricted, across 500 nm, to less than 100 days per year. Chemicals used to clean decks and wash up. Mostly likely to affect behaviour/ movement of skipjack – resulting in repulsion. Intensity minor- very small amount discharged. Time taken to return to normal behaviour on the scale of hours. Confidence high - can be evaluated without data
	Exhaust	1	4	3	Behaviour/movement	Skipjack	6.1	3	1	2	Within AFZ, fishing over the last five years has been restricted, across 500 nm, less than 100 days per year. Exhaust emissions most likely to affect behaviour/movement of skipjack - repulsion. Time taken to return to normal behaviour on the scale of hours. Confidence high, can be evaluated without data.
	Gear loss	1	4	3	Behaviour/movement	Skipjack	6.1	2	1	2	Within AFZ, fishing over the last five years has been restricted, across 500 nm, less than 100 days per year. Major gear loss is extremely rare. Loss of net and rope scraps or broken floats more common. Mostly likely to affect behaviour/movement of skipjack - pelagic species may aggregate under floating objects. Intensity minor - very small volumes lost over the side. Consequence negligible -Time taken to return to normal behaviour on the scale of hours. Confidence high can be evaluated without 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
	Navigation/ steaming	1	4	3	Behaviour/movement	Skipjack	6.1	1	1	2	Within AFZ, fishing over the last five years has been restricted, across 500 nm, less than 100 days per year. Steaming vessel could affect behaviour/movement of skipjack resulting in avoidance. Remote likelihood of detecting the impacts of lost paint on skipjack. Consequence negligible -Time taken to return to normal behaviour on the scale of hours. Confidence high, can be evaluated without data.
	Activity/ presence on water	1	4	3	Behaviour/movement	Skipjack	6.1	1	1	2	Within AFZ, fishing over the last five years has been restricted, across 500 nm, less than 100 days per year. Stationary vessel may affect behaviour/movement of skipjack resulting in avoidance. Remote likelihood of detecting the impacts of lost paint on skipjack. Consequence negligible -Time taken to return to normal behaviour on the scale of hours. Confidence high can be evaluated without data.
Disturb physical processes	Bait collection	0									
	Fishing	1	4	3	Behaviour/movement	Skipjack	6.1	3	1	2	Within AFZ, fishing over the last five years has been restricted, across 500 nm, less than 100 days per year. Fishing intensity moderate over broader scales. Noise and vibrations from winch motors could affect behaviour/movement resulting in repulsion. Consequence negligible, time taken to return to normal on the scale of hours. Confidence high - can be evaluated without data.
	Boat launching	0									
	Anchoring/ mooring	0									
	Navigation/ steaming	1	4	3	Behaviour/movement	Skipjack	6.1	3	1	2	Within AFZ, fishing over the last five years has been restricted, across 500 nm, less than 100 days per year. Noise and vibrations from main engine of vessel may affect behaviour/movement of skipjack resulting in disruption of feeding patterns. Consequence negligible -Time taken to return to normal behaviour on the scale of hours. Confidence high can be evaluated without 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
External Impacts (specify the particular example within each activity area)	Other fisheries	1	6	6	Population size	Skipjack	1.1	3	4	1	Other fisheries present two problems: 1. The stock is distributed throughout the entire western Central Pacific ocean. There are concerns that widespread international fishing has impacted on the proportion of the stock size. International agreements to regulate fishing are under development but not yet in place. 2. Live bait is captured in inshore waters from NSW and occasionally transported to offshore Tasmania. Most likely to affect pilchards via transmission of pathogens. One major mortality event has occurred resulting in dead pilchards on beaches around Tasmania. The cause of this event is unknown. Pilchards released offshore could potentially transmit disease to inshore fish and lifespan of virus in water short. Confidence low - the pilchard die-off event has been studied in detail but the cause remains unknown.
	Aquaculture	0									Pilchards are targeted for skipjack bait and aquaculture feed. Demand for aquaculture feed could impact on the amount of pilchards available for skipjack 'chum' but 'chum' is collected from state fisheries. Aquaculture does not impact on fishing for skipjack offshore. Confidence high - bait collection uses dinghies which can not be deployed safely offshore.
	Coastal development	1	6	6	Behaviour/movement	Skipjack	6.1	2	3	2	Coastal development occurs along most of Australia's coastline 365 days per year. Deep sewage outfalls extend to 2.8 n m from the coastline. The plumes from sewage outfalls off Sydney disrupt the southward migration of large schools heading toward the fishing grounds off Eden. Intensity minor - at a few restricted locations. Confidence high-has been observed from aircraft.
	Other extractive activities	1	6	6	Behaviour/movement	Skipjack	6.1	1	2	1	Widespread oil and gas exploration occurs daily. Skipjack aggregate around structures -potentially oil rigs. Unlikely to have a significant impact. Confidence low-no observational data of skipjack around oil rigs.
	Other non extractive activities	0									
	Other anthropogenic activities	0									

2.3.1 Level 1 (SICA) Documents L1.2 - Byproduct and Bycatch Component;

Direct impact of fishing	Fishing activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
Capture	Bait collection	0	0	0							
	Fishing	1	4	3	Population size	dusky shark (bronze whaler group)	1.1	3	3	1	Within AFZ, fishing over the last five years has been restricted, across 500 nm, less than 100 days per year. Population size of the stock could be affected by capture fishing. Intensity moderate at broader scales. Dusky sharks are thought to be fully exploited in targeted fisheries co-managed by the states and the Commonwealth. Additional mortality occurs in a number of Commonwealth fisheries and has not been quantified or considered the management plans for dusky sharks. Low confidence-data no analysis of the cumulative impacts on dusky sharks
	Incidental behaviour	1	4	3		Southern blue fin tuna	1.1	2	1	1	Within AFZ, fishing over the last five years has been restricted, across 500 nm, to less than 100 days per year. Population size of SBT could be affected by recreational fishing during downtime. Intensity minor - downtime is limited. Unlikely to have measurable impact on widely distributed SBT because recreational fishing effort in the skipjack fishery is virtually insignificant compared to the total commercial pelagic fishery effort that could potentially impact SBT
Direct impact without capture	Bait collection	0	0	0							
	Fishing	1	4	3		dusky shark (bronze whaler group)	1.1	3	3	1	Within AFZ, fishing over the last five years has been restricted, across 500 nm, less than 100 days per year. Fishing intensity moderate at broader scales. Dusky sharks that escape the net before being captured can suffer respiratory stress if held stationary because this species normally relies on movement through the water to ventilate its

Direct impact of fishing	Fishing activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
											gills.
	Incidental behaviour	1	4	3		Southern bluefin tuna	1.1	2	1	2	Within AFZ, fishing over the last five years has been restricted, across 500 nm, less than 100 days per year. Recreational fishing during down time most likely to affect tunas. Intensity minor because down time is limited. SBT are a popular sport fish that can be injured even if not landed. Recreational fishing in the skipjack would have a negligible impact on population size of SBT because effort is virtually insignificant compared to the total commercial pelagic fishery effort that could potentially impact SBT.
	Gear loss	1	4	3	Population size	Southern bluefin tuna	1.1	3	1	2	Within AFZ, fishing over the last five years has been restricted, across 500 nm, less than 100 days per year. Major gear loss is extremely rare. Loss of net and rope scraps or broken floats more common. Mostly likely to affect population size of SBT - pelagic species may be injured or entangled in floating objects. Fishing intensity moderate at broader scales. Consequence negligible -insignificant change in population size. Confidence high - can be evaluated without data.
	Anchoring/ mooring	0	0	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
	Navigation/ steaming	1	4	3	Population size	Southern bluefin tuna	1.1	3	1	2	Within AFZ, fishing over the last five years has been restricted, across 500 nm, less than 100 days per year. Intensity moderate at broader scales. Consequence minor. Steaming is unlikely to have any impact on the population size of any byproduct species, particularly compared to targeted fisheries for t/his species. Could have an impact on behaviour/ movement but there are no operational objectives for behaviour/movement of byproduct species set for the SKJ fishery (see identification of objectives). Confidence high-can be evaluated without data
Addition/ movement of biological material	Translocation of species	0	0	0							see external impacts.
	On board processing	0	0	0							
	Discarding catch	0	0	0							
	Stock enhancement	0	0	0							
	Provisioning	1	4	3	Population size	dusky shark (bronze whaler group)	1.1	3	1	2	Within AFZ, fishing over the last five years has been restricted, across 500 nm, less than 100 days per year. Chum/bait may be scavenged by dusky sharks resulting in increase in populations. Consequence minor-unlikely to have measurable impact on population size, particularly when compared to targeted fisheries for this species. Would have an impact on behaviour movement (resulting in attraction) but there are no operational objectives for behaviour/movement of byproduct species set for the SKJ fishery (see identification of objectives). Confidence high-can be evaluated without 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
	Organic waste disposal	1	4	3	Population size	dusky shark (bronze whaler group)	1.1	2	1	2	Within AFZ, fishing over the last five years has been restricted, across 500 nm, less than 100 days per year. Toilet flushed daily during fishing but unlikely to have an impact on the population size of dusky sharks, particularly compared to the impact of targeted fisheries. Could have a minor impact on behaviour/movement but the re are no operational objectives for byproduct component in the SKJ fishery (see S3 identification of objectives). Confidence high, can be evaluated without data.
Addition of non-biological material	Debris	1	4	3	Population size	Albacore	1.1	2	1	2	Within AFZ, fishing over the last five years has been restricted, across 500 nm, less than 100 days per year. Intensity minor -food wrapping could be lost but in limited amounts. Small tunas known to aggregate around floating objects. Could affect behaviour/movement, resulting in attraction but the re are no operational objectives for behaviour/movement of byproduct component in the SKJ fishery (see S3 identification of objectives). Any impact on population size would be positive but unlikely to be detected at any scale. Confidence high- can be evaluated without data
	Chemical pollution	1	4	3	Population size	Southern bluefin tuna	1.1	2	1	2	Within AFZ, fishing over the last five years has been restricted, across 500 nm, less than 100 days per year. Dishes and decks washed with detergent daily during the fishing season. Intensity minor - very small amounts discharged. Could affect behaviour/movement resulting in repulsion but there are no operational objectives for behaviour movement of byproduct component in the SKJ fishery (see S3 identification of objectives). Any impact on population size would be negative but unlikely to be detected at any scale. Confidence high- can be evaluated without 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	4	3	Population size	Southern bluefin tuna	1.1	3	1	2	Within AFZ, fishing over the last five years has been restricted, across 500 nm, less than 100 days per year. Exhaust discharged daily during the fishing season. Fishing intensity moderate over broader scales. Could affect behaviour/movement resulting in repulsion but there are no operational objectives for behaviour movement of byproduct component in the SKJ fishery (see S3 identification of objectives). Any impact on population size would be negative but unlikely to be detected at any scale. Confidence high - can be evaluated without data.
	Gear loss	1	4	3	Population size	Southern bluefin tuna	1.1	2	1	2	Within AFZ, fishing over the last five years has been restricted, across 500 nm, to less than 100 days per year. Rope, scraps and minor gear loss occurs daily during the fishing season. Intensity minor - very small amounts lost. Could affect behaviour/movement resulting in repulsion but there are no operational objectives for behaviour movement of byproduct component in the SKJ fishery (see S3 identification of objectives). Any impact on population size would be negative but unlikely to be detected at any scale. Confidence high - can be evaluated without data.
	Navigation/ steaming	1	4	3	Population size	Southern bluefin tuna	1.1	1	1	2	Within AFZ, fishing over the last five years has been restricted, across 500 nm, less than 100 days per year. Fishing intensity moderate over broader scales. Steaming vessel could collide with and kill a fish. Intensity minor - unlikely to have a measurable impact at any scale. Any impact on population size would be negative but unlikely to be detected at any scale. Confidence high - can be evaluated without 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
	Activity/ presence on water	1	4	3	Population size	Southern bluefin tuna	1.1	1	1	2	Within AFZ, fishing over the last five years has been restricted, across 500 nm, less than 100 days per year. Fishing intensity moderate over broader scales. Tuna could collide with stationary vessel and die. Any impact on population size would be negative but unlikely to be detected at any scale. Confidence high - can be evaluated without data.
Disturb physical processes	Bait collection	0	0	0							
	Fishing	1	4	3	Population size	Southern bluefin tuna	1.1	3	1	2	Within AFZ, fishing over the last five years has been restricted, across 500 nm, less than 100 days per year. Fishing intensity moderate over broader scales. Noise and vibrations from winch motors could affect behaviour/movement resulting in repulsion but the re are no operational objectives for behaviour movement of byproduct component in the SKJ fishery (see S3 identification of objectives). It is hard to conceive that noise and vibrations could result in even a single mortality. Any impact on population size would be negative but unlikely to be detected at any scale. Confidence high - can be evaluated without data.
	Boat launching	0	0	0							
	Anchoring/ mooring	0	0	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
	Navigation/ steaming	1	4	3	Population size	Southern bluefin tuna	1.1	3	1	2	Within AFZ, fishing over the last five years has been restricted, across 500 nm, less than 100 days per year. Fishing intensity moderate over broader scales. Noise and vibrations from main engines could affect behaviour/movement resulting in repulsion but there are no operational objectives for behaviour movement of byproduct component in the SKJ fishery (see S3 identification of objectives). It is hard to conceive that noise and vibrations could result in even a single mortality. Any impact on population size would be negative but unlikely to be detected at any scale. Confidence high - can be evaluated without data.
External Impacts (specify the particular example within each activity area)	Other fisheries	1	6	6	Population size	dusky shark (bronze whaler group)	1.1	3	3	2	Targeted Commonwealth/ state fisheries are directed to catching dusky sharks. They are taken as bycatch in several Commonwealth fisheries across Western Australia, southern Australia and eastern Australia. The catches in the directed fisheries are though to be at the limit of exploitation and additional mortality which is cumulative across many fisheries may not be sustainable. Confidence low - no assessment of the combined data sets for dusky sharks.
	Aquaculture	0	0	0							
	Coastal development	1	6	6	Geographic range	Southern bluefin tuna	2.1	2	3	1	Coastal development occurs across the continent 365 days per year. Intensity moderate over broader scales. Deep sewage outfalls extend to 2.8 n m from the coastline. The plumes from sewage outfalls off Sydney disrupt the southward migration of large schools of other tuna species. However, there are no operation objectives for behaviour movement of byproduct species in the SKJ fishery. The impact of coastal development may have affected the geographic range of SBT. Intensity minor - at a few restricted locations. The SBT fishery collapsed off NSW. Confidence

Direct impact of fishing	Fishing activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
											low - hard to determine if pollution would affect the distribution of SBT.
	Other extractive activities	1	6	6	Geographic range	Albacore	2.1	3	1	2	Widespread oil and gas exploration occurs daily. Intensity moderate over broader scales. Pelagic tunas aggregate around structures - potentially oil rigs. Intensity moderate concentrated effort in a few areas. Potentially the distributional range of a tuna could be affected by Fish Attracting Devices (FADS). Confidence low -no data on the impact of FADS on the distribution of Tunas in Australian waters.
	Other non extractive activities	0	0	0							
	Other anthropogenic activities	0	0	0							

2.3.1 Level 1 (SICA) Documents 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	0									
	Fishing	1	4	3	Population size	Indian Ocean bottlenose dolphin	1.1	3	3	1	Within AFZ, fishing over the last five years has been restricted, across 500 nm, less than 100 days per year. Fishing intensity moderate across broader scales. Population size of the dolphins could be affected by purse-seine fishing. Captures have been reported in other PS fisheries. Consequence is scored 3 based on precautionary approach. It is hard to determine if PS fishing is likely to impact on bottlenose dolphins such that they further approach extinction because confidence is low - there is no observer data on PS dolphin captures in Commonwealth Fisheries and there is limited data to assess whether bottlenose dolphins are at risk of extinction.
	Incidental behaviour	1	4	3	Population size	Cape Petrel	1.1	2	1	2	Within AFZ, fishing over the last five years has been restricted, across 500 nm, less than 100 days per year. Intensity minor - recreational fishing only during down time which is limited.. Cape petrels are precocious birds that feed on bait scraps and could be foul hooked. Consequence low - thousands of Cape Petrels on the fishing grounds but few if any are caught during recreational fishing. Confidence high - field observations on board commercial hook vessels.
Direct	Bait collection	0	0	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
impact without capture	Fishing	1	4	3	Population size	Indian Ocean bottlenose dolphin	1.1	3	2	1	Within AFZ, fishing over the last five years has been restricted, across 500 nm, less than 100 days per year. Fishing intensity moderate across broader scales. Population size of the dolphins could be affected by purse-seine fishing. Captures have been reported in other PS fisheries. Dolphins are air breathers and even those that escape the net could suffer respiratory stress or pneumonia from water entering the lungs and die subsequently. Consequence is scored 2 based on precautionary approach. It is hard to determine if PS fishing is likely to impact on bottlenose dolphins such that they further approach extinction because confidence is low - there is no observer data on PS dolphin captures in Commonwealth Fisheries and there is limited data to assess whether bottlenose dolphins are at risk of extinction.
	Incidental behaviour	1	4	3	Population size	Cape Petrel	1.1	2	1	2	Within AFZ, fishing over the last five years has been restricted, across 500 nm, less than 100 days per year. Intensity minor - recreational fishing only during down time which is limited. Cape petrels are precocious birds that feed on bait scraps and could be foul hooked momentarily and then escape. Consequence low - thousands of Cape Petrels on the fishing grounds but few if any are caught during recreational fishing. Confidence high - field observations on board commercial hook vessels.
	Gear loss	1	4	3	Population size	white shark	1.1	3	2	1	Within AFZ, fishing over the last five years has been restricted, across 500 nm, less than 100 days per year. Fishing intensity moderate across broader scales. Minor gear loss may include netting scraps and lost ropes. Sharks are known to become entangled is netting resulting in mortality. Consequence is low - the data on sharks killed by entanglement is limited and there is no information on what fisheries are responsible.
	Anchoring/ mooring	0	0	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
	Navigation/steaming	1	4	3	Behaviour/movement	Indian Ocean bottlenose dolphin	6.1	3	2	1	Within AFZ, fishing over the last five years has been restricted, across 500 nm, less than 100 days per year. Steaming across this broad scale. Fishing intensity moderate. The movement of fishing vessels up and down the east coast of Australia could have a minor impact on the migration of whales and dolphins but confidence is low - no data on the impacts
Addition/ movement of biological material	Translocation of species	0	0	0							See external impacts
	On board processing	0	0	0							
	Discarding catch	0	0	0							
	Stock enhancement	0	0	0							
	Provisioning	1	4	3	Population size	Indian Ocean bottlenose dolphin	1.1	3	1	1	Within AFZ, fishing over the last five years has been restricted, across 500 nm, less than 100 days per year. Chum/bait may be scavenged by dolphins resulting in increase in populations. Consequence minor-unlikely to have measurable impact on population size. Confidence low - no observer data on how that can be used to assess if dolphins feed on the chum.
	Organic waste disposal	1	4	3	Behaviour/movement	Indian Ocean bottlenose dolphin	6.1	2	2	1	Within AFZ, fishing over the last five years has been restricted, across 500 nm, less than 100 days per year. Toilet flushed daily. Intensity minor - very small volume. Could have a minor impact on behaviour/movement -repulsion. Consequence minor - returning to normal behaviour in one hour or less. Confidence high, can be evaluated without 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
Addition of non-biological material	Debris	1	4	3	Behaviour/movement	Indian Ocean bottlenose dolphin	6.1	2	1	2	Within AFZ, fishing over the last five years has been restricted, across 500 nm, less than 100 days per year. Intensity minor - loss of food packaging may occur but limited volumes. Mostly likely to affect behaviour/movement - avoidance. Fishing intensity moderate at broader scales. Consequence negligible -Time taken to return to normal behaviour on the scale of hours. Confidence high can be evaluated without data
	Chemical pollution	1	4	3	Behaviour/movement	Indian Ocean bottlenose dolphin	6.1	2	1	2	Within AFZ, fishing over the last five years has been restricted, across 500 nm, less than 100 days per year. Chemicals used to clean decks and wash up. Mostly likely to affect behaviour/movement of dolphins - repulsion. Time taken to return to normal behaviour on the scale of hours. Confidence high can be evaluated without data
	Exhaust	1	4	3	Behaviour/movement	Cape Petrel	6.1	3	1	2	Within AFZ, fishing over the last five years has been restricted, across 500 nm, less than 100 days per year. Solid particle from exhaust entering the air column daily. Mostly likely to affect behaviour/movement of bird in the air - repulsion. Time taken to return to normal behaviour on the scale of hours. Confidence high can be evaluated without data
	Gear loss	1	4	3	Population size	Australian Fur Seal	1.1	2	1	1	Within AFZ, fishing over the last five years has been restricted, across 500 nm, less than 100 days per year. Rope scraps and minor gear loss occurs daily during the fishing season. Intensity minor - very small amount of gear lost. Could affect population size of seals which are known to become entangled in netting. Any impact on population size would be negative but unlikely to have a significant impact on the population. Consequence low - no observer data on interactions between TEP species and skipjack purse seine operations.

Direct impact of fishing	Fishing activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
	Navigation/ steaming	1	4	3	Behaviour/movement	Indian Ocean bottlenose dolphin	1.1	1	1	2	Within AFZ, fishing over the last five years has been restricted, across 500 nm, less than 100 days per year. Dolphins ride bow waves. Intensity negligible - remote likelihood of detection. Consequence negligible -Time taken to return to normal behaviour on the scale of hours. Confidence high can be evaluated without data.
	Activity/ presence on water	1	4	3	Behaviour/movement	Indian Ocean bottlenose dolphin	6.1	1	1	2	Within AFZ, fishing over the last five years has been restricted, across 500 nm, less than 100 days per year. Stationary vessel may affect behaviour/movement of dolphins resulting in avoidance. Consequence negligible -Time taken to return to normal behaviour on the scale of hours. Confidence high can be evaluated without data.
Disturb physical processes	Bait collection	0	0	0							
	Fishing	1	4	3	Behaviour/movement	Indian Ocean bottlenose dolphin	6.1	3	1	1	Within AFZ, fishing over the last five years has been restricted, across 500 nm, less than 100 days per year. Fishing intensity moderate over broader scales. Noise and vibrations from main engines could affect behaviour/movement resulting in repulsion. Time taken to return to normal behaviour on the scale of hours. Confidence high - can be evaluated without data.
	Boat launching	0	0	0							
	Anchoring/ mooring	0	0	0							
	Navigation/steaming	1	4	3	Behaviour/movement	Indian Ocean bottlenose dolphin	6.1	3	1	2	Within AFZ, fishing over the last five years has been restricted, across 500 nm, less than 100 days per year. Noise and vibrations from main engine of vessel may affect behaviour/movement of dolphins resulting in temporary disruption of feeding patterns. Consequence negligible -Time taken to return to normal behaviour on the scale of hours. Confidence high can be evaluated without 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
External Impacts (specify the particular example within each activity area)	Other fisheries	1	6	6	Population size	Indian Ocean bottlenose dolphin	1.1	3	3	2	Dolphins are captured in large quantities in large scale purse seine fishing operations for tunas outside the AFZ. Intensity moderate - moderate impact across a broad scale. Consequence moderate, resulting in population declines but not over long terms. Confidence high - data available on international bycatch of dolphins.
	Aquaculture	0	0	0							
	Coastal development	1	6	6	Behaviour/movement	Indian Ocean bottlenose dolphin	6.1	2	1	1	Coastal development occurs along most of Australia's coastline 365 days per year. Deep sewage outfalls extend to 2.8 n m from the coastline. The plumes from sewage outfalls off Sydney disrupt the southward migration of large schools of fish. Intensity minor - restricted locations. Confidence low- impact on fish has been observed from aircrraft but it is hard to tell if this would affect predatory dolphins
	Other extractive activities	1	6	6	Behaviour/movement	Indian Ocean bottlenose dolphin	6.1	3	1	1	Widespread oil and gas exploration occurs daily. Small fish aggregate around structures -potentially oil rigs. Potentially dolphins could feed on the fish if they aggregated around the rigs. Unlikely to have a significant impact. Confidence low-no observational data on small prey species around oil rigs.
	Other non-extractive activities	0	0	0							
	Other anthropogenic activities	0	0	0							

2.3.1 Level 1 (SICA) Documents L1.4 - Habitat Component;

Direct impact of fishing	Fishing activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
Capture	Bait collection	0	0	0							
	Fishing	1	4	3	Habitat structure and Function	Southern Coastal Pelagic Province	5.1	3	1	1	The jurisdictional boundary of the SKJ fishery effectively includes the entire EEZ, however most fishing activity is concentrated across ~500 nm, on a daily basis during fishing season (<100 days/a). Purse seining is a pelagic method; any interaction with the benthos is unintentional and infrequent. Towing of purse seine nets for skipjack tuna is mainly likely to affect pelagic habitat structure and function transiently as the shot passes through the water. Intensity: moderate, relatively localised and intense. Consequence: Negligible, as water column expected to resume state rapidly. Confidence: low because of insufficient knowledge of pelagic habitat processes related to fishing.
	Incidental behaviour	1	4	3	Habitat structure and Function	Coarse sediment veneer overlying subcropping rock slabs or boulders, with large sponges, inner shelf	5.1	1	1	1	Incidental behaviour possible over the scale of fishery. Downtime activities considered weekly. Recreational fishing by crew resulting in capture of benthic habitat most likely to occur during anchoring, affecting habitat structure and function of inshore inner shelf habitats most frequently encountered. Considered to have more potential for damage to inshore benthic habitats relative to fluid pelagic habitat. Intensity: negligible, considered unlikely that significant amounts of habitat would be captured as a result of downtime activities. Therefore consequence was Negligible. Confidence" low because of a lack of verified data on locations and types of downtime activities.
Direct	Bait collection	0	0	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
impact without capture	Fishing	1	4	3	Habitat structure and Function	Southern Coastal Pelagic Province	5.1	3	1	1	Purse seining is a pelagic method, towing of purse seine nets for skipjack tuna is mainly likely to affect pelagic habitat structure and function transiently as the shot passes through the water. Expected to have minimal residual effect in the pelagic habitat from interaction with the gear during fishing, Any bottom contact likely to be infrequent, but would damage habitat in direct contact with the nets. Intensity: moderate, relatively localised and intense. Consequence: Negligible, as water column expected to resume state rapidly. Confidence: low because of insufficient knowledge of pelagic habitat processes related to fishing.
	Incidental behaviour	1	4	3	Habitat structure and Function	Coarse sediment veneer overlying subcropping rock slabs or boulders, with large sponges, inner shelf	5.1	1	1	1	Incidental behaviour possible over the scale of fishery, recreational activities of crew considered to occur on a weekly scale. Recreational fishing by crew resulting in damage to erect and attached faunas of inshore benthic habitats most likely to occur during anchoring. Intensity: negligible, considered unlikely that significant amounts of habitat would be captured as a result of downtime activities. Consequence: negligible, most indirect impact likely to be on relatively rapidly reproducing algae. Confidence" low because of a lack of verified data on locations and types of downtime activities.

Direct impact of fishing	Fishing activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (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	4	3	Habitat structure and Function	Sedimentary rock, low outcrop, mixed faunal community, inner shelf	5.1	2	1	2	Gear loss possible over entire range of the subfishery, but more likely to occur in the area of greatest fishing effort. Minor gear loss e.g. line or float may occur daily but major gear loss considered to occur a few times a year during the calendar fishing year. Gear loss due to snagging is unlikely given that this is a pelagic method. Lost gear may float until either sinking or being washed ashore impacting shoreline habitats. Lost gear may be irretrievable in deeper waters, may impact benthos in process of balling up and retrieval, or snag on higher relief reefs, potentially damaging habitat in the vicinity, eventually becoming habitat. Intensity: minor, considered a rare event. Consequence: negligible, habitat modification likely to be undetectable. Confidence: high, though effects not visually documented for this fishery, and there is a lack of verified data on rates and types of gear loss.
	Anchoring/ mooring	0	0	0							
	Navigation/steaming	1	4	3	Water quality	Southern Coastal Pelagic Province	1.1	1	1	2	Navigation/ steaming may occur daily during fishing season. The pelagic water quality of the Southern Coastal Pelagic habitat may change with increased turbulence and changes in water mixing that could occur from movement of vessels through water. Intensity and Consequence: negligible due to remote likelihood of detection at any spatial or temporal scale, and interactions that may be occurring are not detectable against natural variation. Confidence scored high because of logical constraints.
Addition/ movement of biological material	Translocation of species	0	0	0							
	On board processing	0	0	0							
	Discarding catch	0	0	0							
	Stock	0	0	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
	enhancement										
	Provisioning	1	4	3	Water quality	Southern Coastal Pelagic Province	1.1	3	1	2	Within AFZ, fishing over the last five years has been restricted, across 500 nm, less than 100 days per year. A chum boat is used during most operations to release bait and berley to attract and direct shoals of skipjack - alters pelagic water quality with the addition of high nutrient load and attraction of species Intensity: moderate at broader scale. Consequence: negligible, time taken to return to normal state on the scale of hours (as soon as chum is gone). Confidence: high can be evaluated without data
	Organic waste disposal	1	4	3	Water quality	Southern Coastal Pelagic Province	1.1	1	2	2	Organic waste disposal possible over the entire scale of fishing effort. Boats subject to MARPOL. Water quality of pelagic habitats is considered to experience greatest impact of organic waste disposal. Overall volume of waste likely to be too small to reach benthos, or accumulate even if it does. Intensity: negligible. Consequence: Minor, addition of high nutrient material is realistically expected to cause short term peaks in productivity or scavenging species interactions, with minimal detectibility within minutes to hours. Confidence: high logical constraints.
Addition of non-biological material	Debris	1	4	3	Habitat structure and Function	Southern Coastal Pelagic Province	5.1	2	2	1	Fishing activity occurs over a small spatial scale. Generation of debris possible over this scale, and may occur on a daily basis during fishing season. Greatest effort within the Southern Coastal Pelagic province habitat, therefore considered the most likely habitat to accumulate floating plastics, and inadvertent losses from fishing operations. All boats subject to MARPOL, which means losses should be unintentional, and retrieved if possible. Debris considered to alter function of pelagos as habitat with the addition of ingestible materials putting susceptible species at risk e.g. seabirds, dolphins or seals. Intensity: minor if adherence to MARPOL regulations. Consequence: minor to habitat directly, as dispersal and small volumes. Consequence: low because the volume of debris generated and habitat susceptibility are unknown.

Direct impact of fishing	Fishing activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
	Chemical pollution	1	4	3	Water quality	Southern Coastal Pelagic Province	1.1	2	1	1	Within AFZ, fishing over the last five years has been restricted, across 500 nm, less than 100 days per year. Chemicals used to clean decks and wash up, may be inadvertent spills, which if small most likely to affect water quality temporarily until dispersal reduces toxicity. Intensity minor- very small amount discharged. Consequence: Time taken to return to normal state likely to be on the scale of hours for most benign forms. Confidence low, effects evaluated without data
	Exhaust	1	4	3	Air quality	Southern Coastal Pelagic Province	2.1	1	1	2	Exhaust from running engines may impact the air quality of the species within Southern Coastal Pelagic habitat (e.g. birds). Intensity: negligible. Consequence: negligible due to rapid dispersal of pollutants in winds, and likely to be physically undetectable over very short time frames. Confidence in assessment: high because effect of exhaust was considered to be very localised, and logical consideration.
	Gear loss	1	4	3	Habitat structure and Function	Sedimentary rock, high outcrop, mixed faunal community, outer-shelf	5.1	2	1	2	Gear loss occurs infrequently over the season. Likely to involve small volumes of nets, ropes, floats. Possible retention by habitat if snag on high relief features/ reefs, but deemed unlikely. Retrieval of large gear is likely to be attempted (loss of whole nets unlikely) however, may be irretrievable in deeper waters. Lost gear eventually becomes habitat. Intensity: minor, considered an uncommon event. Consequence: negligible, habitat modification likely to be undetectable. Confidence: high, though effects not documented, there is a low rate and volume of gear loss.
	Navigation/ steaming	1	4	3	Water quality	Southern Coastal Pelagic Province	1.1	1	1	2	Addition of non-biological material will occur during the normal course of steaming throughout the fishing operations. Changes to the pelagic water quality of the Southern Coastal Pelagic habitat are likely to be undetectable over these scales due to rapid dispersal. Intensity and Consequence: negligible due to remote likelihood of detection at any spatial or temporal scale, and interactions that may be occurring are not detectable against natural variation.

Direct impact of fishing	Fishing activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (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 scored high because of logical constraints.
	Activity/ presence on water	1	4	3	Water quality	Southern Coastal Pelagic Province	1.1	1	1	2	Activity/presence on water of purse seine fishing vessels expected to pose greatest risk for the quality of the pelagic habitat through the addition of noise, turbulence, and attraction of predators associated with fishing activities. Intensity and Consequence: negligible, remote likelihood of impact at any spatial or temporal scale. Confidence: high, considered unlikely that vessel presence/activity would lead to water quality changes in any persistent way.
Disturb physical processes	Bait collection	0	0	0							
	Fishing	1	4	3	Water quality	Southern Coastal Pelagic Province	3.1	2	2	1	Purse seining is a pelagic method. Towing of purse seine nets for skipjack tuna is mainly likely to affect pelagic habitat structure and function transiently as the shot creates localised turbulence and temporary increases in nutrient vis the presence of burleigh, and biomass. Intensity: minor, localised. Consequence: Minor, impacts likely to be undetectable relatively quickly and water column expected to resume state rapidly. Confidence: low because of insufficient knowledge of pelagic habitat processes related to fishing.
	Boat launching	0	0	0							
	Anchoring/ mooring	0	0	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
	Navigation/ steaming	1	4	3	Habitat structure and function	Southern Coastal Pelagic Province	5.1	1	1	2	Minimal disturbance of physical processes will occur during the normal course of steaming throughout the fishing zone. Turbulence and disturbance of pelagic water quality is unlikely to affect normal water column processes for long. Any disruption to these processes can therefore be expected to alter habitat function only briefly for macroscopic fauna. Intensity and Consequence: negligible due to remote likelihood of detection at any spatial or temporal scale and interactions that may be occurring are not detectable against natural variation. Confidence scored high because of logical constraints.
External Impacts (specify the particular example within each activity area)	Other fisheries	1	6	6	Habitat structure and function	Southern Coastal Pelagic Province	5.1	3	2	1	All other Commonwealth Fisheries (apart from the Subantarctic Fisheries) occur within the operational boundary of the Skipjack Tuna Fishery. Within the current area of effort for Skipjack, many different targeting methods and gears are used. The fisheries with greatest potential to overlap in pelagic effort include the SPF, SBT, SWTBF, and the ETBF. The consequence of this form of interaction is likely to be minor for pelagic habitats as any detectible effect will be difficult to discern against natural variation. Other Commonwealth fisheries with effort overlap with the SKJ fishery are demersal i.e. GAB, SET, SESSF. Benthic/ demersal gears have more measurable effects on habitat structure and function than pelagic capture methods. For the purposes of this assessment benthic impacts are only occurring in inshore waters and are not assessed here. Intensity: moderate at the broader spatial scale. Consequence: minor, the cumulative effects of fishing on pelagic habitats may be occurring yet are unlikely to alter the intrinsic nature of water as habitat. Confidence: low because of insufficient knowledge of pelagic habitat dynamics.
	Aquaculture	0	0	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	1	6	6	Habitat structure and function	Coarse sediments, current rippled, mixed faunal community, inner-shelf	5.1	2	3	2	Coastal development occurs along most of Australia's coastline 365 days per year. Areas of intensity are likely to impact benthic habitat structure and function with addition of runoff, debris, high nutrient loads e.g. Deep sewage outfalls off Sydney extend to 2.8 n m from the coastline, from which plumes extend into inner shelf habitats. May disrupt pelagic balance (e.g. algal blooms) and benthic habitats altering dynamics and structure. Intensity: minor over entire scale - at a few restricted locations. Consequence: possibly moderate in localised areas. Confidence: high, data available.
	Other extractive activities	1	6	6	Habitat structure and function	Fine sediments, current rippled, mixed faunal community, inner and outer-shelf	5.1	3	3	1	Widespread oil and gas exploration occurs within inner and outer shelf. Benthic habitats around exploration sites and infrastructure likely to be impacted during construction and exploratory drills. Impacts not clear, but likely to be greatest on sediment habitats through removal of faunas, disruption to sediments, clearing. Confidence: low- impacts on habitats not understood.
	Other non extractive activities	0	0	0							
	Other anthropogenic activities	0	0	0							

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

Direct impact of fishing	Fishing Activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
Capture	Bait collection	0	0	0							
	Fishing	1	4	3	Functional group composition	Southern Coastal	2.1	3	2	1	Within AFZ, fishing over the last five years has been restricted, across 500 nm, less than 100 days per year. => Skipjack purse seine fishing most likely to effect Functional group composition, i.e. removal of a member of the small pelagic/ tuna functional group (important prey for larger tunas, sharks and billfishes) from Southern Coastal Pelagic community => Intensity moderate –i.e. the impact was considered to be potentially severe at local scales but moderate at broader spatial scale => Consequence minor, i.e. it was considered that fishing would result in minor changes in relative abundance of community constituents up to 5% => Confidence low because effect of removing functional group on food web not evaluated
	Incidental behaviour	1	4	3	Species composition	Southern Coastal	1.1	2	2	2	Within AFZ, fishing over the last five years has been restricted, across 500 nm, less than 100 days per year=>Recreational fishing during down time most likely to affect he Southern Coastal Pelagic community because SBT are a popular sport fish that can be injured even if not landed and determined most at risk to capture => intensity minor – the impact was considered to occur rarely => Consequence minor - undetectable impact on population size of SBT or sharks and therefore community => Confidence high can be evaluated without data.
Direct	Bait collection	0	0	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
impact without capture	Fishing	1	4	3	Functional group composition	Southern Coastal	2.1	2	2	1	Within AFZ, fishing over the last five years has been restricted, across 500 nm, less than 100 days per year=>Recreational fishing during down time most likely to affect he Southern Coastal Pelagic community because=> Skipjack purse seine fishing (not resulting in capture) most likely to effect Functional group composition, i.e. damage or mortality to the tuna functional group from the Southern Coastal Pelagic community => intensity minor –i.e. the impact of non-capture damage or mortality was considered to occur rarely because mechanics of purse seine fishing unlikely to strongly impact fish not captured => Consequence minor because it was considered that damage or mortality to non-caught tunas is unlikely to have impacts on the tuna functional group in its own right => Confidence low because effect of removing functional group on food web not evaluated
	Incidental behaviour	1	4	3	Species composition	Southern Coastal	1.1	2	1	2	Within AFZ, fishing over the last five years has been restricted, across 500 nm, less than 100 days per year=> Recreational fishing without capture most likely to affect species composition of Southern Coastal Pelagic community resulting from attraction to bait => intensity minor – i.e. the impact was considered to occur rarely => Consequence negligible, i.e. it was considered that attraction to bait by large predators would result in minor and transient changes in relative abundance of community constituents => Confidence high can be evaluated without data.
	Gear loss	1	4	3	Species composition	Southern Coastal	1.1	1	1	2	Within AFZ, fishing over the last five years has been restricted, across 500 nm, less than 100 days per year=> Major gear loss is extremely rare. Loss of net and rope scraps or broken floats more common=> Gear loss was considered to impact species composition of Southern Coastal Pelagic community by entanglement or injury of top predators => Intensity negligible –i.e. the likelihood of impact was considered remote => consequence negligible => Confidence high because intensity negligible.
	Anchoring/ mooring	0	0	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
	Navigation/ steaming	1	4	3	Species composition	Southern Coastal	1.1	2	1	1	Within AFZ, fishing over the last five years has been restricted, across 500 nm, less than 100 days per year. => Navigation/steaming occurs on a daily basis during fishing season => The Southern Coastal Pelagic community was considered most at risk to Navigation/steaming from mortality due to direct interactions => intensity minor occurs in restricted localized area => Consequence negligible, i.e. it was considered that Navigation/ steaming is unlikely to result in detectable impacts on the species composition of pelagic community => Confidence low because of a lack of information on interactions between Navigation/ steaming and community dynamics. .
Addition/ movement of biological material	Translocation of species	0	0	0							Risks are present but occur within the bait collection sector in state waters - See external impacts/other fisheries.
	On board processing	0	0	0							
	Discarding catch	0	0	0							
	Stock enhancement	0	0	0							
	Provisioning	1	4	3	Distribution of community	Southern Coastal	3.1	2	2	1	Within AFZ, fishing over the last five years has been restricted, across 500 nm, less than 100 days per year. A chum boat is used during most operations to release bait and berley to attract and direct shoals of skipjack - alters behaviour => provisioning was considered to impact on distribution of Southern Coastal Pelagic community by increasing relative abundance of scavenging species e.g. large, rare top order predators or seabirds =>intensity minor –i.e. thought to occur rarely => Consequence minor because only minor changes in relative abundance of constituents perceived to occur => Confidence low no data.
	Organic waste disposal	1	4	3	Distribution of community	Southern Coastal	3.1	2	1	2	Within AFZ, fishing over the last five years has been restricted, across 500 nm, less than 100 days per year => Organic waste disposal (food scraps, toilet flushing) considered to occur on a daily basis during fishing season although MARPOL rules applicable => greatest impact on distribution in Southern Coastal Pelagic by increasing relative abundance of scavenging species e.g. large, rare top order predators or seabirds or by repulsion => intensity minor -volume of discharge is small => Consequence negligible because no changes in relative abundance of constituents reported => Confidence high negligible impacts.

Direct impact of fishing	Fishing Activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
Addition of non-biological material	Debris	1	4	3	Species composition	Southern Coastal	1.1	2	2	2	Within AFZ, fishing over the last five years has been restricted, across 500 nm, less than 100 days per year=>Loss of food packaging may occur=>Mostly likely to affect species composition in Southern Coastal community by pelagic species aggregating around floating objects => intensity minor –i.e. thought to occur rarely => Consequence minor because considered only a minor change to relative abundance of seabird unlikely to change outside natural variation => Confidence high- changes likely to be undetectable and transient
	Chemical pollution	1	4	3	Distribution of community	Southern Coastal	3.1	2	1	2	Within AFZ, fishing over the last five years has been restricted, across 500 nm, less than 100 days per year. Chemicals used to clean decks and wash up. Mostly likely to affect distribution of community members by repulsion. Intensity minor- very small amount discharged. Consequence negligible Time taken to return to normal behaviour on the scale of hours. Confidence high can be evaluated without data
	Exhaust	1	4	3	Distribution of community	Southern Coastal	3.1	2	1	1	Within AFZ, fishing over the last five years has been restricted, across 500 nm, less than 100 days per year=> The Southern Coastal Pelagic community considered most likely to be effected by exhaust because most activity occurs in this community => Exhaust was considered to have greatest community level impact on Distribution of the community by forcing susceptible species, birds, further offshore or along shore =>intensity minor –i.e. thought to occur rarely and at a very localised scale => Consequence negligible change to local abundance of susceptible birds unlikely to change outside natural variation => Confidence low because relative species susceptibility to exhaust was unknown.
	Gear loss	1	4	3	Distribution of community	Southern Coastal; Southern Coastal inner shelf 0-110 m	3.1	1	1	1	Within AFZ, fishing over the last five years has been restricted, across 500 nm, less than 100 days per year => Major gear loss is extremely rare. Loss of net and rope scraps or broken floats more common. => distribution of community in Southern Coastal inner shelf community was considered most likely to interact with lost gear by creating new benthic habitat or pelagic species may aggregate under floating objects=> intensity negligible –i.e. the likelihood of impact was considered remote => consequence negligible => Confidence low because of a lack of verified data on rates and types of gear loss and insufficient knowledge of trophic interactions.

Direct impact of fishing	Fishing Activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
	Navigation/ steaming	1	4	3	Distribution of community	Southern Coastal	3.1	2	2	1	Within AFZ, fishing over the last five years has been restricted, across 500 nm, less than 100 days per year. Noise and vibrations from main engine of vessel may affect behaviour> Most Navigation/steaming considered to occur in the Southern Coastal Pelagic community => Navigation/steaming was considered impact Distribution of community => intensity minor –i.e. scavengers may follow fishing vessels, however community level impact considered to be rarely detectable => Consequence minor – any change in community distribution perceived to result in only minor changes in relative abundances => Confidence low because of a lack of information on interactions between Navigation/ steaming and community dynamics.
	Activity/ presence on water	1	4	3	Distribution of community	Southern Coastal	3.1	1	1	2	Within AFZ, fishing over the last five years has been restricted, across 500 nm, less than 100 days per year. => Most Activity/ presence on water considered to occur in the Southern Coastal Pelagic community => Activity/ presence on water was considered to have greatest community level impact by affecting Distribution of community => The intensity was scored as Negligible –i.e. remote likelihood of impact at any spatial or temporal scale => consequence negligible => Confidence in consequence score was high because it was considered highly unlikely that vessel presence/activity would lead to community level changes in its own right.
Disturb physical processes	Bait collection	0	0	0							
	Fishing	1	4	3	Distribution of community	Southern Coastal	3.1	1	1	2	Within AFZ, fishing over the last five years has been restricted, across 500 nm, less than 100 days per year. => Disruption of physical processes as a result of Skipjack purse seine fishing most likely to effect distribution of the Southern Coastal Pelagic community => intensity negligible because disturbance localized => Consequence negligible because remote likelihood of impact at any spatial or temporal scale => Confidence high because considered very unlikely for there to be community level impacts associated with disturbance of pelagic processes from seine netting.
	Boat launching	0	0	0							
	Anchoring/ mooring	0	0	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
	Navigation/steaming	1	4	3	Distribution of community	Southern Coastal	3.1	2	2	2	Within AFZ, fishing over the last five years has been restricted, across 500 nm, less than 100 days per year.=> Distribution of community was considered most likely to be impacted by noise generated by navigation/steaming in the Southern Coastal by introducing noise and visual stimuli => Intensity minor because navigation/ steaming occurs in a restricted location => Consequence minor as detectable impact on scale of hours to days => Confidence high because any local effect of noise on water quality will cease when fishing vessels move on.
External Impacts (specify the particular example within each activity area)	Other fisheries	1	6	6	Functional group composition	Southern Coastal	2.1	3	4	1	Other fisheries present two problems: 1. The stock is distributed throughout the entire western Central Pacific ocean. There are concerns that widespread international fishing has impacted on the proportion of the stock size. 2. Live bait is captured in inshore waters from NSW and occasionally transported to offshore Tasmania. Most likely to affect pilchards via transmission of pathogens. One major mortality event has occurred resulting in dead pilchards on beaches around Tasmania. The cause of this event is unknown. Pilchards released offshore could potentially transmit disease to inshore fish and lifespan of virus in water short. Other fisheries most likely to effect Functional group composition, i.e. removal of the tuna, shark and small pelagics functional groups from the Southern Coastal Pelagic community =>intensity moderate –i.e. the impact was considered to be potentially severe at local scales but moderate at broader spatial scale => Consequence severe particularly if more than one functional group impacted=> Confidence low -no observations of pathogens or stock decline
	Aquaculture	0	0	0							
	Coastal development	1	6	6	Distribution of community	Eastern Coastal Pelagic	3.1	2	2	1	Coastal development occurs along most of Australia's coastline 365 days per year. Deep sewage outfalls extend to 2.8 n m from the coastline. The plumes from sewage outfalls off Sydney disrupt the southward migration of large schools heading toward the fishing grounds off Eden. Intensity minor - at a few restricted locations=>Consequence minor=>Confidence low-plumes have been observed from aircrraft.
	Other extractive activities	1	6	6	Distribution of community	Southern Coastal	3.1	3	2	1	Widespread oil and gas exploration occurs daily. Skipjack and other pelagic species may aggregate around structures -potentially oil rigs=>intensity moderate => Consequence minor=> Confidence low because of insufficient knowledge of trophic dynamics. Confidence low-no observational data of skipjack around oil rigs.

Direct impact of fishing	Fishing Activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
	Other non extractive activities	0	0	0							
	Other anthropogenic activities	1	6	6	Distribution of community	Southern Coastal	3.1	2	2	1	Shipping and Tourism activities such as shark diving off Port Lincoln, whale watching etc occurs during fishing season and generate organic waste, rubbish, chemical /oil spills disturbing distribution of Southern Coastal Pelagic community species by attracting scavengers or causing mortality => intensity moderate.=> Consequence minor, i.e. it was considered that impact would be undetectable => Confidence low because of a lack of information

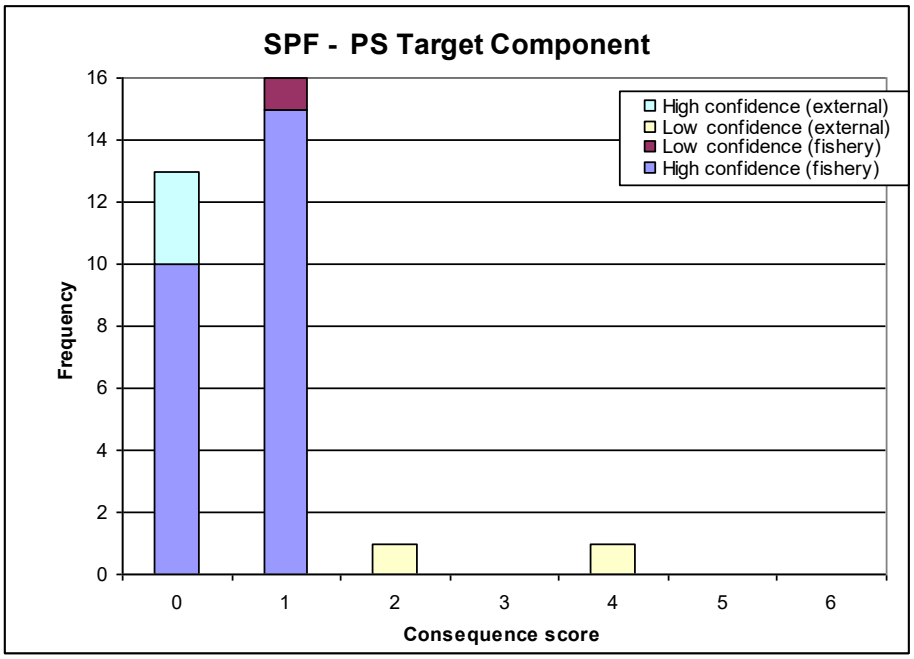
2.3.11 Summary of SICA results

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, and differentiating those that did so with high confidence (in bold).

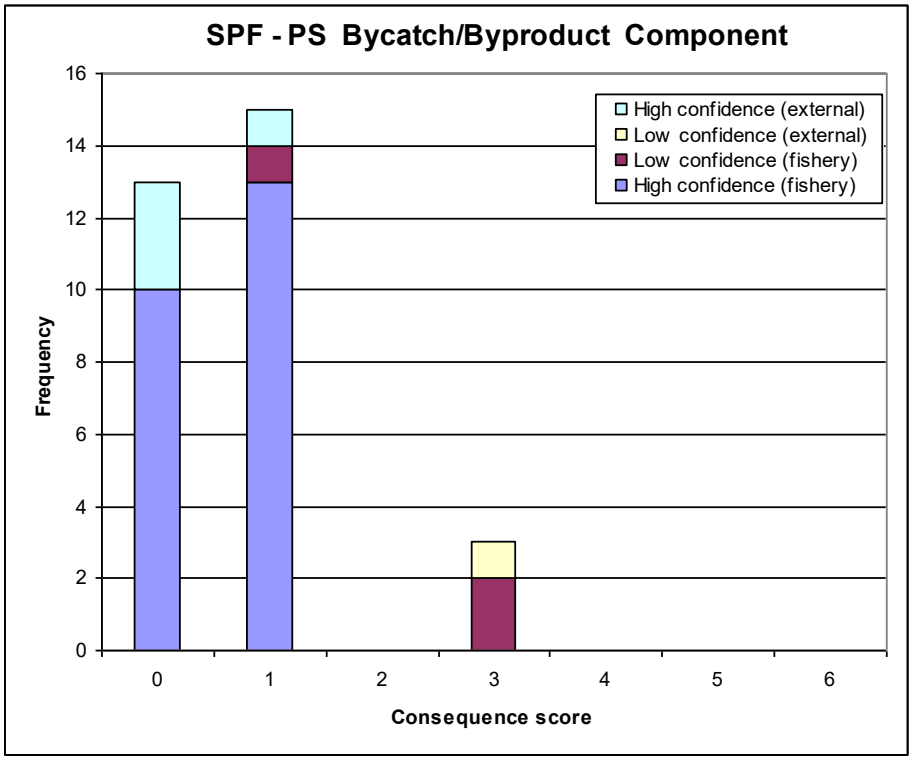
Level 1 (SICA) Document L1.6. Summary table of consequence scores for all activity/component combinations.

Direct impact of fishing	Fishing Activity	Target	Bycatch Byproduct	TEP	Habitat	Communities
Capture	Bait collection	0	0	0	0	0
	Fishing	1	3	3	1	2
	Incidental behaviour	1	1	1	1	2
Direct impact without capture	Bait collection	0	0	0	0	0
	Fishing	1	3	2	1	2
	Incidental behaviour	1	1	1	1	1
	Gear loss	1	1	2	1	1
	Anchoring/ mooring	0	0	0	0	0
	Navigation/ steaming	1	1	2	1	1
Addition/ movement of biological material	Translocation of species	0	0	0	0	0
	On board processing	0	0	0	0	0
	Discarding catch	0	0	0	0	0
	Stock enhancement	0	0	0	0	0
	Provisioning	1	1	1	1	2
	Organic waste disposal	1	1	2	1	1
Addition of non-biological material	Debris	1	1	1	2	2
	Chemical pollution	1	1	1	1	1
	Exhaust	1	1	1	1	1
	Gear loss	1	1	1	1	1
	Navigation/ steaming	1	1	1	1	2
	Activity/ presence on water	1	1	1	1	1
Disturb physical processes	Bait collection	0	0	0	0	0
	Fishing	1	1	1	2	1
	Boat launching	0	0	0	0	0
	Anchoring/ mooring	0	0	0	0	0
	Navigation/steaming	1	1	1	1	2
External Impacts (specify the particular example within each activity area)	Other fisheries	4	3	3	2	4
	Aquaculture	0	0	0	0	0
	Coastal development	3	3	1	3	2
	Other extractive activities	2	1	1	3	2
	Other non-extractive activities	0	0	0	0	0
	Other anthropogenic activities	0	0	0	0	2

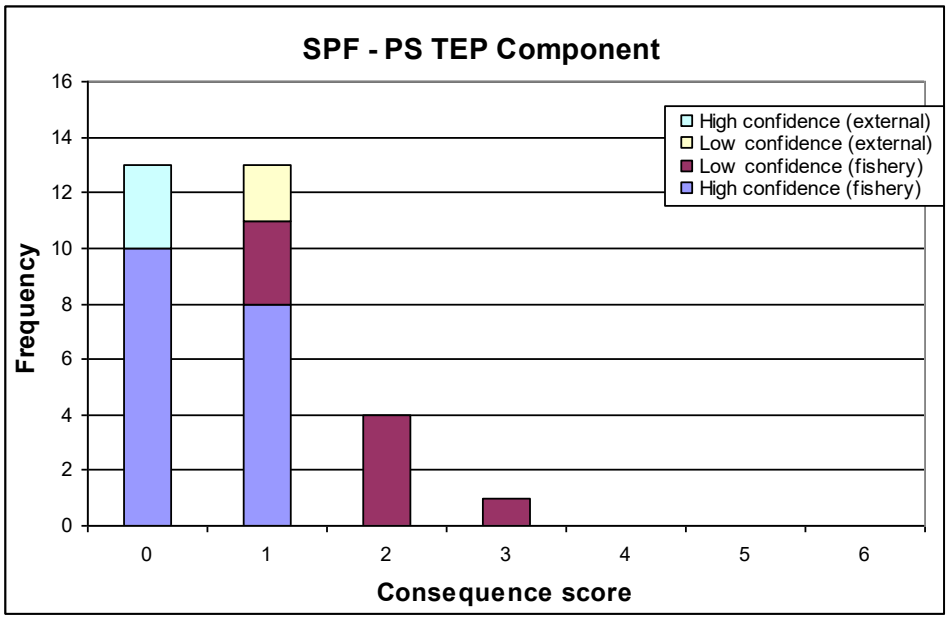
Target species: Frequency of consequence score differentiated between high and low confidence.



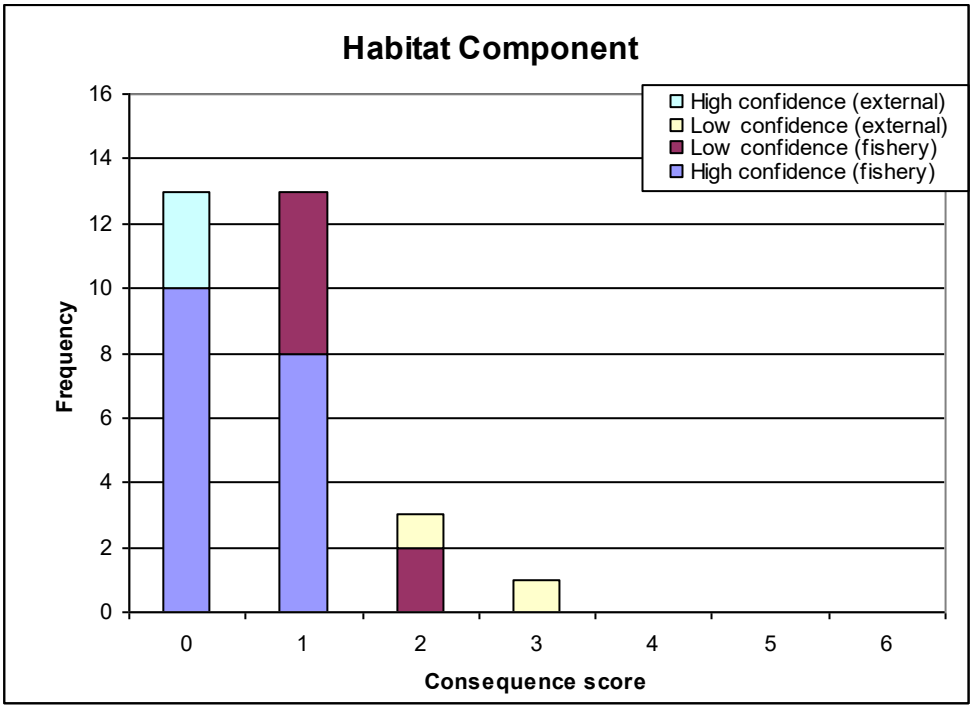
Byproduct and bycatch species: Frequency of consequence score differentiated between high and low confidence



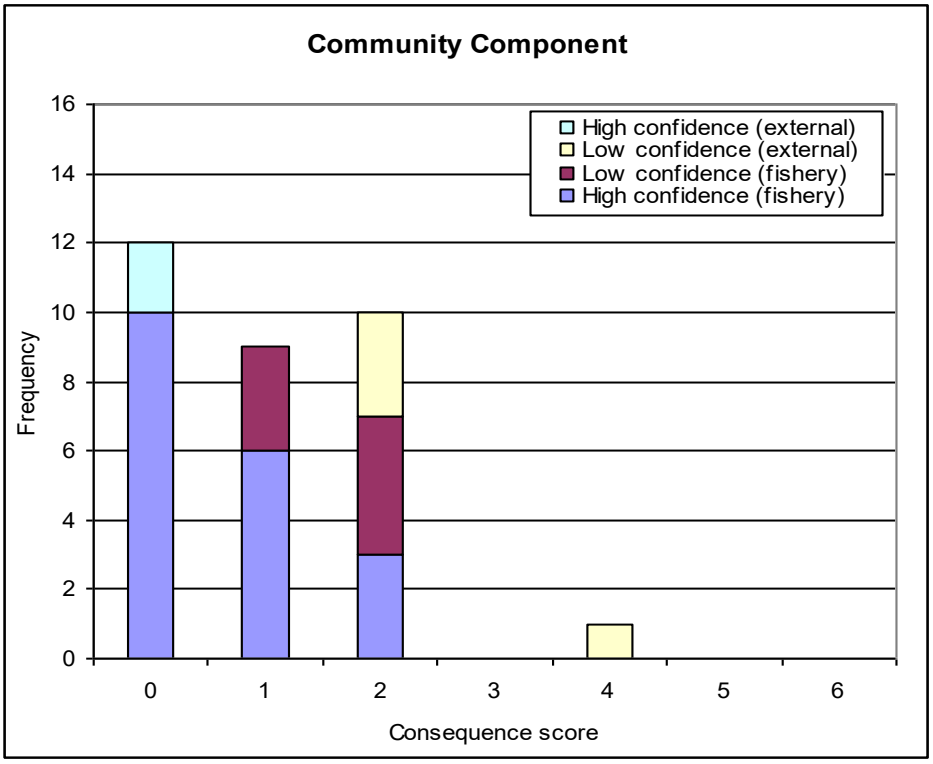
TEP species: Frequency of consequence score differentiated between high and low confidence (SICA excel workbook)



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

Target species were eliminated at the end of Level 1 because the level of effort by Australian vessels impacting on the skipjack stocks, which are distributed throughout the entire western Central Pacific and Indian Oceans is considered so small as to have unmeasurable impacts. There was at least one risk score of 3 (moderate) or above for two components: Byproduct/bycatch species and TEP species.

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

- Direct impact of fishing on byproduct/bycatch and TEP components.

These remaining hazards were assessed in more detail at Level 2 based on the precautionary approach.

Significant external hazards included International fisheries and coastal development. Risks rated as major (risk scores 4) were related to International fisheries for skipjack.

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:

- Byproduct/Bycatch
- TEP Species

Capture and interaction with byproduct and TEP species is anecdotally reported to be low but there are no independent field observations that can be used as supporting argument. Therefore both components are given further consideration based on the precautionary principle.

The activities that resulted in consequence scores of 3 for these components were direct impact of capture fishing (both components) and impact of fishing without capture (bycatch). Potentially both of these components could be impacted by capture fishing. In addition, direct impact without capture could have moderate consequences for dusky sharks. These sharks do not have a spiracle, relying on motion to ventilate the gills. Dusky sharks that become trapped but then escape the net are likely to suffer from respiratory stress and die after release. Again, this hazard would probably be eliminated with observer data.

Among the External impacts, capture fishing had consequence scores of 4 for target and community components. Annual removal of 2 million tonnes of skipjack may have depleted the stock, even across broad scales and is likely to have impacted on pelagic communities at broad scales.

The SICA has removed some components from further analysis, as these are judged to be impacted with low consequence by the set of activities considered. Those components excluded are

- Target species
- Habitats
- Communities

The target species component had no consequence scores of 3 or above. Over 2004, and 2005 combined, the total catch By Australian vessels was 199 tonnes. The impact of this catch on the entire western Central Pacific and Indian Ocean stocks was considered to have minor consequences. The international catch in 1999 peaked at 2 million tonnes. The recent Australian catches represent 0.01% of the international figure.

Purse seine gear generally does not come into contact with the bottom and habitats were eliminated.

Communities were eliminated because effort in the current Australian fishery is minimal.

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 from direct impacts of fishing only. In all assessments to date this has been the hazard with the greatest risks identified at Level 1. 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 noted 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.

<u>Habitats</u>
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
Susceptibility			
Availability	General depth range (Biome)	Spatial overlap of subfishery with habitat defined at biomic scale	Habitat occurs within the management area
Encounterability	Depth zone and feature type	Habitat encountered at the depth and location at which fishing activity occurs	Fishing takes place where habitat occurs
	Ruggedness (fractal dimension of substratum and seabed slope)	Relief, rugosity, hardness and seabed slope influence accessibility to different sub-fisheries	Rugged substratum is less accessible to mobile gears. Steeply sloping seabed is less accessible to mobile gears
	Level of disturbance	Gear footprint and intensity of encounters	Degree of impact is determined by the frequency and intensity of encounters (inc. size, weight and mobility of individual gears)
Selectivity	Removability/ mortality of fauna/ flora	Removal/ mortality of structure forming epifauna/ flora (inc. bioturbating infauna)	Erect, large, rugose, inflexible, delicate epifauna and flora, and large or delicate and shallow burrowing infauna (at depths impacted by mobile gears) are preferentially removed or damaged.
	Areal extent	How much of each habitat is present	Effective degree of impact greater in rarer habitats: rarer habitats may maintain rarer species.
	Removability of substratum	Certain size classes can be removed	Intermediate sized clasts (~6 cm to 3 m) that form attachment sites for sessile fauna can be permanently removed
	Substratum hardness	Composition of substrata	Harder substratum is intrinsically more resistant
	Seabed slope	Mobility of substrata once dislodged; generally higher levels of structural fauna	Gravity or latent energy transfer assists movement of habitat structures, eg turbidity flows, larger clasts. Greater density of filter feeding animals found where currents move up and down slopes.
Productivity			
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 each ecological component (species or habitat) is scored for risk based on attributes for productivity and susceptibility, and the results are plotted as shown in Figure 13.

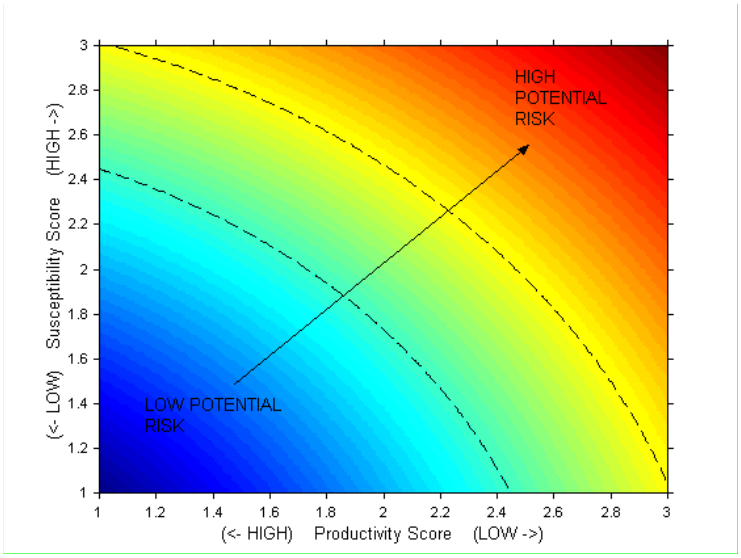


Figure 13. The axes on which risk to the ecological units is plotted. The *x*-axis includes attributes that influence the productivity of a unit, or its ability to recover after impact from fishing. The *y*-axis includes attributes that influence the susceptibility of the unit to impacts from fishing. 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 levels.

There are seven steps for the PSA undertaken for each component brought forward from Level 1 analysis.

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 to 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.

ERA_ SPECIES_ID	TAXA_ NAME	SCIENTIFIC_NAME	CAAB_ CODE	FAMILY_ NAME	COMMON_NAME	Role	Source	Explanation for why taxa excluded
825	Teleost	Sardinops neopilchardus	37085002	Clupeidae	pilchard	TA/BAIT		Target component eliminated - stage 1
1088	Teleost	Trachurus declivis	37337002	Carangidae	Jack Mackerel	TA/BAIT		Target component eliminated - stage 1
540	Teleost	Trachurus novaezelandiae	37337003	Carangidae	Yellow tail scad	TA/BAIT		Target component eliminated - stage 1
807	Teleost	Trachurus murphyi	37337077	Carangidae	Peruvian Jack Mackerel	TA/BAIT		Target component eliminated - stage 1
511	Teleost	Arripis georgianus	37344001	Arripidae	Tommy rough	TA/BAIT		Target component eliminated - stage 1
155	Teleost	Emmelichthys nitidus	37345001	Emmelichthyidae	redbait	TA/BAIT		Target component eliminated - stage 1
210	Teleost	Scomber australasicus	37441001	Scombridae	Blue Mackerel	TA/BAIT		Target component eliminated - stage 1
64	Teleost	Katsuwonus pelamis	37441003	Scombridae	Skipjack Tuna	TA		Target component eliminated - stage 1

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

Summary of Species PSA results

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. There is no observer program for this fishery.

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).

Byproduct species *Skipjack Tuna Fishery*

ERA species ID	Scientific name	Common name	Average logbook catch (kg) (2001-04)	Missing > 3 attributes (Y/N)	Number of missing productivity attributes (out of 7)	Number of missing susceptibility attributes (out of 5)	Productivity (additive) 1- low risk, 3 - high risk	Susceptibility (mult) 1- low risk, 3 - high risk	2D risk value (P&S) 1.41- low risk, 4.24 - high risk	Susceptibility override used?	2D P&S risk category	High/Med risk category (Refer 2.4.8)	Comments
Teleost													
895	Thunnus alalunga	Albacore	1,250	N	0	0	1.71	2.33	2.90	N	Med	Spatial uncertainty	
62	Thunnus obesus	Bigeye Tuna	0	N	0	0	1.71	2.33	2.90	N	Med	Spatial uncertainty	
212	Thunnus albacares	Yellowfin Tuna	5,325	N	0	0	1.57	2.33	2.81	N	Med	Spatial uncertainty	
255	Thunnus maccoyii	Southern Bluefin Tuna	135,000	N	0	0	2.00	1.67	2.60	N	Low		
211	Sarda australis	australian bonito	0	N	0	0	1.57	1.44	2.13	N	Low		
814	Coryphaena hippurus	Dolphin Fish (mahi mahi)	0	N	0	0	1.43	1.44	2.03	N	Low		

Bycatch species *Skipjack Tuna Fishery*

ERA species ID	Scientific name	Common name	Average logbook catch (kg) (2001-04)	Missing > 3 attributes (Y/N)	Number of missing productivity attributes (out of 7)	Number of missing susceptibility attributes (out of 5)	Productivity (additive) 1- low risk, 3 - high risk	Susceptibility (mult) 1- low risk, 3 - high risk	2D risk value (P&S) 1.41- low risk, 4.24 - high risk	Susceptibility override used?	2D P&S risk category	High/Med risk category (Refer 2.4.8)	Comments
Chondrichthyan													
808	Carcharhinus obscurus	Dusky Shark	0	N	0	0	3.00	2.33	3.80	N	High	Spatial uncertainty	
964	Isurus oxyrinchus	Shortfinned Mako or Blue Pointer	0	N	0	0	2.43	2.33	3.37	N	High	Spatial uncertainty	
972	Lamna nasus	Porbeagle shark	0	N	0	0	2.71	1.67	3.19	N	High	Low overlap	
1039	Prionace glauca	Blue Shark	0	N	0	0	2.57	1.67	3.06	N	Med	Low attribute score	
853	Manta birostris	Manta Ray	0	N	0	0	2.43	1.67	2.95	N	Med	Low attribute score	
Teleost													
213	Xiphias gladius	Broad Billed Swordfish	0	N	0	0	1.86	2.33	2.98	N	Med	Spatial uncertainty	
851	Makaira indica	Black Marlin	0	N	0	0	1.86	2.33	2.98	N	Med	Spatial uncertainty	
852	Makaira mazara	Blue Marlin	0	N	0	0	2.00	1.44	2.47	N	Low		
884	Tetrapturus audax	Striped marlin	25	N	0	0	1.86	1.44	2.35	N	Low		
908	Auxis thazard	Frigate mackerel	0	N	0	0	1.29	1.44	1.93	N	Low		

TEP species *Skipjack Tuna Fishery*

ERA species ID	Scientific name	Common name	Average logbook catch (kg) (2001-04)	Missing > 3 attributes (Y/N)	Number of missing productivity attributes (out of 7)	Number of missing susceptibility attributes (out of 5)	Productivity (additive) 1- low risk, 3 - high risk	Susceptibility (mult) 1- low risk, 3 - high risk	2D risk value (P&S) 1.41- low risk, 4.24 - high risk	Susceptibility override used?	2D P&S risk category	High/Med risk category (Refer 2.4.8)	Comments
Chondrichthyan													
315	Carcharodon carcharias	white shark	0	N	0	0	2.86	1.67	3.31	N	High	Low overlap	
313	Carcharias taurus	grey nurse shark	0	N	0	0	2.71	1.67	3.19	N	High	Low attribute score	
1067	Rhincodon typus	whale shark	0	N	0	0	2.71	1.44	3.07	N	Med	Low attribute score	
Marine bird													
1691	Pseudobulweria rostrata	Tahiti Petrel	0	Y	5	2	3.00	3.00	4.24	N	High	Missing data	
1673	Thalassarche nov. sp.	Pacific Albatross	0	Y	6	2	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	
628	Diomedea antipodensis	Antipodean 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	
799	Diomedea sanfordi	Northern Royal Albatross	0	N	1	1	2.57	3.00	3.95	N	High	Spatial uncertainty	
1031	Thalassarche carteri	Indian Yellow-nosed Albatross	0	N	1	1	2.57	3.00	3.95	N	High	Spatial uncertainty	
894	Thalassarche salvini	Salvin's albatross	0	Y	3	1	2.57	3.00	3.95	N	High	Missing data	
1428	Diomedea amsterdamensis	Amsterdam Albatross	0	N	1	1	2.57	3.00	3.95	N	High	Spatial uncertainty	
1580	Calonectris leucomelas	streaked shearwater	0	Y	3	1	2.57	3.00	3.95	N	High	Missing data	
1045	Pterodroma cervicalis	White-necked Petrel	0	Y	3	1	2.57	3.00	3.95	N	High	Missing data	

1051	Pterodroma solandri	Providence Petrel	0	Y	3	1	2.57	3.00	3.95	N	High	Missing data
1054	Puffinus bulleri	Buller's Shearwater	0	Y	3	1	2.57	3.00	3.95	N	High	Missing data
1694	Puffinus creatopus	Pink-footed Shearwater	0	Y	3	1	2.57	3.00	3.95	N	High	Missing data
827	Fregata andrewsi	Christmas frigatebird	0	N	1	1	2.57	3.00	3.95	N	High	Spatial uncertainty
1032	Thalassarche bulleri	Buller's Albatross	0	N	1	1	2.43	3.00	3.86	N	High	Spatial uncertainty
1033	Thalassarche cauta	Shy Albatross	0	N	1	1	2.43	3.00	3.86	N	High	Spatial uncertainty
1035	Thalassarche chrysostoma	Grey-headed Albatross	0	N	1	1	2.43	3.00	3.86	N	High	Spatial uncertainty
1085	Thalassarche melanophrys	Black-browed Albatross	0	N	1	1	2.43	3.00	3.86	N	High	Spatial uncertainty
1009	Phoebetria palpebrata	Light-mantled Albatross	0	N	1	1	2.43	3.00	3.86	N	High	Spatial uncertainty
314	Fulmarus glacialoides	Southern fulmar	0	N	1	1	2.43	3.00	3.86	N	High	Spatial uncertainty
939	Halobaena caerulea	Blue Petrel	0	Y	3	1	2.43	3.00	3.86	N	High	Missing data
1052	Lugensa brevirostris	Kerguelen Petrel	0	Y	3	1	2.43	3.00	3.86	N	High	Missing data
1003	Pachyptila turtur	Fairy Prion	0	Y	3	1	2.43	3.00	3.86	N	High	Missing data
1042	Procellaria parkinsoni	Black Petrel	0	N	2	1	2.43	3.00	3.86	N	High	Spatial uncertainty
1043	Procellaria westlandica	Westland Petrel	0	N	2	1	2.43	3.00	3.86	N	High	Spatial uncertainty
1693	Pterodroma baraui	Barau's Petrel	0	Y	3	1	2.43	3.00	3.86	N	High	Missing data
1046	Pterodroma leucoptera	Gould's Petrel	0	Y	4	1	2.43	3.00	3.86	N	High	Missing data
1047	Pterodroma macroptera	Great-winged Petrel	0	N	2	1	2.43	3.00	3.86	N	High	Spatial uncertainty
1048	Pterodroma mollis	Soft-plumaged Petrel	0	Y	3	1	2.43	3.00	3.86	N	High	Missing data
1050	Pterodroma nigripennis	Black-winged Petrel	0	Y	3	1	2.43	3.00	3.86	N	High	Missing data
1053	Puffinus assimilis	Little Shearwater (Tasman Sea)	0	Y	3	1	2.43	3.00	3.86	N	High	Missing data
1055	Puffinus carneipes	Flesh-footed Shearwater	0	N	1	1	2.43	3.00	3.86	N	High	Spatial uncertainty
1059	Puffinus pacificus	Wedge-tailed Shearwater	0	N	1	1	2.43	3.00	3.86	N	High	Spatial uncertainty
1060	Puffinus tenuirostris	Short-tailed Shearwater	0	N	1	1	2.43	3.00	3.86	N	High	Spatial uncertainty
918	Fregetta grallaria	White-bellied Storm-Petrel (Tasman Sea),	0	Y	3	1	2.43	3.00	3.86	N	High	Missing data
917	Fregetta tropica	Black-bellied Storm-Petrel	0	Y	3	1	2.43	3.00	3.86	N	High	Missing data
861	Papasula abbotti	Abbots booby	0	N	2	1	2.43	3.00	3.86	N	High	Spatial uncertainty
325	Catharacta skua	Great Skua	0	N	1	1	2.43	3.00	3.86	N	High	Spatial uncertainty
1610	Pterodroma heraldica	Herald Petrel	0	Y	3	1	2.43	3.00	3.86	N	High	Missing data
1034	Thalassarche chlororhynchos	Yellow-nosed Albatross, Atlantic Yellow-	0	N	1	1	2.29	3.00	3.77	N	High	Spatial uncertainty
1008	Phoebetria fusca	Sooty Albatross	0	N	1	1	2.29	3.00	3.77	N	High	Spatial uncertainty
595	Daption capense	Cape Petrel	0	N	1	1	2.29	3.00	3.77	N	High	Spatial uncertainty

73	Macronectes giganteus	Southern Giant-Petrel	0	N	1	1	2.29	3.00	3.77	N	High	Spatial uncertainty
981	Macronectes halli	Northern Giant-Petrel	0	N	1	1	2.29	3.00	3.77	N	High	Spatial uncertainty
1041	Procellaria aequinoctialis	White-chinned Petrel	0	N	1	1	2.29	3.00	3.77	N	High	Spatial uncertainty
494	Procellaria cinerea	Grey petrel	0	N	1	1	2.29	3.00	3.77	N	High	Spatial uncertainty
504	Pterodroma lessoni	White-headed petrel	0	N	1	1	2.29	3.00	3.77	N	High	Spatial uncertainty
1049	Pterodroma neglecta	Kermadec Petrel (western)	0	N	2	1	2.29	3.00	3.77	N	High	Spatial uncertainty
1057	Puffinus griseus	Sooty Shearwater	0	N	1	1	2.29	3.00	3.77	N	High	Spatial uncertainty
1432	Phaethon rubricauda	Red-tailed Tropicbird	0	N	1	1	2.29	3.00	3.77	N	High	Spatial uncertainty
1549	Morus capensis	Cape gannet	0	N	1	1	2.29	3.00	3.77	N	High	Spatial uncertainty
998	Morus serrator	Australasian Gannet	0	N	1	1	2.29	3.00	3.77	N	High	Spatial uncertainty
1433	Sula dactylatra	Masked Booby	0	N	1	1	2.29	3.00	3.77	N	High	Spatial uncertainty
881	Sula leucogaster	Brown boobies	0	N	1	1	2.29	3.00	3.77	N	High	Spatial uncertainty
1434	Sula sula	Red-footed Booby	0	N	1	1	2.29	3.00	3.77	N	High	Spatial uncertainty
829	Fregata ariel	Lesser frigatebird	0	N	1	1	2.29	3.00	3.77	N	High	Spatial uncertainty
203	Anous stolidus	Common noddy	0	N	1	1	2.29	3.00	3.77	N	High	Spatial uncertainty
975	Larus pacificus	Pacific Gull	0	N	1	1	2.29	3.00	3.77	N	High	Spatial uncertainty
1017	Sterna bergii	Crested Tern	0	N	1	1	2.29	3.00	3.77	N	High	Spatial uncertainty
1018	Sterna caspia	Caspian Tern	0	N	1	1	2.29	3.00	3.77	N	High	Spatial uncertainty
898	Eudyptula minor	Little Penguin	0	N	1	1	2.14	3.00	3.69	N	High	Spatial uncertainty
1056	Puffinus gavia	Fluttering Shearwater	0	N	2	1	2.14	3.00	3.69	N	High	Spatial uncertainty
1058	Puffinus huttoni	Hutton's Shearwater	0	N	2	1	2.14	3.00	3.69	N	High	Spatial uncertainty
1438	Anous minutus	Black Noddy	0	N	1	1	2.14	3.00	3.69	N	High	Spatial uncertainty
67	Anous tenuirostris	Lesser noddy	0	N	2	1	2.14	3.00	3.69	N	High	Spatial uncertainty
973	Larus dominicanus	Kelp Gull	0	N	1	1	2.14	3.00	3.69	N	High	Spatial uncertainty
1582	Procelsterna cerulea	grey ternlet	0	N	1	1	2.14	3.00	3.69	N	High	Spatial uncertainty
1016	Sterna bengalensis	Lesser crested tern	0	N	2	1	2.14	3.00	3.69	N	High	Spatial uncertainty
1020	Sterna fuscata	Sooty tern	0	N	1	1	2.14	3.00	3.69	N	High	Spatial uncertainty
1021	Sterna hirundo	Common tern	0	N	1	1	2.14	3.00	3.69	N	High	Spatial uncertainty
1023	Sterna paradisaea	Arctic tern	0	N	1	1	2.14	3.00	3.69	N	High	Spatial uncertainty
1025	Sterna sumatrana	Black-naped tern	0	N	2	1	2.14	3.00	3.69	N	High	Spatial uncertainty
1004	Pelagodroma marina	White-faced Storm-Petrel	0	N	1	1	2.00	3.00	3.61	N	High	Spatial uncertainty
1014	Sterna albifrons	Little tern	0	N	1	1	2.00	3.00	3.61	N	High	Spatial uncertainty
1015	Sterna anaethetus	Bridled Tern	0	N	1	1	2.00	3.00	3.61	N	High	Spatial uncertainty

1019	Sterna dougallii	Roseate tern	0	N	1	1	2.00	3.00	3.61	N	High	Spatial uncertainty
1024	Sterna striata	White-fronted Tern	0	N	1	1	2.00	3.00	3.61	N	High	Spatial uncertainty
1006	Pelecanoides urinatrix	Common Diving-Petrel	0	N	1	1	1.86	3.00	3.53	N	High	Spatial uncertainty
555	Garrodia nereis	Grey-backed storm petrel	0	Y	3	1	2.43	2.33	3.37	N	High	Missing data
1086	Thalassarche steadi	White-capped Albatross	0	N	2	0	2.71	1.67	3.19	N	High	Widely distributed
1435	Fregata minor	Great Frigatebird, Greater Frigatebird	0	N	1	1	2.14	2.33	3.17	N	Med	Spatial uncertainty
556	Oceanites oceanicus	Wilson's storm petrel (subantarctic)	0	N	1	1	2.00	2.33	3.07	N	Med	Spatial uncertainty
912	Phalacrocorax fuscescens	Black faced cormorant	0	N	1	0	2.57	1.67	3.06	N	Med	Low attribute score
974	Larus novaehollandiae	Silver Gull	0	N	3	0	2.14	1.67	2.71	N	Med	Low attribute score
Marine mammal												
253	Arctocephalus pusillus doriferus	Australian Fur Seal	0	N	0	0	2.29	3.00	3.77	N	High	Spatial uncertainty
902	Feresa attenuata	Pygmy Killer Whale	0	N	0	0	2.86	1.67	3.31	N	High	Low attribute score
934	Globicephala macrorhynchus	Short-finned Pilot Whale	0	N	0	0	2.86	1.67	3.31	N	High	Low attribute score
935	Globicephala melas	Long-finned Pilot Whale	0	N	0	0	2.86	1.67	3.31	N	High	Low attribute score
937	Grampus griseus	Risso's Dolphin	0	N	0	0	2.86	1.67	3.31	N	High	Low attribute score
1002	Orcinus orca	Killer Whale	0	N	0	0	2.86	1.67	3.31	N	High	Low attribute score
1044	Pseudorca crassidens	False Killer Whale	0	N	1	0	2.86	1.67	3.31	N	High	Low attribute score
1091	Tursiops truncatus	Bottlenose Dolphin	0	N	0	0	2.86	1.67	3.31	N	High	Low attribute score
1494	Tursiops aduncus	Indian Ocean bottlenose dolphin	0	N	1	0	2.86	1.67	3.31	N	High	Low attribute score
985	Mesoplodon bowdoini	Andrew's Beaked Whale	0	N	1	0	2.86	1.67	3.31	N	High	Low attribute score
986	Mesoplodon densirostris	Blainville's Beaked Whale	0	N	0	0	2.86	1.67	3.31	N	High	Low attribute score
987	Mesoplodon gingkodens	Gingko Beaked Whale	0	N	1	0	2.86	1.67	3.31	N	High	Low attribute score
989	Mesoplodon hectori	Hector's Beaked Whale	0	N	0	0	2.86	1.67	3.31	N	High	Low attribute score
991	Mesoplodon mirus	True's Beaked Whale	0	N	0	0	2.86	1.67	3.31	N	High	Low attribute score

864	Delphinus capensis	Common dolphin, long-beaked	0	N	1	0	2.29	2.33	3.27	N	High	Widely distributed	
1440	Indopacetus pacificus	Longman's Beaked Whale	0	Y	4	1	3.00	1.22	3.24	N	High	Missing data	
959	Hyperoodon planifrons	Southern Bottlenose Whale	0	N	1	0	2.86	1.44	3.20	N	High	Low attribute score	
988	Mesoplodon grayi	Gray's Beaked Whale	0	N	1	0	2.86	1.44	3.20	N	High	Low attribute score	
990	Mesoplodon layardii	Strap-toothed Beaked Whale	0	N	1	0	2.86	1.44	3.20	N	High	Low attribute score	
1098	Ziphius cavirostris	Cuvier's Beaked Whale	0	N	0	0	2.86	1.44	3.20	N	High	Low attribute score	
970	Lagenodelphis hosei	Fraser's Dolphin	0	N	1	0	2.71	1.67	3.19	N	High	Low attribute score	
832	Lagenorhynchus cruciger	Hourglass dolphin	0	N	1	1	2.71	1.67	3.19	N	High	Low attribute score	
61	Lissodelphis peronii	Southern Right Whale Dolphin	0	N	1	0	2.71	1.67	3.19	N	High	Low attribute score	
1081	Stenella coeruleoalba	Striped Dolphin	0	N	0	0	2.71	1.67	3.19	N	High	Low attribute score	
969	Kogia simus	Dwarf Sperm Whale	0	N	0	0	2.71	1.67	3.19	N	High	Low attribute score	
256	Balaenoptera acutorostrata	Minke Whale	0	N	0	0	2.86	1.30	3.14	Y	Med	Low attribute score	Expert over-ride: Encounterability reduced from 3 to 2- A plankton feeder not attracted to schools of bait (observer workshop August 2005)
968	Kogia breviceps	Pygmy Sperm Whale	0	N	0	0	2.86	1.22	3.11	N	Med	Low attribute score	
1036	Physeter catodon	Sperm Whale	0	N	0	0	2.86	1.22	3.11	N	Med	Low attribute score	
269	Berardius arnuxii	Arnoux's Beaked Whale	0	N	0	0	2.86	1.22	3.11	N	Med	Low attribute score	
1030	Tasmacetus shepherdi	Tasman Beaked Whale	0	N	1	0	2.86	1.22	3.11	N	Med	Low attribute score	
261	Balaenoptera borealis	Sei Whale	0	N	0	0	2.86	1.15	3.08	Y	Med	Low attribute score	See minke whale
262	Balaenoptera edeni	Bryde's Whale	0	N	0	0	2.86	1.15	3.08	Y	Med	Low attribute score	See minke whale
268	Balaenoptera physalus	Fin Whale	0	N	0	0	2.86	1.15	3.08	Y	Med	Low attribute score	See minke whale

1439	Balaenoptera bonaerensis	Antarctic Minke Whale	0	N	1	0	2.86	1.15	3.08	Y	Med	Low attribute score	See minke whale
984	Megaptera novaeangliae	Humpback Whale	0	N	0	0	2.71	1.44	3.07	Y	Med	Low attribute score	See minke whale
1007	Peponocephala electra	Melon-headed Whale	0	N	1	0	2.57	1.67	3.06	N	Med	Low attribute score	
1080	Stenella attenuata	Spotted Dolphin	0	N	1	0	2.57	1.67	3.06	N	Med	Low attribute score	
289	Caperea marginata	Pygmy Right Whale	0	N	1	0	2.71	1.30	3.01	Y	Med	Low attribute score	See minke whale
1076	Sousa chinensis	Indo-Pacific Humpback Dolphin	0	N	0	0	2.71	1.22	2.98	N	Med	Low attribute score	
1083	Steno bredanensis	Rough-toothed Dolphin	0	N	0	0	2.71	1.22	2.98	N	Med	Low attribute score	
295	Hydrurga leptonyx	Leopard seal	0	N	0	0	2.71	1.22	2.98	Y	Med	Low attribute score	Expert over-ride. Availability reduced from 3 to 1. Dertailed mapping applies to Autralian continent. This species mainly from Antarctica. Frequent vistior to SE Aust but not as far north as Sydney where current effort is concentrated (Distributional information from DEH and AAD web-sites, fishery effort data)
993	Mirounga leonina	Elephant seal	0	N	0	0	2.71	1.22	2.98	Y	Med	Low attribute score	See Leopard seal
813	Dugong dugon	Dugong	0	N	1	0	2.71	1.22	2.98	N	Med	Widely distributed	
896	Eubalaena australis	Southern Right Whale	0	N	0	0	2.71	1.15	2.95	Y	Med	Low attribute score	See minke whale
1082	Stenella longirostris	Long-snouted Spinner Dolphin	0	N	0	0	2.43	1.67	2.95	N	Med	Low attribute score	
216	Arctocephalus forsteri	New Zealand Fur-seal	0	N	0	0	2.43	1.67	2.95	N	Med	Low attribute score	
1000	Neophoca cinerea	Australian Sea-lion	0	N	0	0	2.43	1.67	2.95	N	Med	Low attribute score	
860	Orcaella brevirostris	Irrawaddy dolphin	0	N	1	0	2.57	1.22	2.85	N	Med	Low attribute score	
612	Delphinus delphis	Common Dolphin	0	N	0	0	2.29	1.67	2.83	N	Med	Low attribute score	
263	Arctocephalus tropicalis	Subantarctic fur seal	0	N	0	0	2.29	1.67	2.83	N	Med	Low attribute	

												score	
265	Balaenoptera musculus	Blue Whale	0	N	0	0	2.57	1.15	2.82	Y	Med	Low attribute score	See minke whale
971	Lagenorhynchus obscurus	Dusky Dolphin	0	N	0	0	2.29	1.22	2.59	N	Low		
Marine reptile													
1531	Hydrophis czeblukovi	fine-spined seasnake	0	Y	6	2	3.00	1.67	3.43	N	High	Missing data	
1421	Hydrophis coggeri	Slender-necked Seasnake	0	Y	6	1	3.00	1.22	3.24	N	High	Missing data	
1689	Parahydrophis mertoni	Northern mangrove seasnake	0	Y	6	1	3.00	1.22	3.24	N	High	Missing data	
1415	Aipysurus tenuis	Brown-lined Seasnake	0	Y	4	1	2.71	1.67	3.19	N	High	Missing data	
1530	Disteira kingii	spectacled seasnake	0	Y	3	1	2.71	1.67	3.19	N	High	Missing data	
1681	Hydrophis atriceps	Black-headed seasnake	0	Y	3	1	2.71	1.67	3.19	N	High	Missing data	
1686	Hydrophis melanosoma	Black-banded robust seasnake	0	Y	4	1	2.71	1.67	3.19	N	High	Missing data	
1687	Hydrophis pacificus	Large-headed Seasnake	0	Y	4	1	2.71	1.67	3.19	N	High	Missing data	
1688	Hydrophis vorisi	A seasnake	0	Y	4	1	2.71	1.67	3.19	N	High	Missing data	
613	Dermochelys coriacea	Leathery turtle	0	N	1	0	2.57	1.67	3.06	N	Med	Low attribute score	
1411	Aipysurus eydouxii	Spine-tailed Seasnake	0	Y	3	1	2.57	1.67	3.06	N	Med	Missing data	
1420	Hydrelaps darwiniensis	Black-ringed Seasnake	0	Y	4	1	2.57	1.67	3.06	N	Med	Missing data	
1683	Hydrophis caerulescens	Dwarf seasnake	0	Y	3	1	2.57	1.67	3.06	N	Med	Missing data	
1684	Hydrophis gracilis	Slender seasnake	0	Y	3	1	2.57	1.67	3.06	N	Med	Missing data	
1408	Acalyptophis peronii	Horned Seasnake	0	N	3	0	2.71	1.22	2.98	N	Med	Low attribute score	
1410	Aipysurus duboisii	Dubois' Seasnake	0	N	3	0	2.71	1.22	2.98	N	Med	Low attribute score	
254	Astrotia stokesii	Stokes' seasnake	0	N	3	0	2.71	1.22	2.98	N	Med	Low attribute score	
1416	Disteira major	Olive-headed Seasnake	0	N	3	0	2.71	1.22	2.98	N	Med	Low attribute score	
1422	Hydrophis mcdowelli	seasnake	0	N	3	0	2.71	1.22	2.98	N	Med	Low attribute score	
1423	Hydrophis ornatus	seasnake	0	N	3	0	2.71	1.22	2.98	N	Med	Low attribute score	
1005	Pelamis platurus	yellow-bellied seasnake	0	N	3	0	2.71	1.22	2.98	N	Med	Low attribute score	
324	Caretta caretta	Loggerhead	0	N	1	0	2.43	1.67	2.95	N	Med	Low attribute score	
541	Chelonia mydas	Green turtle	0	N	1	0	2.43	1.67	2.95	N	Med	Low attribute score	

822	Eretmochelys imbricata	Hawksbill turtle	0	N	1	0	2.43	1.67	2.95	N	Med	Low attribute score	
844	Lepidochelys olivacea	Olive Ridley turtle	0	N	1	0	2.43	1.67	2.95	Y	Med	Low attribute score	Expert over-ride: Availability reduced from 3 to 1. Detailed mapping analysis not available. Restricted to Coral Sea and does not overlap with current effort. (Distributional information from DEH, fishery effort data)
857	Natator depressus	Flatback turtle	0	N	2	0	2.43	1.67	2.95	N	Med	Low attribute score	
1679	Laticauda colubrina	Banded wide faced Sea krait	0	N	2	1	2.43	1.67	2.95	N	Med	Low attribute score	
1409	Aipysurus apraefrontalis	Short-nosed Seasnake	0	Y	4	0	2.57	1.22	2.85	N	Med	Missing data	
1413	Aipysurus fuscus	Dusky Seasnake	0	Y	4	0	2.57	1.22	2.85	N	Med	Missing data	
1680	Laticauda laticaudata	Large scaled sea krait	0	N	2	1	2.29	1.67	2.83	N	Med	Low attribute score	
1414	Aipysurus laevis	Olive Seasnake, Golden Seasnake	0	N	1	1	2.29	1.67	2.83	N	Med	Low attribute score	
1424	Lapemis hardwickii	Spine-bellied Seasnake	0	N	1	1	2.14	1.67	2.71	N	Med	Low attribute score	
1417	Emydocephalus annulatus	Turtle-headed Seasnake	0	N	3	0	2.29	1.22	2.59	N	Low		
957	Hydrophis elegans	Elegant seasnake	0	N	2	0	2.14	1.22	2.47	N	Low		
1418	Enhydrina schistosa	Beaked Seasnake	0	N	0	0	2.00	1.22	2.34	N	Low		
Teleost													
308	Heteroclinus perspicillatus	Common weedfish	0	N	3	0	2.29	1.22	2.59	N	Low		
1074	Solenostomus cyanopterus	Blue-finned Ghost Pipefish, Robust Ghost	0	N	3	0	2.14	1.15	2.43	N	Low		
1075	Solenostomus paradoxus	Harlequin Ghost Pipefish, Ornate Ghost Pipefish	0	N	3	0	2.14	1.15	2.43	N	Low		
1548	Heraldia sp. 1 [in Kuiter, 2000]	Western upsidedown pipefish	0	N	0	0	1.43	1.44	2.03	N	Low		
1666	Hippocampus kelloggi	Kellogg's Seahorse	0	N	0	0	1.43	1.44	2.03	N	Low		
1668	Hippocampus subelongatus	West Australian Seahorse	0	N	0	0	1.43	1.44	2.03	N	Low		
1669	Idiotropiscis larsonae	Helen's Pygmy Pipehorse	0	N	0	0	1.43	1.44	2.03	N	Low		

1699	Idiotropiscis australe	Southern Pygmy Pipehorse	0	N	0	0	1.43	1.44	2.03	N	Low
1011	Phyllopteryx taeniolatus	Weedy Seadragon, Common Seadragon	0	N	0	0	1.57	1.22	1.99	N	Low
1667	Hippocampus kuda	Spotted Seahorse, Yellow Seahorse	0	N	0	0	1.57	1.22	1.99	N	Low
1010	Phycodurus eques	Leafy Seadragon	0	N	0	0	1.57	1.15	1.95	N	Low
949	Hippocampus taeniopterus	Spotted Seahorse, Yellow Seahorse	0	N	0	0	1.57	1.15	1.95	N	Low
361	Dunckerocampus dactyliophorus	Ringed Pipefish	0	N	0	0	1.57	1.15	1.95	N	Low
569	Doryrhamphus melanopleura	Bluestripe Pipefish	0	N	0	0	1.57	1.15	1.95	N	Low
55	Doryrhamphus janssi	Cleaner Pipefish, Janss' Pipefish	0	N	0	0	1.57	1.15	1.95	N	Low
568	Doryrhamphus malus	Flagtail Pipefish, Negros Pipefish	0	N	0	0	1.57	1.15	1.95	N	Low
983	Maroubra perserrata	Sawtooth Pipefish	0	N	0	0	1.57	1.07	1.90	N	Low
1072	Solegnathus robustus	Robust Spiny Pipehorse, Robust Pipehorse	0	N	0	0	1.43	1.22	1.88	N	Low
1070	Solegnathus dunckeri	Duncker's Pipehorse	0	N	0	0	1.43	1.22	1.88	N	Low
318	Hippocampus spinosissimus	Hedgehog Seahorse	0	N	0	0	1.43	1.22	1.88	N	Low
1665	Hippocampus histrix	Spiny Seahorse	0	N	0	0	1.43	1.22	1.88	N	Low
320	Solegnathus guentheri	Indonesian Pipefish, Gunther's Pipehorse	0	N	0	0	1.43	1.15	1.83	N	Low
1089	Trachyrhamphus bicoarctatus	Bend Stick Pipefish, Short-tailed Pipefish	0	N	0	0	1.43	1.15	1.83	N	Low
360	Haliichthys taeniophorus	Ribboned Seadragon, Ribboned Pipefish	0	N	0	0	1.43	1.15	1.83	N	Low
1092	Urocampus carinirostris	Hairy Pipefish	0	N	0	0	1.43	1.15	1.83	N	Low
946	Hippocampus bleekeri	pot bellied seahorse	0	N	0	0	1.43	1.15	1.83	N	Low
953	Histiogamphelus briggsii	Briggs' Crested Pipefish, Briggs' Pipefish	0	N	0	0	1.43	1.15	1.83	N	Low
961	Hypselognathus rostratus	Knife-snouted Pipefish	0	N	0	0	1.43	1.15	1.83	N	Low
978	Leptoichthys fistularius	Brushtail Pipefish	0	N	0	0	1.43	1.15	1.83	N	Low
995	Mitotichthys semistriatus	Half-banded Pipefish	0	N	0	0	1.43	1.15	1.83	N	Low

1026	Stigmatopora argus	Spotted Pipefish	0	N	0	0	1.43	1.15	1.83	N	Low
1028	Stipecampus cristatus	Ring-backed Pipefish	0	N	0	0	1.43	1.15	1.83	N	Low
1061	Pugnaso curtirostris	Pug-nosed Pipefish	0	N	0	0	1.43	1.15	1.83	N	Low
994	Mitotichthys mollisoni	Mollison's Pipefish	0	N	0	0	1.43	1.15	1.83	N	Low
1095	Vanacampus poecilolaemus	Australian Long-snout Pipefish, Long-snouted Pipefish	0	N	0	0	1.43	1.15	1.83	N	Low
996	Mitotichthys tuckeri	Tucker's Pipefish	0	N	0	0	1.43	1.15	1.83	N	Low
1073	Solegnathus spinosissimus	spiny pipehorse	0	N	0	0	1.43	1.15	1.83	N	Low
938	Halicampus grayi	Mud Pipefish, Gray's Pipefish	0	N	0	0	1.43	1.15	1.83	N	Low
566	Corythoichthys conspicillatus	Yellow-banded Pipefish, Network Pipefish	0	N	0	0	1.43	1.15	1.83	N	Low
114	Acentronura breviperula	Hairy Pygmy Pipehorse	0	N	0	0	1.43	1.15	1.83	N	Low
53	Bulbonaricus brauni	Braun's Pughead Pipefish, Pug-headed Pipefish	0	N	0	0	1.43	1.15	1.83	N	Low
1583	Bulbonaricus davaoensis	[a pipefish]	0	N	0	0	1.43	1.15	1.83	N	Low
546	Campichthys tricarinatus	Three-keel Pipefish	0	N	0	0	1.43	1.15	1.83	N	Low
387	Choeroichthys latispinosus	Muiron Island Pipefish	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
578	Corythoichthys ocellatus	Orange-spotted Pipefish, Ocellated Pipefish	0	N	0	0	1.43	1.15	1.83	N	Low
1587	Corythoichthys paxtoni	[a pipefish]	0	N	0	0	1.43	1.15	1.83	N	Low
452	Corythoichthys schultzi	Schultz's Pipefish	0	N	0	0	1.43	1.15	1.83	N	Low
401	Cosmocampus banneri	Roughridge Pipefish	0	N	0	0	1.43	1.15	1.83	N	Low
1588	Cosmocampus darrosanus	[a pipefish]	0	N	0	0	1.43	1.15	1.83	N	Low
580	Cosmocampus howensis	Lord Howe Pipefish	0	N	0	0	1.43	1.15	1.83	N	Low
1589	Cosmocampus maxweberi	[a pipefish]	0	N	0	0	1.43	1.15	1.83	N	Low
904	Festucalex cinctus	Girdled Pipefish	0	N	0	0	1.43	1.15	1.83	N	Low
1590	Festucalex gibbsi	[a pipefish]	0	N	0	0	1.43	1.15	1.83	N	Low
321	Festucalex scalaris	Ladder Pipefish	0	N	0	0	1.43	1.15	1.83	N	Low
914	Filicampus tigris	Tiger Pipefish	0	N	0	0	1.43	1.15	1.83	N	Low

54	Halicampus brocki	Brock's Pipefish	0	N	0	0	1.43	1.15	1.83	N	Low
359	Halicampus dunckeri	Red-hair Pipefish, Duncker's 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
1593	Halicampus mataafae	[a pipefish]	0	N	0	0	1.43	1.15	1.83	N	Low
57	Halicampus nitidus	Glittering Pipefish	0	N	0	0	1.43	1.15	1.83	N	Low
454	Halicampus spinirostris	Spiny-snout Pipefish	0	N	0	0	1.43	1.15	1.83	N	Low
945	Hippichthys penicillus	Beady Pipefish, Steep-nosed Pipefish	0	N	0	0	1.43	1.15	1.83	N	Low
951	Hippocampus planifrons	Flat-face Seahorse	0	N	0	0	1.43	1.15	1.83	N	Low
1603	Hippocampus zebra	[a pipefish]	0	N	0	0	1.43	1.15	1.83	N	Low
954	Histiogamphelus cristatus	Rhino Pipefish, Macleay's Crested Pipefish	0	N	0	0	1.43	1.15	1.83	N	Low
960	Hypselognathus horridus	Shaggy Pipefish, Prickly Pipefish	0	N	0	0	1.43	1.15	1.83	N	Low
967	Kimblaeus bassensis	Trawl Pipefish, Kimbla Pipefish	0	N	0	0	1.43	1.15	1.83	N	Low
390	Lissocampus fatiloquus	Prophet's Pipefish	0	N	0	0	1.43	1.15	1.83	N	Low
992	Micrognathus andersonii	Anderson's Pipefish, Shortnose Pipefish	0	N	0	0	1.43	1.15	1.83	N	Low
1604	Micrognathus pygmaeus	[a pipefish]	0	N	0	0	1.43	1.15	1.83	N	Low
547	Micrognathus micronotopterus	Tidepool Pipefish	0	N	0	0	1.43	1.15	1.83	N	Low
1605	Micrognathus natans	[a pipefish]	0	N	0	0	1.43	1.15	1.83	N	Low
1606	Microphis brachyurus	[a pipefish]	0	N	0	0	1.43	1.15	1.83	N	Low
798	Microphis manadensis	Manado River Pipefish, Manado Pipefish	0	N	0	0	1.43	1.15	1.83	N	Low
1243	Mitotichthys meraculus	Western Crested Pipefish	0	N	0	0	1.43	1.15	1.83	N	Low
1607	Nannocampus lindemanensis	[a pipefish]	0	N	0	0	1.43	1.15	1.83	N	Low
1001	Notiocampus ruber	Red Pipefish	0	N	0	0	1.43	1.15	1.83	N	Low
1608	Phoxocampus diacanthus	[a pipefish]	0	N	0	0	1.43	1.15	1.83	N	Low
1609	Siokunichthys breviceps	[a pipefish]	0	N	0	0	1.43	1.15	1.83	N	Low
1071	Solegnathus sp. 1 [in Kuiter, 2000]	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
322	Trachyrhamphus longirostris	Long-nosed Pipefish, Straight Stick Pipefish	0	N	0	0	1.43	1.15	1.83	N	Low

1093	Vanacampus margaritifer	Mother-of-pearl Pipefish	0	N	0	0	1.43	1.15	1.83	N	Low
1096	Vanacampus vercoi	Verco's Pipefish	0	N	0	0	1.43	1.15	1.83	N	Low
56	Bhanotia fasciolata	Corrugated Pipefish, Barbed Pipefish	0	N	0	0	1.43	1.15	1.83	N	Low
950	Hippocampus minotaur	Bullneck Seahorse	0	N	0	0	1.43	1.15	1.83	N	Low
1597	Hippocampus bargibanti	pygmy seahorse	0	N	0	0	1.43	1.15	1.83	N	Low
1591	Halicampus boothae	[a pipefish]	0	N	0	0	1.43	1.15	1.83	N	Low
362	Phoxocampus belcheri	Rock Pipefish	0	N	0	0	1.43	1.15	1.83	N	Low
948	Hippocampus queenslandicus	Kellogg's Seahorse	0	N	0	0	1.43	1.15	1.83	N	Low
1598	Hippocampus dahli	[a pipefish]	0	N	0	0	1.43	1.15	1.83	N	Low
1676	Hippocampus biocellatus	False-eyed seahorse	0	N	0	0	1.43	1.15	1.83	N	Low
1677	Hippocampus tuberculatus	Knobby Seahorse	0	N	0	0	1.43	1.15	1.83	N	Low
1602	Hippocampus tristis	[a pipefish]	0	N	0	0	1.43	1.15	1.83	N	Low
1596	Hippocampus alatus	[a pipefish]	0	N	0	0	1.43	1.15	1.83	N	Low
1601	Hippocampus procerus	[a pipefish]	0	N	0	0	1.43	1.15	1.83	N	Low
548	Hippocampus subelongatus	West Australian Seahorse	0	N	0	0	1.43	1.15	1.83	N	Low
1600	Hippocampus multispinus	[a pipefish]	0	N	0	0	1.43	1.15	1.83	N	Low
1599	Hippocampus hendriki	[a pipefish]	0	N	0	0	1.43	1.15	1.83	N	Low
1678	Hippocampus grandiceps	Bighead Seahorse	0	N	0	0	1.43	1.15	1.83	N	Low
549	Hippocampus angustus	Western Spiny Seahorse	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
966	Kaupus costatus	Deep-bodied 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
1027	Stigmatopora nigra	Wide-bodied Pipefish, Black 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
105	Acentronura australe	Southern Pygmy Pipehorse	0	N	0	0	1.43	1.07	1.79	N	Low
287	Campichthys galei	Gale's 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
563	Corythoichthys amplexus	Fijian Banded Pipefish, Brown-banded 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
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
1675	Hippichthys parvicarinatus	Short-keeled 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
1242	Nannocampus subosseus	Bony-headed 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
1094	Vanacampus phillipi	Port Phillip Pipefish	0	N	0	0	1.29	1.07	1.68	N	Low

Summary of Habitat PSA results

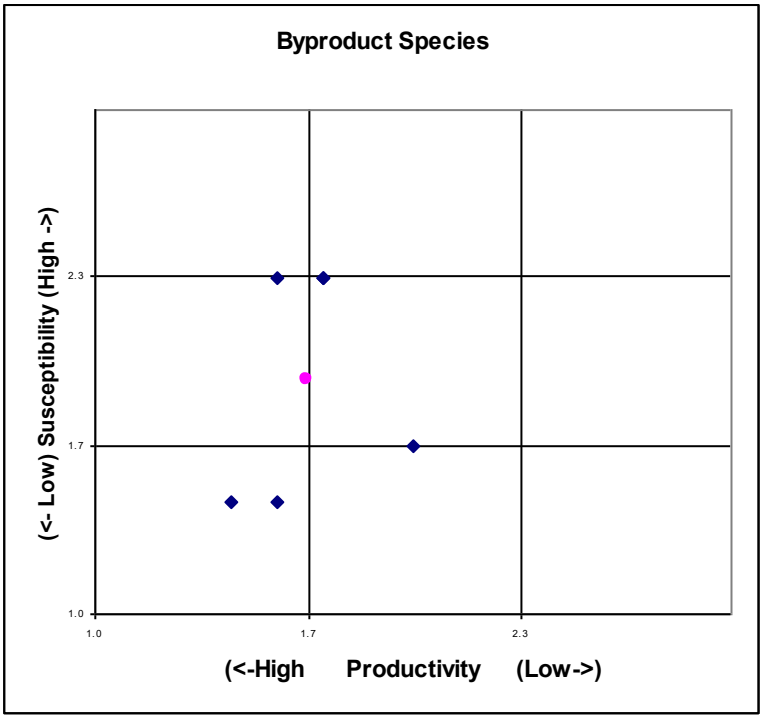
Not examined

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

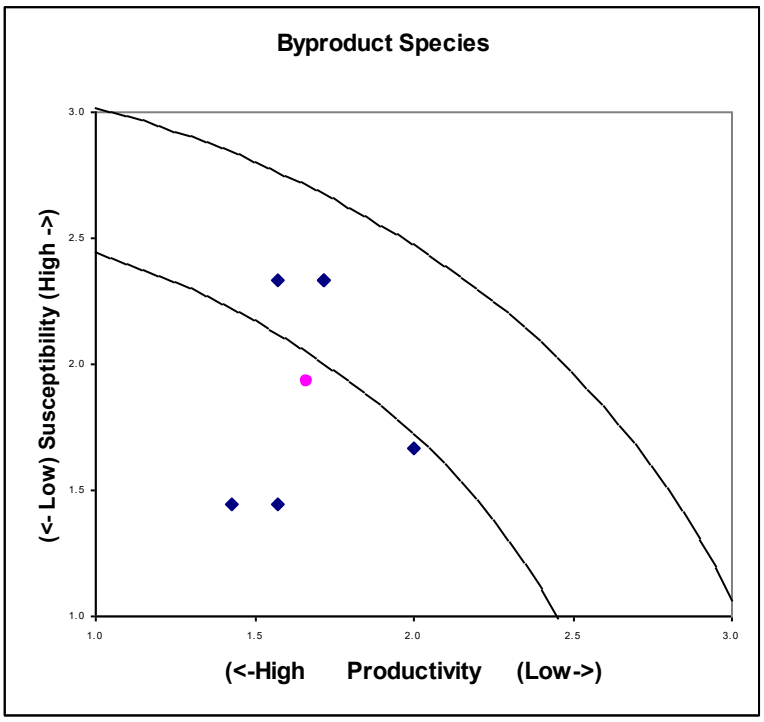
The average productivity and susceptibility scores for each unit of analysis (e.g. for each species) are then used to place the individual units of analysis on 2D plots (as below). The relative position of the units on the plot will determine relative risk at the unit level as per PSA plot below. The 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

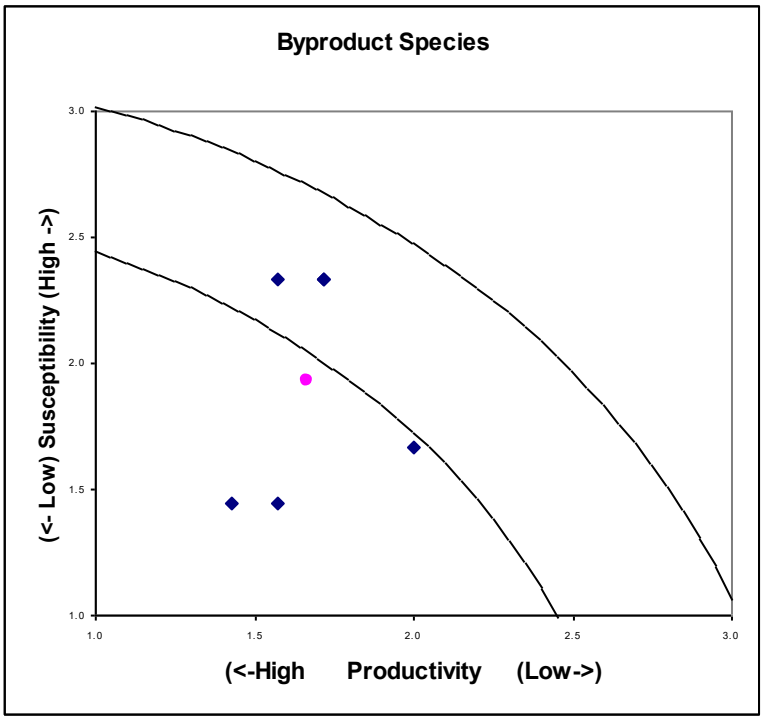
PSA plot for target species: Not applicable



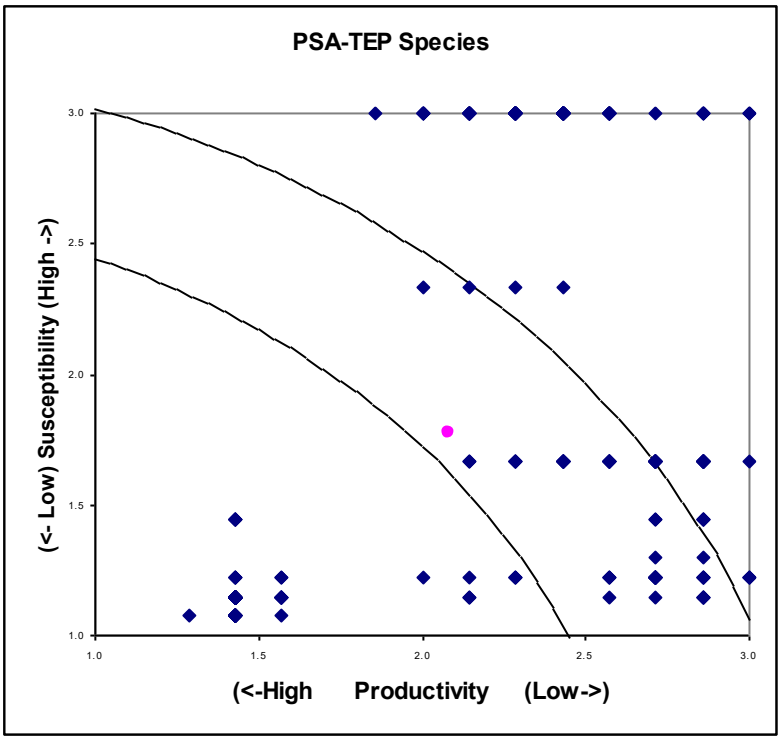
PSA plot for byproduct species



PSA plot for discards/bycatch species



PSA plot for TEP species



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)**.

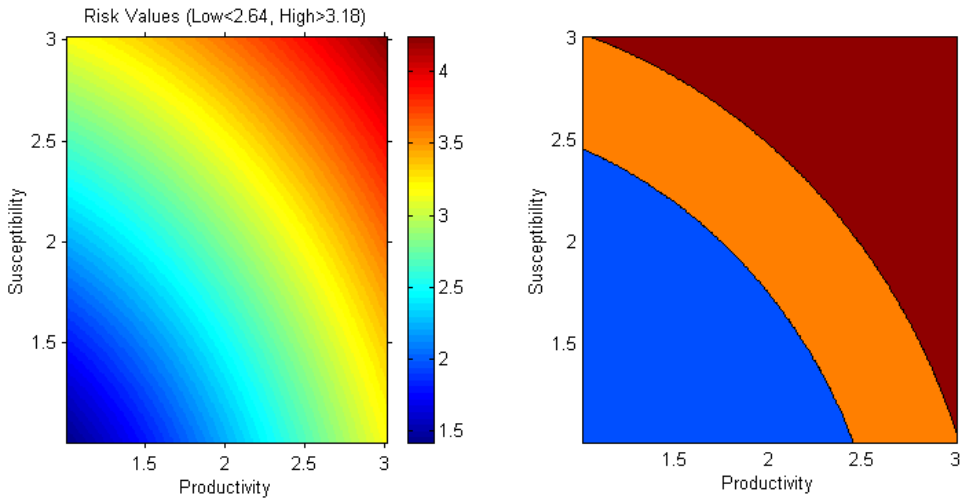


Figure 17. Overall risk values in the PSA plot. Left panel. Colour map of the distribution of the euclidean overall risk values. Right panel. The PSA plot contoured to show the low (blue) risk, medium (orange) risk and high (red) risk values.

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 to 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.

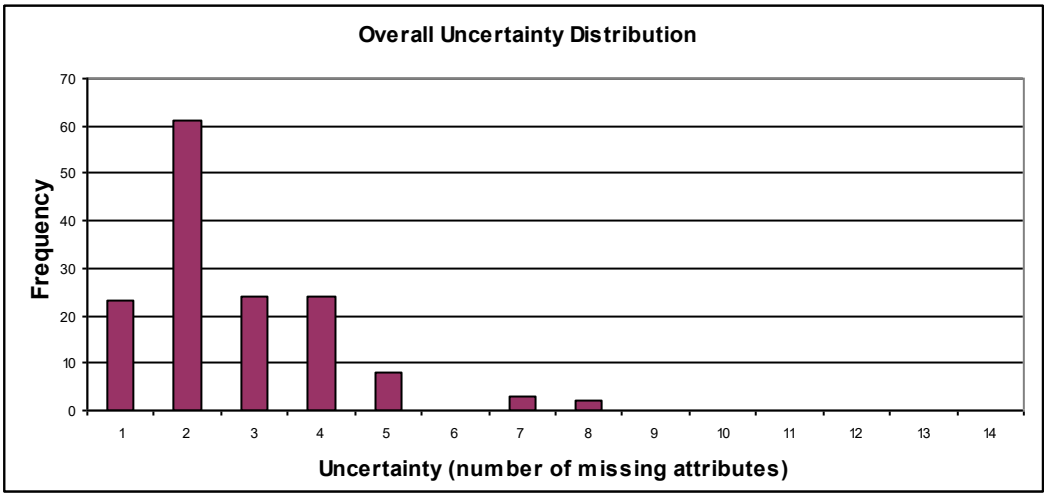
<u>Availability of information</u>
The ability to score each species based on information on each attribute [varied/did not vary] between the attributes (as per summary below). With regard to the productivity attributes, [least known productivity attribute] was missing in [X]% of [units], and so the most conservative score was used, while information on [best known productivity attribute] could be found or calculated for [Y% of units]. 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 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	274	256	297	314	314	257	184
n species scores with attribute unknown, (conservative score used)	46	64	23	6	6	63	136
% unknown information	14	20	7	2	2	20	43
Susceptibility Attributes	Availability	Encounter ability		Selectivity	PCM		
		Bathymetry overlap	Habitat				
Total species scores for attribute							
n species scores with attribute unknown, (conservative score used)							
% unknown information							

Each species considered in the analysis had information for an average of 6.1, (87%) productivity attributes and [C (D%)] susceptibility attributes. This meant that, on average, conservative scores were used for less than [E%] of the attributes for a single species. [Units] had missing information for between [F and G] of the combined [H] productivity and susceptibility attributes.

Results Overall uncertainty distribution in PSA workbook ranking graphs worksheet



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

Habitats:
Not examined

Correlation between attributes

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 fecundity and reproductive strategy. 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 generally 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 selectivity, 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	0.69	X					
Fecundity	0.54	0.76	X				
Max size	0.34	0.47	0.30	X			
Min size at maturity	0.47	0.68	0.55	0.84	X		
Reproductive strategy	0.52	0.77	0.93	0.32	0.57	X	
Trophic level	0.56	0.84	0.66	0.47	0.65	0.69	X

Correlation matrix for the four species susceptibility aspects. 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	0.52	X		
Selectivity	0.45	0.59	X	
Post-capture mortality	#DIV/0!	#DIV/0!	#DIV/0!	X

Habitat Component:

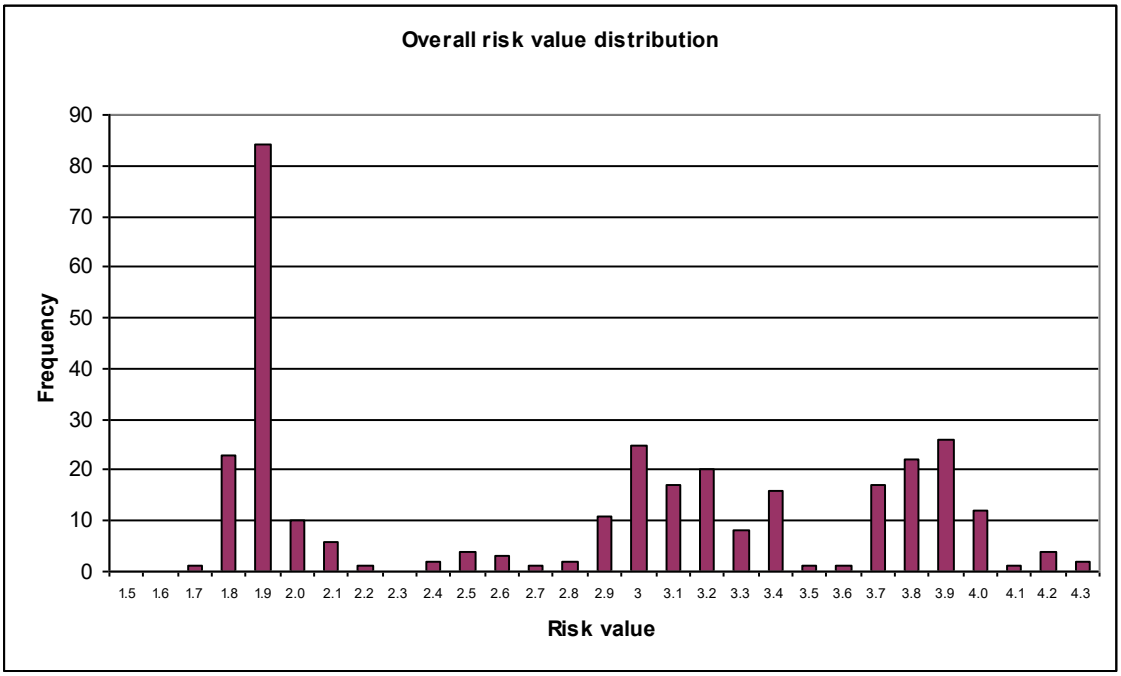
Not examined

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 [X], with a range of [Y – Z]**.** The actual values for each species are shown in *Summary of PSA results* (above). A total of [A units, (B%)] were classed as high risk, [B (C%)] were in the medium risk category, and [D (E%)] as low risk**.**

Results: Frequency distribution of the overall PSA risk values

Frequency distribution of the overall risk values generated for the [X units] in the [fishery sub-fishery] PSA.

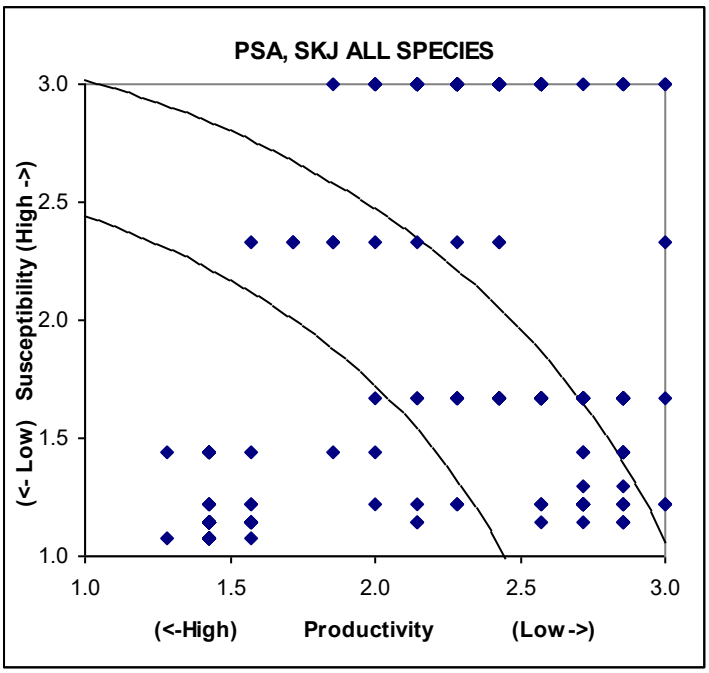


Overall Risk Values for Habitats
Not examined

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

Results Plot for all species in the sub-fishery PSA risk values

PSA plot for all units examined (Excludes target and bait species) in the SKJ fishery sub-fishery. Species in the upper right of the plot are at highest risk.



The number of attributes with missing information is of particular interest, because the conservative scoring means these units may be scored at higher risk than if all the information was known. This relationship between the overall risk score and the number of missing attributes shows that an increase in the number of missing attributes (and hence conservative scores used) results in a skew to higher risk values. This suggests that as information becomes available on those attributes, the risk values may decline for some units.

2.4.6 Evaluation of the PSA results (Step 6)

Species Components:
The PSA analysis of the Skipjack Tuna sub-fishery was presented to a Stakeholder/ Management meeting in Canberra on 15 November 2005. The PSA methodology has since been reviewed and revised. The following results reflect the revised methodology (as at 10 April 2006 see appendix B table L2.1).

Overall
Of the 320 species assessed at Level 2 using the PSA analysis, expert/observer over-rides were used on 12 species. A total of 124 species were found to be at high risk. Of these, 31 species had more than 3 missing attributes.

For most species there was little missing data. The average number of missing attributes was 1.2 out of a possible 12. The distribution of scores was somewhat skewed toward high and low. Most of the high risk species were birds (85) and mammals (25). The number of high risk scores would probably be reduced with observer data.

Results:

Summary of average productivity, susceptibility and overall risk scores.

Component	Measure	
All species	Number of species	320
	Average of productivity total	2.1
	Average of susceptibility total	1.8
	Average of overall risk value (2D)	2.8
	Average number of missing attributes	1.2
Byproduct species	Number of species	6
	Average of productivity total	1.7
	Average of susceptibility total	1.9
	Average of overall risk value (2D)	2.6
	Average number of missing attributes	0.0
Bycatch species	Number of species	10
	Average of productivity total	2.1
	Average of susceptibility total	1.9
	Average of overall risk value (2D)	2.9
	Average number of missing attributes	0.0
TEP species	Number of species	304
	Average of productivity total	2.08
	Average of susceptibility total	1.78
	Average of overall risk value (2D)	2.78
	Average number of missing attributes	1.28

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

Risk category	High	Medium	Low	Total
Byproduct species		3	3	6
Bycatch species	3	4	3	10
TEP species	121	54	129	304
Total	124	61	135	320

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

Risk category	High	Medium	Low	Total
Chondrichthyan	5	3		8
Marine bird	85	4		89
Marine mammal	25	26	1	52
Marine reptile	9	23	3	35
Teleost		5	131	136
Total	124	61	135	320

Discussion of species results

Target species
Not examined

Byproduct species

Of the 6 byproduct species, 0 were classified as high risk, 3 as medium risk and 3 as low risk. There were no missing attributes for byproduct indicating results for this component are likely to be reliable. All byproduct species examined for the SKJ fishery (tunas and dolphin fish) are pelagic species that are widely distributed outside the current range of effort.

Bycatch species

Of the 10 bycatch species, 3 are classified as high risk, 4 as medium risk and 3 as low risk. There were no missing attributes for bycatch species, but there is some uncertainty in the availability (susceptibility) scores for the 3 high risk species, which were all chondrichthyans.

The three high risk species were the short finned mako, the porbeagle shark and the dusky shark (bronze whaler group). Anecdotal evidence suggests that these species are only caught in small numbers in the fishery. Two species are mainly out of range of the fishery. Only 0.1% of the range of the porbeagle is fished, similarly the blue shark is a cosmopolitan species. It is likely that the risk scores for these two species at least will be reduced when corroborating evidence is provided from forthcoming observer programs or other independent field observations. However, the dusky shark is a concern at this stage. Recent assessments suggest that the dusky shark is fished to the limit of sustainability in targeted fisheries and even a small amount of additional mortality (3%) could be unsustainable. (McAuley 2005)

TEP species

Chondrichthyans

Three TEP chondrichthyans were considered. Two were evaluated as high risk (white shark, grey nurse shark) and one species medium risk (whale sharks). The whale shark is a plankton feeder that is unlikely to be attracted to chum bait. The white shark occurs widely outside the fishery and the distribution of effort in the SKJ fishery only covers 0.1% of the range of the white shark. Even though this species is listed as vulnerable on the EPBC list it is unlikely that the SKJ fishery poses a significant threat. The grey nurse has an endemic population within the range of the fishery and is listed as Endangered. There are no records of grey nurse captures in SKJ logbooks, but this needs to be validated with observer data.

Marine Birds

Of the 89 species of marine birds considered, 85 were evaluated as high risk. The only species of birds that were not scored high risk were out of range of recent effort in the target fishery. These four medium risk bird species were tropical, sub-Antarctic or inner shelf only. In other fisheries with observer data, the number of high risk bird species was much lower e.g. GABT (0), SPF-Midwater (3). It seems intuitive that the risk posed by purse seine gear for birds is negligible compared to other gears, because there are neither warp wires nor hooks to capture the baits. However, birds may scavenge chum/bait which could attract them to the vicinity of the net.

Marine mammals
Of the 52 species of marine mammals examined, 25 were evaluated as high risk, 26 medium and 1 low. The high risk species were mainly dolphins and beaked whales as well as the Australian fur-seal. The Australian fur-seal has had a level three assessment which suggests the population, which breeds in Bass Strait, is in a healthy state. The other dolphins and beaked whales probably need further consideration. A number of dolphins have been captured in purse seine fisheries in SA waters. The medium risk species included beaked whales, dolphins and seals that are out of range of the recent effort in the fishery, as well as baleen whales which are not attracted to chum bait. The low risk marine mammal (dusky dolphin) is mainly restricted to the inner-shelf.

Marine Reptiles
This fishery appears to pose little risk for marine reptiles. Of the 35 species considered, 9 were evaluated as high risk. However these species have poorly known distributions and 4 – 8 missing attributes.

Teleosts
A total of 124 species of sygnathids (seahorses and pipefishes) and one species of weedfish were considered. All are restricted to the inner shelf (<110 m) which is inshore or most of the recent targeted effort for skipjack and all were evaluated as low risk.

Habitat Component:
Not evaluated at level 2

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 be further examined 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.

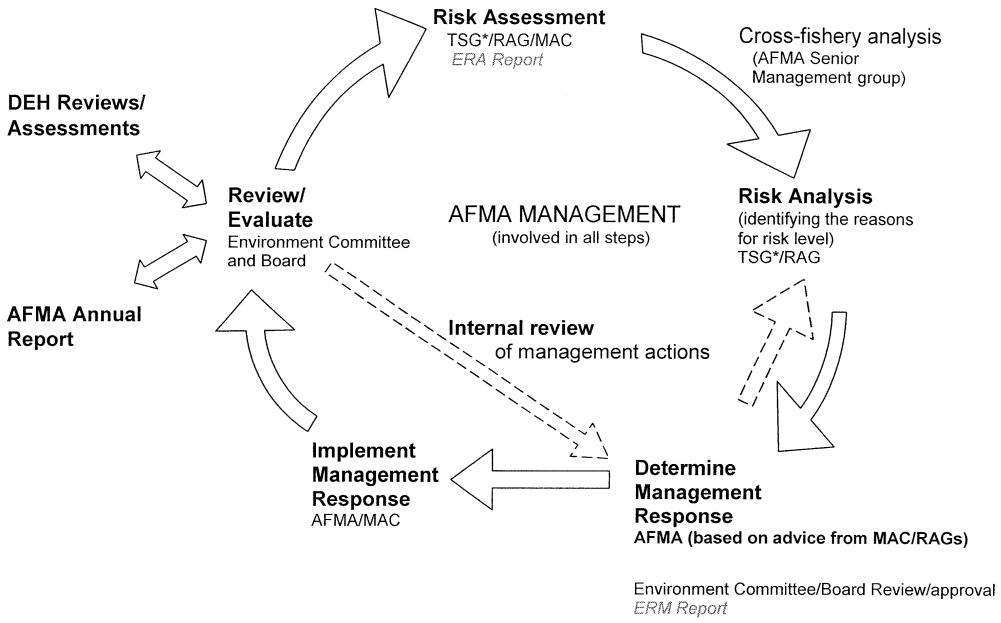
The output from the Level 2 analysis will result in four options:

- The risk of fishing on 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 fishing on 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 fishing on 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 fishing on 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 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



*TSG – Technical Support Group - currently provided by CSIRO.

2.4.8 High/Medium risk categorisation (Step 8)

Following the Level 2 PSA scoring of target, bycatch and byproduct, and TEP species, the high and medium risk species have been divided into five categories that highlight potential reasons for the higher risk scores. These categories should also help identify areas of uncertainty and assist decisions regarding possible management responses for these species. The categories are independent 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 more than 3 missing attributes (out of 12 possible) could lead to a change in risk score if the information became known. This is because where information is missing for an attribute, that attribute is automatically scored as high risk. The choice of 3 attributes was identified using sensitivity analysis.
- **Category 2**: **Spatial overlap**
    - **2A. Widely distributed** *(More than 80% of the full range of a species is outside the jurisdictional boundary of the fishery)*. Rationale: These species may have refuge outside the fishery.
    - **2B. Low overlap** *(<20% overlap between effort and the species distribution inside the fishery).* 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 to decide on cutoffs may be misplaced if the categories are just used as a guide. A similar analysis could be undertaken for the encounterability and selectivity attributes, but there is more information available for availability (overlap) for most species and overlap may be more informative about risk. A subtle change in fishing practice could modify encounterability or selectivity, while to change availability requires a major change in fleet location, which will be easier to detect.
- **Category 3**: **Low (susceptibility) attribute score** (*One of the susceptibility attribute scores = 1).* Rationale: These species may be scored high risk based on productivity risk alone, even if their susceptibility is very low.
- **Category 4**: **Spatial uncertainty** (*No detailed distributional data available*) Availability was calculated using less reliable mapping data or distributional categories: 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 Other**: *risk score not affected by 1-4 considered above*

Categorisation results - High risk species

Detailed species by species results of the categorisation are presented for medium and high risk species in the Tables in section 2.4.2 of this report. The following is a brief summary of the results for species classified as high risk from the PSA analyses.

Of the 124 species classified as high risk in the SKJ fishery, 31 had missing data (Category 1), 2 are widely distributed outside the fishery (Category 2A), and 2 had low overlap inside the fishery (Category 2B). There were no Other high risk species.

Risk Category	Description	Total
Category 1	High risk - Missing data	31
Category 2A	High risk - Widely distributed outside fishery	2
Category 2B	High risk - Low overlap inside fishery	2
Category 3	High risk – One susceptibility attribute scored low	23
Category 4	High risk - Spatial uncertainty	66
Category 5	High risk - Other	0
	Total High risk	124

It is important to stress that this categorization does not imply a down-grading of risk. It is intended as a tool to focus subsequent discussions on risk treatment and identify needs for further data. 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 further consideration of the high risk species. These categories may also indicate the presence of false positives in the high risk species category, but only further analysis or data can determine this.

2.5 Level 3

Target
The target species is to be managed by output controls, but given that Australia's proportion of the International catch is so small there seems to be very little information to base Australia's Total Allowable Catch on.

Byproduct/ bycatch
Dusky sharks may be over-fished (McAuley, 2005).

TEP
Interaction between purse seine gear and dolphins are well documented for overseas and SA State fisheries. There are no yield estimates to establish a sustainable harvest rate for dolphins in Australian fisheries. Trigger limits and observer coverage are in place for dolphins in the SPF – MWT sub-fishery.

3. General discussion and research implications

The fishery uses purse seine gear to target surface schools of skipjack tuna from the outer shelf out to potentially the open ocean. The fishing method is probably highly species specific with minimal bycatch but there is no supporting data from observer programs to verify the bycatch or level of TEP interactions. Observer coverage is recommended as means to address these uncertainties. However, there're was only a small amount of effort around Eden in the fishery in 2004 and none in 2005. There are plans to implement observer coverage when effort increases.

3.1 Level 1

The target species component was eliminated from consideration after Level 1. The scale of Australia impact on the WCPO stock is four orders of magnitude smaller than the international catch from the same stock.

Habitats were eliminated at the end of level 1 because the gear does not come into contact with the benthos.

Communities were eliminated at the end of level 1 because the impact of Australian vessels on the target species is minor and there is no impact on habitats. Internationally, the large skipjack catch is likely to impact on communities, but mainly outside the EEZ.

There was uncertainty regarding the level of capture and interactions with TEP species and bycatch species. In the absence of observer data, these components could not be eliminated, based on the precautionary principle.

Section about residual risk for species to go here

3.2 Level 2

The level one analysis suggested large TEP species and some discard species could be at risk if, they are in fact captured in the fishery. In international and SA State purse seine fisheries, concerns are greatest for dolphins.

3.2.1 Species at risk

Of the list of species rated as high risk from the PSA analyses, the authors consider that 2 species needs further evaluation or cumulative impacts and the impacts on birds and mammals need to be re-evaluated as soon as observer data is available. This judgment is based on taxonomy/identification, distribution, stock structure, movements, conservation status and overlap with this/other fisheries as discussed below

Species	*Risk Category*	*Role*
Chondrychthians		
• Dusky shark	* Widely distributed	Bycatch
Marine Mammals		
• Dolphins (various species)	* Low attribute score (very low productivity)	TEP

Byproduct species were eliminated at Level 2. These species were pelagic species (mainly tunas) caught in small numbers in the skipjack fishery and are widely distributed outside the fishery. These species have high fecundity

Among the bycatch species, three species of shark scored high risk. Of these, two species are probably false positives (rarely caught). The remaining species, the dusky shark, is of concern in a number of Commonwealth, State and co-managed fisheries.

Within the TEP Component, the level two analysis eliminated the seahorses and pipefishes from further consideration, because these species occur in waters much shallower than where skipjack are normally targeted. Among the marine birds and mammals, it was difficult to eliminate species without observer data to check which species are actually caught. Dolphins are of greatest concerns in other purse-seine fisheries.

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

None at risk. Eliminated at end of 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.

The key uncertainty in this fishery is that the number of interactions with dolphins and sharks is unverified.

Research needs

General recommendations for research and monitoring

- That AFMA collect independent observer data from Australian purse seine operations for skipjack tuna. This is needed in addition to purse seine observer data for southern bluefin tuna because the operations differ fundamentally in their potential impacts on dolphins and sharks. The SBT is not a ‘crush fishery’ that is the catch are transferred to holding pens. In the SKJ, the catch is brailed out of the seine net and air breathing mammals could be suffocated

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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

Date	Format received	Comment from stakeholder	Action/explanation
Sept 28 2006	Written comments from AFMA	No comments regarding Skipjack Tuna Fishery	None required

Appendix B: PSA results summary of stakeholder discussions

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

The following comments were provided at the SKJ meeting in Canberra 15 November 2005.

Common name	Comments from meeting, and follow-up	Actions	Outcome
	Methodology: Need to determine what the boundaries for the assessment is – AFMA manages the skipjack on the high seas. Will have some impact on the habitat and community analysis if extending outside the AFZ.	AFZ. Target species to be managed on high seas by international agreements. AFMA remains responsible for other living resources in the AFZ Includes habitats and communities?	Only consider impacts on species, communities and habits in the AFZ
	Methodology: With pelagic species – need to confirm what the boundaries of the stock are – the fish in the AFZ only or the total stock/population of the species being fished. Needs to be standardised across all pelagic fishery ERAs.	AFZ. Even if pelagic species are managed by international agreements, AFMA remain responsible for other living resources in the AFZ, that are impacted by fisheries. See above	Makes no difference to availability scores for migratory cosmopolitan pelagic tunas anyway. No mapping for these Availability= low.(worldwide)
Skipjack	**Scoping** Fishing is not restricted to around Eden and Port Lincoln – while these are the core areas of fishing, effort has occurred as far up the East Coast as Coffs Harbour and down around Hobart.	Modify General Fishery Characteristics	modified
Skipjack	**Scoping** Fishery is a fully international fishery – there is no stand alone Australian stock of skipjack. It is influenced by international stocks and recruitment.	Modify General Fishery Characteristics	modified
Skipjack	**Scoping** Fishery extends onto the high seas, AFMA's jurisdictional boundary.	Modify General Fishery Characteristics	modified
	Scoping Bait Collection does occur in	1. Modify General Fishery Characteristics	Bait is collected in a dinghy

Common name	Comments from meeting, and follow-up	Actions	Outcome
	Commonwealth waters under the skipjack entitlement. Bait collection is permitted in the western zone of the fishery but in practice most bait collection occurs in state waters i.e. an external activity	Bait collection Hazard is still present (scores 1 in Hazard ID). Permitted as an internal activity (Andrew Townley) 2. Change rationale in Hazard ID	which is not feasible offshore. State waters only – external activity
	Scoping (see also Level 1) No use of imported baits – all chum is live and caught locally	1. Modify scoping 2. Review worst case scenario for translocation of disease.	Change scenario
	Scoping (also Level 2) The assessment should be based on a much higher catch as there is an expectation that effort will increase next year. This increase could be on the scale of a 10 fold increase in catch (ie based on a catch of 10,000 tonnes). (BRIAN JEFFERIES)	The protocol is to base the ERA on 2001-2004 effort figures. We can not base a Level 2 PSA assessment on projected effort because we could not predict where that effort will be. The Fishery ERA report should be reviewed if there is a 50% increase in effort. This is detailed in the assessment and consistent across all fisheries The fishery failed in summer 06. and effort fell further. 1. Note possible causes of failure in scoping. Note 06 effort and catch in scoping.	Modified documentation. No changes to risk scores
	Scoping (and level 1) There has been a significant reduction in effort since 2003. The fishing season is shorter than documented: less than 100 days per year temporal scale 3. Although there is the expectation that effort will increase (up to 10 fold) in the next year or so and therefore the season may possibly go over 100 days per year.	1. Note in scoping 2. Modify temporal scales in Level 1	Modified documentation. No changes to risk scores
	Scoping SBT – quota needs to be held to land SBT in the skipjack fishery.	1. Note in scoping	Updated scoping
	Scoping Limits on sharks and marlin for the old	1. Note in scoping	Updated scoping

Common name	Comments from meeting, and follow-up	Actions	Outcome
	ETBF/WTBF apply to the new skipjack fishery		
	Scoping Old limits on dolphin fish and frigate mackerel do not apply.	1. Note in scoping	Updated scoping
	Scoping Australia will be a partner in the WCPO Agreement, major player through chairing the RFMO.	1. Note in scoping	Updated scoping
	Scoping VMS only mandatory outside the AFZ	1. Note in regulations/scoping	Updated scoping
Dusky shark	**Scoping – species list** Dusky shark – industry don't believe it is caught or interacted with. Expect it is a mis-identification – possibly with bronze whalers as a number are caught. Need to review where the species is included from – how did it get on the list?	They are the same species with different common names. 'Bronze whaler' is a collective term for at least two species of 'whaler' sharks caught in purse seine fisheries: The dusky shark (Carcharhinus obscurus) occurs on the inner and outer shelf from out to 400 m. The true bronze whaler (*C. brachyurus*) only occurs on the inner shelf out to 100 m , too shallow for the SKJ fishery but caught in state fisheries. The only way to check would be too look at the teeth (serrated in dusky shark, smooth and hook shaped in the bronze whaler). In practice this is not possible without killing the shark or the **scientist**. 1. Add source for dusky shark in scoping Denis Brown (as'bronze whaler') 2. Explain common name confusion in level 2 Evaluation	Add source for species in scoping Comments added to Level 2 documentation
	Scoping (Species list) Redbait – should not be included in the assessment. Redbait is a deepwater species	1. Remove from assessment. Not recorded in logbook data.	Deleted
Frigate mackerel	**Scoping (level 2)** Frigate mackerel – is a byproduct – not a discard	1. Change role in fishery	Change role in fishery

Common name	Comments from meeting, and follow-up	Actions	Outcome
Broadbill swordfish	**Scoping (level 2)** Broadbill swordfish – is a byproduct – if it is caught it is retained.	1. Change role in scoping and PSA	Change role in fishery
Anchovy	**Scoping (level 2)** Anchovy – principal bait species – needs inclusion. May be an issue of a number of anchovy species being caught but will be recorded in logbooks as Anchovy.	1. add to species list	Extra species added
	Scoping (level 2) Tommy rough – possibly should not be as a target bait species – are not targeted and may be better as byproduct/bycatch.	1. Change role in scoping and PSA	Change role in fishery
	Hazard ID: Chemical pollution – should scored 1 – oil leaking in the bilge etc.	**1. Review consequence score in Level 1**	**Reduced consequence score in Level 1**
	Hazard ID: Other fisheries – need to check if skipjack caught as byproduct in the SBT fishery is assessed in the SBT ERA or if it needs to be in this ERA.	**1. Include in the ERA as external impact**	**considered at level 1**
	Hazard ID: Other extractive activities – should be 1 – species aggregate around rigs etc	**1. Modify hazard ID and Level 1.**	**considered at level 1**
	Hazard ID: Other Non-extractive activities – should be 1 – FADs and other similar devices (not used in fishery by may be present)	**1. Modify hazard ID and Level 1.**	**considered at level 1**
	Hazard ID: Coastal Development – should be 1 – coastal runoff drives pelagic systems. Should also refer to waste water treatment and disposal.	**1. Modify hazard ID and Level 1.**	**considered at level 1**
	Hazard ID: All hazard ID rationale needs tidying – 'needs monitoring' and 'impacts from skipjack unknown' are mentioned in a couple of spots and could apply to all. Remove it.	**1. modify rationale in level 1**	**Modified level 1**
	Hazard ID: Although some of the changes to scores discussed may or may not change the consequence scores or affect which components go through to level two, industry were keen to see rationale documented carefully as the ERA	**1. modify rationale in level 1**	**Modified level 1**

Common name	Comments from meeting, and follow-up	Actions	Outcome
	reports will be widely discussed in future.		
LEVEL 1.	**Level 1. Target species – Capture fishing** Meeting agreed it should be a '2' if using the broader WCP stock. (James Findlay). Eliminate Target at level1	Use AFZ. Still could be a reduced from a 3 to a 2 and would not require a level 2. Will get level 3 harvest strategy evaluation anyway (ministerial directive 05). Alternative worst case scenario is impact on other target (bait species) but they are mainly caught external to	Target species not required to go through to level 2
	Level 1 Bycatch impact of capture fishing: Tunas are probably not the worst case unit for this component if the boundaries of the stock for assessment are the stock range not just the AFZ. The dusky shark may be.	Change worse case scenario to dusky shark	
	Level 2 observer over-rides Industry would like to see PS observer data from other fisheries examined, to determine if this can be applied to the SKJ fishery. Particularly other Australian PS fisheries, the NZ fishery and the PS fisheries in the WCPO. James was uncomfortable about applying data from different geographic regions, particularly where the fishing operation may be undertaken differently to Australia and distances from land/ rookeries were very different to the Australian fishery.	None available for any purse sine fishery in Australia. The minister has directed the fishery to obtain observer data.	*Observer data to be incorporated in future ERA. In all likelihood the number of high risk species will be reduced*
	Level 2 TEP Try a bit harder to get better maps of birds – discussion with AAD bird experts would be beneficial.	Maps of foraging range only	

Appendix C: SICA consequence scores for ecological components

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 5%.	**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%.
Age/size/sex structure	**4. Age/size/sex structure** No	**4. Age/size/sex structure**	**4. Age/size/sex structure**	**4. Age/size/sex structure**	**4. Age/size/sex structure**	**4. Age/size/sex structure** Long-term

Sub-component	Score/level					
	1 Negligible	2 Minor	3 Moderate	4 Major	5 Severe	6 Intolerable
	detectable change in age/size/sex structure. Unlikely to be detectable against background variability for this population.	Possible detectable change in age/size/sex structure but minimal impact on population dynamics.	Impact on population dynamics at maximum sustainable level, long-term recruitment dynamics not adversely affected.	Long-term recruitment dynamics adversely affected. Time to recover to original structure up to 5 generations free from impact.	Long-term recruitment dynamics adversely affected. Time to recover to original structure up to 10 generations free from impact.	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 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	**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
		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 recruitment dynamics	**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	**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
			not adversely damaged.		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 is 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 number of spawning	**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
			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 on the scale of hours.	**6. Behaviour/ movement** Possible detectable change in behaviour/ movement but minimal impact on population dynamics. Time to return to	**6. Behaviour/ movement** Detectable change in behaviour/ movement with the potential for some impact on population dynamics. Time to return to	**6. Behaviour/ movement** Change in behaviour/ movement, impact adversely affecting population dynamics. Time to return to original behaviour/	**6. Behaviour/ movement** Change in behaviour/ movement. Impact adversely affecting population dynamics. Time to return to original behaviour/

Sub-component	Score/level					
	1 Negligible	2 Minor	3 Moderate	4 Major	5 Severe	6 Intolerable
			original behaviour/ movement on the scale of days to weeks	original behaviour/ movement on the scale of weeks to months	movement on the scale of months to years.	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 the scale of hours.	**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 recovery time of	**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 recovery time of days	**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 long-term survival	**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
		hours to days.	to weeks.		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 to centuries.

Sub-component	Score/level					
	1 Negligible	2 Minor	3 Moderate	4 Major	5 Severe	6 Intolerable
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 Interactions which	3. Distribution of the community Possible detectable	3. Distribution of the community Detectable change in	3. Distribution of the community Geographic range of	3. Distribution of the community Change in	3. Distribution of the community Change in

Sub-component	Score/level					
	1 Negligible	2 Minor	3 Moderate	4 Major	5 Severe	6 Intolerable
	affect the distribution of communities unlikely to be detectable against natural variation.	change in geographic range of communities but minimal impact on community dynamics change in geographic range up to 5 % of original.	geographic range of communities with some impact on community dynamics Change in geographic range up to 10 % of original.	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.	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.	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- & geochemical cycling	5. Bio- and geochemical cycles Only minor changes in relative abundance of other	5. Bio- and geochemical cycles Changes in relative abundance of other constituents leading	5. Bio- and geochemical cycles Changes in relative abundance of constituents leading to major changes to	5. Bio- and geochemical cycles Changes in relative abundance of constituents leading	5. Bio- and geochemical cycles Ecosystem function catastrophically altered as a result of

Sub-component	Score/level					
	1 Negligible	2 Minor	3 Moderate	4 Major	5 Severe	6 Intolerable
	unlikely to be detectable against natural variation.	constituents leading to minimal changes to bio- & geochemical cycling up to 5%.	to minimal changes to bio- & geochemical cycling, up to 10%.	bio- & geochemical cycling, up to 25%.	to Severe changes to bio- & geochemical cycling. Recovery period measured in years to decades.	community changes affecting bio- and geo- chemical cycles, total collapse of ecosystem processes. Recovery period measured in decades to centuries.