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Australian Fisheries Management Authority

Ecological Risk Assessment for Effects of Fishing

REPORT FOR THE SOUTHERN BLUEFIN TUNA PURSE SEINE SUB-FISHERY

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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 Southern Bluefin Tuna Purse Seine Fishery (wild capture and tow component) was undertaken using the ERAEF method (version 9.2). ERAEF stands for "Ecological Risk Assessment for Effect of Fishing", and was developed in a research program sponsored 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 fishing 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 based on results 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 report for the Southern Bluefin Tuna Purse Seine Fishery includes the following sections:

- Scoping
- Level 1 results for all components
- Level 2 results for two species components

Fishery Description

Gear:	Purse seine then transfer to tow cages of live fish
Area:	Currently concentrated on the shelf break in the eastern Great Australian Bight, to the point of transfer to growout cages at Port Lincoln
Depth range:	50 to 700m
Fleet size:	5-10 purse seine vessels, plus bait and tow boats
Effort:	Three month catch season
Landings:	~5,265 t in 2005
Discard rate:	Unknown, believed to be very low
Main target species:	Southern bluefin tuna
Management:	Quota management system
Observer program:	AFMA-run observer program on catch and tow vessels since summer of 2003/04.

Ecological Units Assessed

Target species:	1 and 10 bait species used in capture
Byproduct/bycatch species:	6 and 8 respectively
TEP species:	182 within fishery jurisdiction
Habitats:	209 benthic within fishery jurisdiction, 2 pelagic within current fishery area
Communities:	2 demersal, 2 pelagic within current fishery area

Level 1 Results

Two ecological components were eliminated at Level 1 (habitats and bycatch/byproduct species); there was at least one risk score of 3 – moderate – or above for three components.

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

- Fishing (direct and indirect impacts on 3 components, Target, TEP and communities)
- Translocation of species (impact on TEP species and communities)
- Discarding catch (impact on TEP species)
- Navigation and steaming (impact on communities)

Significant external hazards included other fisheries in the region, aquaculture, and other anthropogenic activities.

Risks rated as major (risk score of 4) were related to direct or indirect impacts from primary fishing operations, and the risk of impact to TEP species from translocation of species. There were no scenarios scored as severe (risk score of 5).

Impacts from fishing on target and TEP species components were assessed in more detail at Level 2. Community impacts should also be examined in future iterations; time was insufficient to complete this analysis following development of the ERAEF Level 2 community analysis.

Level 2 Results

Species
A total of 193 species in the target species and TEP species components were assessed at Level 2 using the PSA analysis. Of these, 2 were assessed to be at high risk, including the target species southern bluefin tuna, and one TEP species (white shark). The remaining species were at medium or low risk. Of the 193 species assessed, expert over rides were used on 180 species. Of the 2 species assessed to be at high risk, none had more than 3 missing attributes.

The population status of southern bluefin tuna is agreed to be at 10% or less of the 1960 level; debate about the possibility of recruitment failure or stock collapse at the current level of harvest occurs within the CCSBT meetings. The current level of fishing (in total, including domestic and international fisheries) may be too high to allow recovery to the 1980's level, as specified in the international management plan. In the context of this assessment, identifying SBT as a high risk species at Level 2 means that assessment at Level 3 is recommended. A variety of Level 3 analyses occur at present, including a stock assessment, and so information to judge the risk in greater detail exists.

The targeted nature of the fishery, the depth at which it is conducted, and the fact that the catch is not crushed during harvest (fish are transferred live and in water to tow cages), minimizes risk of capture of non-target species, and those that might be captured, have the opportunity for escape or release. Interactions with white sharks have been reported, and releasing this species alive is challenging both logistically, and from an employee health and safety perspective. The status of white sharks is uncertain, and any incidental mortality is considered a risk at this time. Various operational strategies employed by industry – such as feeding/discarding practices on the tow boats – are advocated by industry as effective in minimizing the risk of interactions occurring, and that they suggest that interactions that do occur result in minimal or zero white shark mortality.

Habitats
The habitat component did not require assessment at Level 2 for the SBT purse seine fishery.

Communities
The community component could not yet be assessed at Level 2 for the SBT purse seine fishery, but should be considered in future assessments when the methods to do this are fully developed.

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.

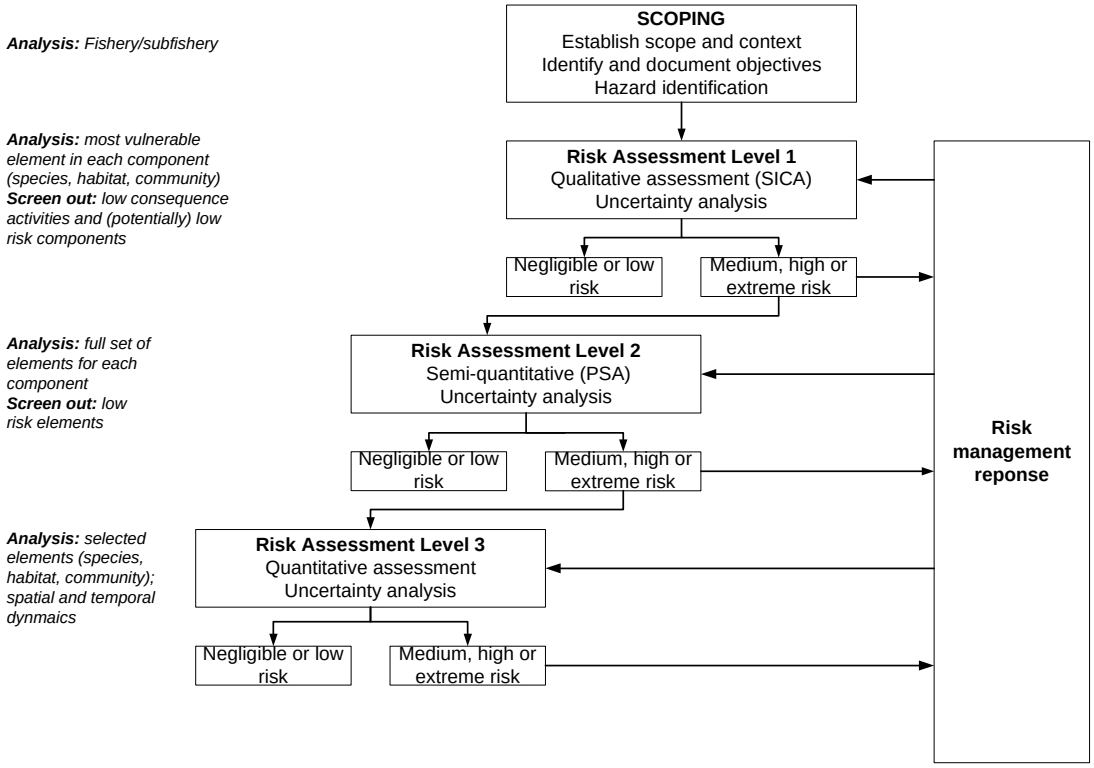


Figure 1. Overview of ERAEF showing focus of analysis for each level at the left in italics.

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.

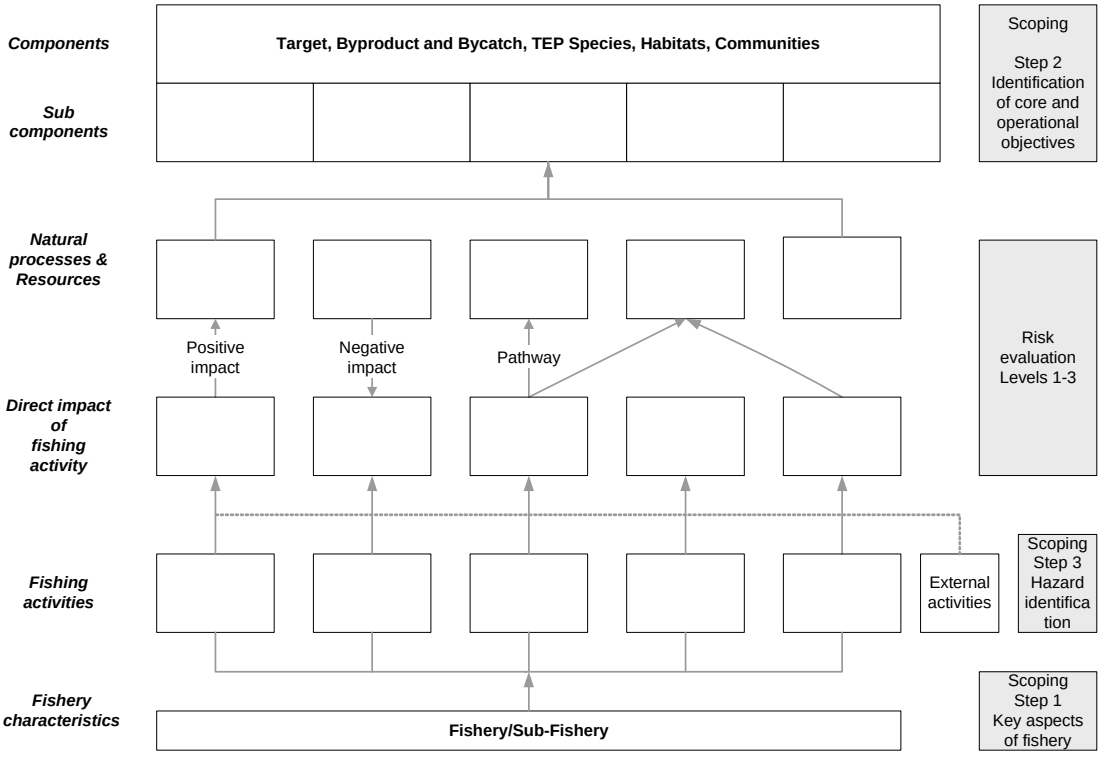


Figure 2. Generic conceptual model used in ERAEF.

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 Documents S2A, S2B and S2C).
2. Selection of objectives (Section 2.2.3; Scoping Document S3) is a challenging part of the assessment, because these are often poorly defined, particularly with regard to the habitat and communities components. Stakeholder involvement is necessary to agree on the set of objectives that the risks will be evaluated against. A set of preliminary objectives relevant to the sub-components is selected by the drafting authors, and then presented to the stakeholders for modification. An agreed set of objectives is then used in the Level 1 SICA analysis. The agreement of the fishery management advisory body (e.g. the MAC, which contains representatives from industry, management, science, policy and conservation) is considered to represent agreement by the stakeholders at large.
3. Selection of activities (hazards) (Section 2.2.4; Scoping Document S4) that occur in the sub-fishery is made using a checklist of potential activities provided. The checklist was developed following extensive review, and allows repeatability between fisheries. Additional activities raised by the stakeholders

can be included in this checklist (and would feed back into the original checklist). The background information and consultation with the stakeholders is used to finalize the set of activities. Many activities will be self-evident (e.g. fishing, which obviously occurs), but for others, expert or anecdotal evidence may be required.

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

The SICA analysis evaluates the risk to ecological components resulting from the stakeholder-agreed set of activities. Evaluation of the temporal and spatial scale, intensity, sub-component, unit of analysis, and credible scenario (consequence for a sub-component) can be undertaken in a workshop situation, or prepared ahead by the draft fishery ERA report author and debated at the stakeholder meeting. Because of the number of activities (up to 26) in each of five components (resulting in up to 130 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, and 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 high 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 addressing the requirements of the EPBC Act as evaluated by Department of the Environment and Heritage.

Subsequent risk assessment iterations for a fishery

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

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

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

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

2. Results

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

The results presented below are for the purse seine sub-fishery of the southern bluefin tuna fishery. This assessment covers the wild fishery and the tow operation, but not the grow-out phase of the industry.

2.1 Stakeholder Engagement

2.1 Summary Document SD1. Summary of stakeholder involvement for southern bluefin tuna purse seine sub-fishery.

ERA report stage	Type of stakeholder interaction	Date of stakeholder interaction	Composition of stakeholder group (names or roles)	Summary of outcome
Scoping	Phone calls and email	1. 24 Feb, 14 Mar 2003 2. 27 Mar 2003	1. A.Bodsworth AFMA SBT fishery manager 2. Bob Stanley AFMA observer manager	1. List of potential by-catch / by-product, and TEP species; Hazard Identification advice. 2. Brief summary of latest findings from observer program. Information considered sufficient to move to Level 1
	Meeting. Executive Officer of fishery distributed information ahead of time	April 29, 2003, Adelaide (see report for this meeting)	MAC	Feedback on activities, preferred objectives, and species habitats and community lists was provided. Agreed to develop more out of session
Level 1 (SICA)	Meeting	April 29, 2003 (see report for this meeting)	MAC	Agreed on the species list, debated the credible scenarios, and required explanation of the consequence scoring
	Draft report tabled at meeting by AFMA (Alice Fistr)	Tuesday 9 Sept, Canberra (see summary for this meeting)	MAC	Results of revised Level 1 presented to MAC
	Workshop	October 15, 2003, Port Lincoln	FAG	Discussed Level 1
Level 2 (PSA)	Workshop	October 15, 2003, Port Lincoln	FAG	Discussed Level 2, improvements to come in the completion of attribute data for the PSA
	Workshop	June 9-10, 2005,	FAG	Presented revised PSA, and

ERA report stage	Type of stakeholder interaction	Date of stakeholder interaction	Composition of stakeholder group (names or roles)	Summary of outcome
		Port Lincoln		overall ERA report results
Final report	Phone calls	May 2006	Fisheries managers	Observer protocols sent Detailed information held by AFMA, Bob Stanley agreed to send
Final report and all stages of analysis	Dedicated meeting	June 13, 2006. Port Lincoln	Workshop David Ellis (industry) Joe Puglisi (industry) Brian Jeffriess (industry) Mario Valcic (industry) Ryan Murphy (AFMA) Nicole Flint (AFMA) Tim Smith (AFMA) Tony Kingston (SBTMAC Executive Officer) Alistair Hobday (CSIRO)	Response/action discussed by stakeholders, MAC to consider recommendations, Tony Kingston prepared briefing paper.
Final report	Email and circulation by AFMA	July-August 2006	Various, coordinated by AFMA	General and specific comments on the draft (delivered May 30) considered and incorporated where appropriate.
Final report	MAC comments	July 2006	As for June 13 meeting	Comments from the MAC on the ERA on the white shark Level 2 PSA results (see Appendix B)
Final report	AFMA – coordinated comments	October 2006	Unknown	See Appendix A.

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

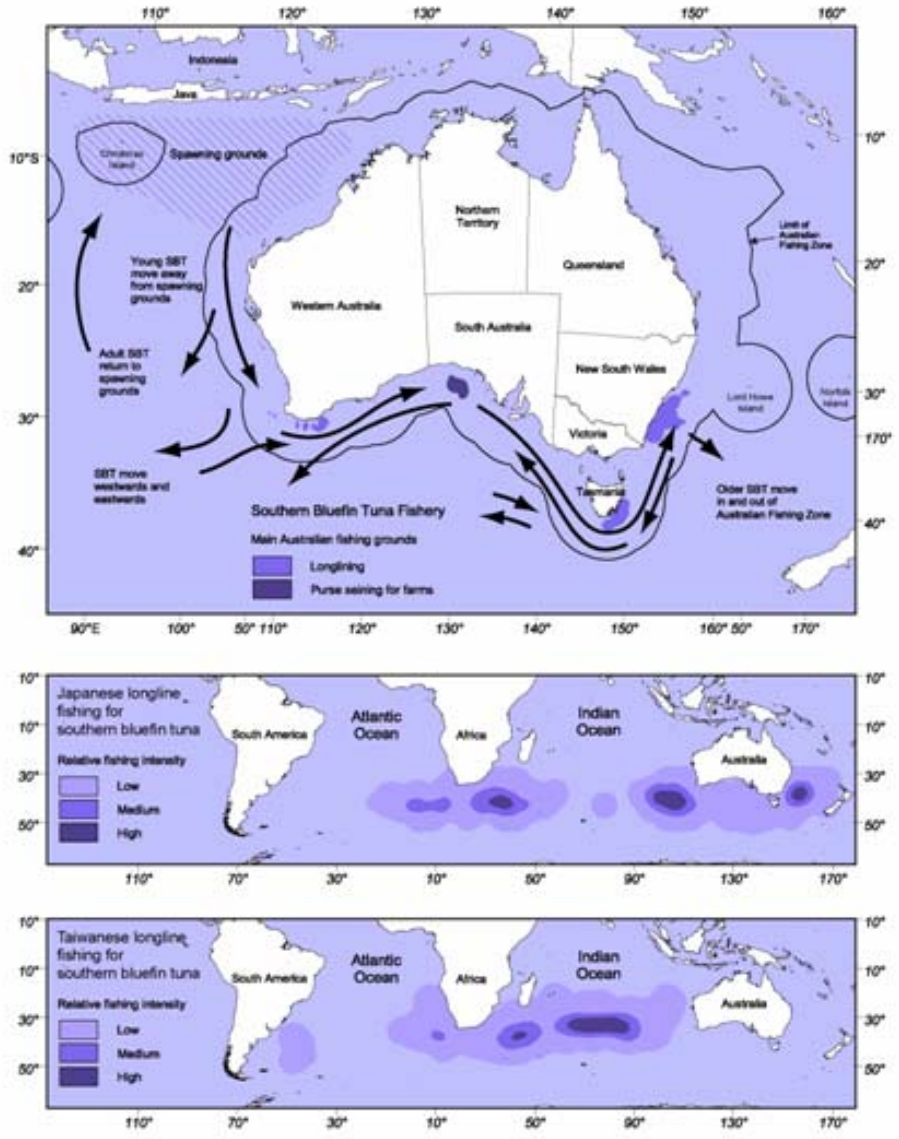
2.2.1 General Fishery Characteristics (Step 1).

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: Southern Bluefin Tuna Fishery
Date of assessment: initiated March 12, 2003, updated October 2005, May 2006
Assessor: Alistair Hobday

General Fishery Characteristics	
Fishery Name	Southern Bluefin Tuna Fishery
Sub-fisheries	*Identify sub-fisheries on the basis of fishing method/area.* The Australian component of the Southern Bluefin Tuna (SBT) fishery uses the purse seine method (currently 98.6% of quota capture), secondary is SBT taken as bycatch by longline in other Commonwealth fisheries.
Sub-fisheries assessed	*The sub-fisheries to be assessed on the basis of fishing method/area in this report.* This assessment will only consider the dominant purse seine sub-fishery as longline practices are covered under assessments of other Commonwealth fisheries e.g. the Eastern Tuna and Billfish Fishery (ETBF).
Start date/history	*Provide an indication of the length of time the fishery has been operating.* The Australian commercial fishery for SBT has changed dramatically over the years since trolling catches were first recorded off New South Wales and Tasmania in the 1930s (see **S1.1 table 1**). One of the key developments in the Australian fishery over the last decade has been the increasing significance of SBT purse seine fishing for the purpose of transferring live fish to static grow out cages (commenced 1990-91). The catch of SBT for farming purposes comes under Commonwealth jurisdiction while the farming operations are carried out in waters under South Australian jurisdiction. Therefore, this Ecological Risk Assessment of the Commonwealth fishery encompasses fish capture to the point of transfer to farm cages.

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.* SBT is a highly migratory species and is widely distributed throughout waters of the southern oceans between 30 and 50° south, including the Australian fishing zone (AFZ), but only rarely in the eastern Pacific**.** The purse seine fishery occurs in the Great Australian Bight (GAB) between approximately 130 to 137° E and 32 to 36° S.  Map depicting the general movement patterns of SBT and main Australian fishing grounds. Source: AFFA, 2001. Fishery Status Reports 2000. Bureau of Rural Sciences, Canberra, ACT.
Regions or Zones within the fishery	*Any regions or zones used within the fishery for management purposes and the reason for these zones if known* The Australian domestic fishery shares SBT stocks with Japan and New Zealand, either operating within national waters or on the high seas. The Commission of the CCSBT sets total allowable catch (TAC) and determines national allocations for its member countries. The national allocation may be taken anywhere.
Fishing season	*What time of year does fishing in each sub-fishery occur?* Purse seine fishing for SBT occurs from December to April in the GAB, although the quota year runs from 1 December to 30 November each year.

Target species and stock status	*Species targeted and where known stock status.* Southern bluefin tuna (*Thunnus maccoyii*) are estimated to be at less than 10% of the pre-fished (1960) biomass (CCSBT 2005). They are classified as overfished globally. A management strategy to guide the setting of global quotas and to pursue stock rebuilding is currently being finalised by Commission for the Conservation of SBT (CCSBT) members.
Bait Collection and usage	*Identify bait species and source of bait used in the sub-fishery. Describe methods of setting bait and trends in bait usage.* Bait fishing to support SBT operations occurs largely in coastal regions in the same area. The bait is used to attract schools of SBT to the capture boats. Bait is also purchased for use in capture and feeding fish during the tow back to grow-out cages.
Current entitlements	*The number of current entitlements in the fishery. Note latent entitlements. Licences/permits/boats and number active.* Number of Statutory Fishing Right (SRF) owners as at December 2003 was 112 (www.afma.gov.au, accessed May 28, 2006), with about 5-10 purse seine vessels active in any one year. Additional live bait, pontoon towing and feeding vessels are also involved (CCSBT 2002b).
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 recent quota levels in the fishery by fishing method (sub-fishery).In table form* The total SBT quota for the last five years (and since 1991) is capped in Australia. National catch allocations for member countries were determined and set by the CCSBT at its October 2004 meeting. Australia received a national allocation of 5,265 tonnes and AFMA subsequently set the Australian TAC at this level for the 2004-2005 season. Over 98% of that quota is taken in the purse seine sub-fishery.
Current and recent fishery effort trends by method	*The most recent estimate of effort levels in the fishery by fishing method (sub-fishery). Summary of the recent effort trends in the fishery by fishing method (sub-fishery). In table form* Purse seine vessels take 98.6% of the Australian SBT quota, with the remainder taken by longline as incidental catch by fishers operating in the Eastern Tuna and Billfishes Fishery (CCSBT 2002b). There are no management controls for effort. Effort has fluctuated widely as SBT fishing methods have changed. While catch per unit effort is easily obtained for longlining (e.g. catch per 1000 hooks), a surrogate of effort in purse seine fishing is currently not assessed. The overall effect of purse seine fishing has been to reduce the number of boats targeting SBT e.g. in the 2000-01 quota year 8 SBT purse seine vessel operated, however various support craft including live bait, pontoon-towing and feeding vessels were also involved. A summary of the development of the Australian SBT fishery is provided in **S1.1 table 1**.
Current and recent fishery catch trends by method	*The most recent estimate of catch levels in the fishery by fishing method (sub-fishery) (total and/or by target species). Summary of the recent catch trends in the fishery by fishing method (sub-fishery). In table form* Experimental farming commenced in 1991. The 1995-1996 quota year saw 3,320 mt caught by seining and transferred into farm cages for out growing, the trend continued with 95% of catch entering cages in 1999 (Young & Leary 1999). For the seasons 1999-2000 and 2000-2001 SBT caught for fish farms in South Australia, using purse seine vessels, utilize 98.6% of the Australian quota, with the remainder taken by longline. There were no SBT poled commercially off South Australia or trolled off Tasmania during either season (CCSBT 2002a). See the table below for breakdown of catch by state and fishing method for quota years 1988 to 2000.

Quota year	Western Australia			South Australia				New South Wales			Tasmania			Large longliners			Australia total				Total
	Albany Pole	Esperance Pole	total	pole & purse seine	Farm Cages	long-line	Total	pole & purse seine	Long-Line	Total	troll	long-Line	Total	Aust. charter	joint-venture	total	Domestic Surface	domestic long-line	total long-line	RTMP	All Gears
1988–89	204	221	425	4872	0	0	4872	0	1	1	2	0	2	0	684	684	5299	1	685	0	5986
1989–90	133	97	230	4199	0	0	4199	0	6	6	14	0	14	0	400	400	4443	6	406	0	4855
1990–91	175	45	220	2588	0	0	2588	0	15	15	57	0	57	255	881	1136	2865	15	1151	[1]300	4316
1991–92	17	0	17	1629	138	14	1781	34	90	124	36	20	56	59	2057	2116	1854	124	2240	800	4894
1992–93	0	0	0	716	722	68	1506	16	238	254	23	44	67	0	2735	2735	1477	350	3085	650	5212
1993–94	0	0	0	621	1294	55	1970	0	286	286	7	105	112	0	2299	2299	1922	446	2745	270	4937
1994–95	0	0	0	908	1954	2	2864	0	157	157	4	109	113	0	1295	1295	2866	268	1563	650	5081
1995–96	0	0	0	1447	3362	0	4809	28	89	117	0	262	262	0	0	0	4837	351	351	0	5188
1996–97	0	0	0	2000	2498	0	4497	7	229	236	2	242	244	0	0	0	4507	472	472	0	4979
1997–98	0	0	^0	916	3488	^0	4403	~0	475	475	!0	219	219	0	0	0	4433	664	664	0	5097
1998–99	0	0	^0	28	4991	^0	5018	~0	97	97	!0	116	116	0	0	0	5016	216	216	0	5232
1999–00[#]	0	0	^0	0	5130	13	5143	0	114	114	0	!0	!0	0	0	0	5130	127	127	0	5257
2000–01	0	0	^0	0	5162	6	5168	0	32	32	0	!0	!0	0	0	0	5162	38	38	0	5244

*Dates: 1 October to 30 September for 1988–89 to 1990–91; 1 October 1991 to 31 October 1992 for 1991–92; 1 November to 31 October for 1992–93 and 1993–94; 1 November 1994 to 15 December 1995 for 1994–95; 16 December 1995 to 15 December 1996 for 1995–96; and 16 December 1996 to 30 November 1997 for 1996–97; 1 December to 30 November for 1997–98; 1998–99; 1999–00 and 2000–01.

[1]Note that a further 700t of Australian quota was 'frozen' (not allocated) in 1990–91.

^ 1997–98 and 1998–99 WA and SA non-farm catches are included in SA pole and purse seine catch and in 1999–00 and 2000–01 WA longliner is included in SA longliner catch due to confidentiality guidelines.

~ 1997–98 to 1998–99 NSW pole and purse seine catches are included in NSW longline catch due to confidentiality guidelines.

! 1997–98 and 1998–99 Tas troll catches are included in Tas longline and in 1999–00 and 2000–01 Tas longline is included in NSW longline due to confidentiality guidelines.

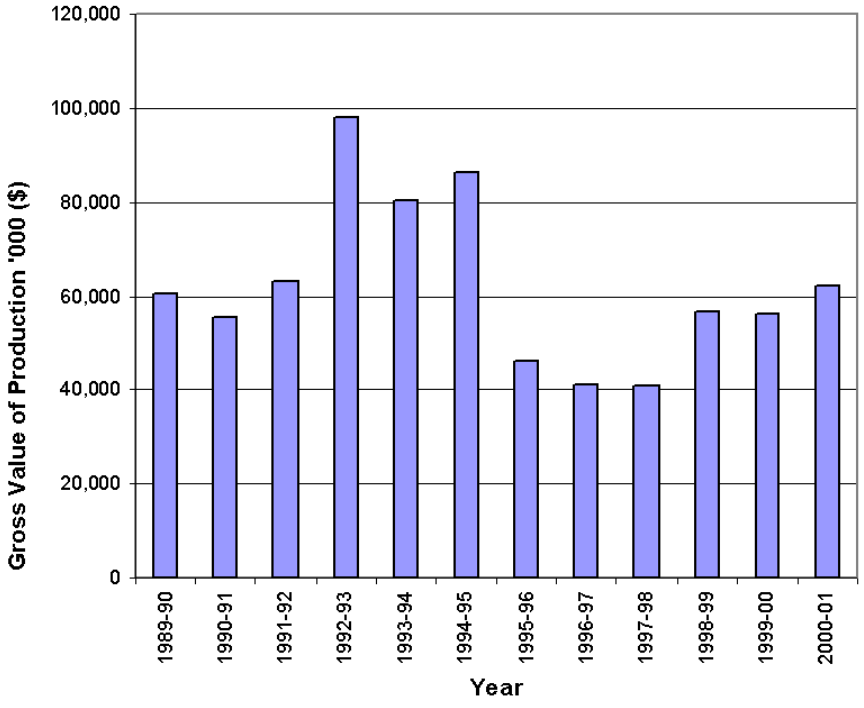
Table 1: Australian Catch by Gear and State for Quota Years 1988-89 to 2000-01

Since the early 1990's a TAC has restricted total world catch to near 15 600 mt: Australia 5131 mt; Japan 6027 mt; New Zealand 380 mt; Indonesia, Korea, Taiwan and others 4041 mt. There is an additional Australian scientific quota of 10 mt per season for 2005.

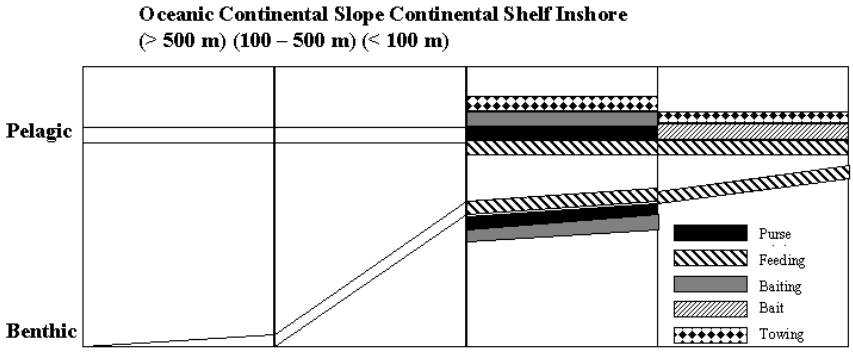
Current and recent value of fishery ($)

Note current and recent value trends by sub-fishery. In table form

The SBT Fishery is a valuable fishery to South Australia and Australia. The Australian Bureau of Agricultural and Resource Economics (ABARE) figures indicate an increase in the Gross Value of Production (GVP) over three years, culminating in an estimated 264 million dollars for the 2000/01 season, and an estimated $3 million of longline catch (ABARE, 2001). The figure below provides the Gross Value of SBT production for the past eleven years for the commonwealth component of the fishery (the wild-caught component excluding any value-adding requirements). This does not include the GVP that is derived from the aquaculture component of the fishery (farm sector).



Relationship with other fisheries	*Commercial and recreational, state, national and international fisheries List other fisheries operating in the same region any interactions* Management for the global SBT fishery is undertaken by Australia, Japan and New Zealand under the Convention for the Conservation of SBT. The convention establishes the Commission for the Conservation of SBT (CCSBT). The Commission sets a total allowable catch (TAC) and determines national allocations for its member countries. The Commission is also responsible for determining management measures and key strategies for the SBT Fishery at the international level (AFMA 2003aa). Catches of SBT by non-CCSBT signatories (e.g. Indonesia, Korea, and Taiwan) are now estimated to account for one third of the global catch of the species. Minor SBT quota is fished in the Eastern Tuna and Billfish Fishery (status variable) (Young & Leary, 1999) and SBT are also landed by recreational troll fishers in Australian waters. Fisheries that operate in the same region as the Southern Bluefin Tuna Fishery include the Commonwealth managed • Eastern Tuna and Billfish Fishery, • Southern and Western Tuna and Billfish Fishery, • Skipjack Tuna Fishery (previously part of the Tuna and Billfish Fisheries), • Small Pelagic, including the former Jack Mackerel Fishery and the State managed • Western Australian Pilchard Fishery • South Australian Pilchard Fishery. There are other fisheries that overlap the operational area of the SBT Fishery. However those mentioned above are principally related to the SBT fishery because they either catch SBT as a byproduct or catch SBT prey species. These prey species may then be used as feed in the SBT purse seine or grown out farms. **S1.1 table 2** below identifies the target species in each fishery, and the relationship with the SBT Fishery (AFMA 2002).
Gear	
Fishing gear and methods	*Description of the methods and gear in the fishery, average number days at sea per trip.* The Australian SBT fishery uses the purse seine method. The proximity of the Great Australian Bight (GAB) fishing grounds to Port Lincoln provides a unique opportunity for sea ranching of SBT. This process (cited from Smart & Clarke 1999) involves vessels fishing the GAB from December to April targeting schools of juvenile SBT (age 2 –5 years, 15 – 25 kg) with purse seine. The purse seine is a large net that is circled around a suitably sized school of SBT (attracted and aggregated by baiting). Rather than landing the fish, the fish are transferred from the purse seine through a net gate to specially designed towing pontoons. The towing pontoons hold 60 – 120 tonnes of SBT that are fed and are towed slowly (1-2 knots) for a period of ten to twenty days before reaching Port Lincoln with death of some fish reported to occur (CCSBT 2002a) (see target species issues). On arrival to Port Lincoln the SBT are transferred into grow out pontoons (farm cages) anchored to the ocean floor. The SBT are then fattened for several months and sold direct to Japanese markets as frozen or chilled fish. The method produces high quality fish, which attract premium prices (CCSBT 2003a). A portion of the catch is taken with the use of live bait. Bait collection for SBT fishing involves the setting of small purse seine or dip nets. Bait species are listed in scoping document S1.2.
Fishing gear restrictions	*Any restrictions on gear* None
Selectivity of gear and fishing methods	*Description of the selectivity of the sub-fishery methods* Purse seining is selective both by use and design. Aerial spotting from planes to locate SBT schools, accurate echo-sounders and knowledge of SBT behaviour allow skippers to specifically target SBT. 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 impact occurs as no contact is made with the substrate. Once enclosed in the net, the appropriate mesh size avoids fish being gilled and therefore damaged. The method is considered highly selective with few reported interactions with protected species, however there is no validated information on bycatch or byproduct species (AFMA 2002).
Spatial gear zone set	*Description where gear set i.e. continental shelf, shelf break, continental slope (range nautical miles from shore)* The present fishery (2001-2006) occurs along the shelf break of the Great Australia Bight, approximately 100 nautical miles from the shore.
Depth range gear set	*Depth range gear set at in metres* Purse-seine gear is set in waters deeper than 50 meters, as the gear extends from the surface to a depth of 50 meters. 
How gear set	*Description how set, pelagic in water column, benthic set (weighted) on seabed* The gear is active, in that it is set from a surface vessel, and surrounds a school of fish, before being closed. The fish are then transferred to a towing cage.
Area of gear impact per set or shot	*Description of area impacted by gear per set (square metres)* The water column is the only habitat impacted, and the area covered may be several square kilometres.
Capacity of gear	*Description number hooks per set, net size weight per trawl shot* The gear has the capacity to capture schools up to 50 tonnes in weight
Effort per annum all boats	*Description effort per annum of all boats in fishery by shots or sets and hooks, d for all boats* There is no measure of effort in this fishery.
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* There is little to no fishing gear loss in this fishery, but it might infrequently occur
Issues	
Target species issues	*List any issues, including biological information such as spawning season and spawning location, major uncertainties about biology* **Global population issues:** All recent assessments of the SBT population agree that the parental biomass is at a low level compared to the 1980 level which was adopted as the management target by the CCSBT. However, substantial uncertainty and disagreement exists about the probability of the SBT stock recovering while catches remain at their current levels (e.g. Davis 1998). Gaps in knowledge include a lack of exact catch rates (high bycatch of SBT by Indonesian and Taiwanese longline fisheries), natural mortality, recruitment levels and numbers of fish in areas that are not fished (i.e. there is a lack of fisheries independent data) (CSIRO 1999).

	Life history issues: The only known breeding area is in the Indian Ocean, south-east of Java, Indonesia. SBT can live for up to forty years, reach a weight of over 200 kilograms, and measure more than 2 metres in length. There is some uncertainty about the size and age when on average they become mature. This is the subject of current research by Commission members. The available data suggests that it is around 1.5 metres and no younger than age 8, recent research suggests that the age of maturity may in fact be closer to 12 years (Davis *et al* 2001). Mature females produce several million or more eggs in a single spawning period. Breeding takes place from September to April in warm waters south of Java. The young of the year migrate south down the west coast of Australia. During the summer months (December-April), juveniles are found in the coastal waters off the southern coast of Australia and spend their winters in deeper, temperate oceanic waters. After age 5, they are seldom found in near shore surface waters. As SBT breed in the one area (south of Java) and are morphologically similar wherever they are found, they are managed as one breeding stock (CCSBT 2003). **Domestic fishery issues:** While Offshore Constitutional Settlement arrangements are broadly in place for SBT, SBT is taken in several other fisheries. SBT is also an important recreational fishing species in South Australia, Tasmania and Victoria. The collection and sharing of information across jurisdictions and sectors is a key jurisdictional issue, however, complementary management is essential. There are three distinct tuna fisheries managed under Commonwealth jurisdiction and some conflicts arise where catches in one fishery impact on the stocks of another. This usually results in some level of discarding and is addressed in the ETBF with spatial restrictions in areas where SBT may occur (ETBF 2005). **Fish death rates in transport:** In the 1996 CCSBT Commission meeting, Japan highlighted likely high mortalities of purse-seined fish and emphasised the need for observers on the vessels (Hayes 1997). Australia replied that dead fish were removed from cages during towing and that the weight of dead fish was debited against quota. Mortality during towing and transferring was 1.4% in 1995 and 1.5 % in 1996 (Hayes 1997). Mortality rates have been greatly reduced since the original operations where mortality rates were between 20 and 35 % when fish caught were held in tanks on board the boats until transfer to farm cages (Hayes 1997). Target bait species: High volume of fish is required for baiting and feeding SBT. The listed bait fish are an important prey/bait component of juvenile SBT (AFMA 2002), therefore potential for bait fish species to be caught to supplement bait/feed supplies. The only area restriction for bait collection is the no take zone of the GAB Marine Park (Edyvane 1998).
Byproduct and bycatch issues and interactions	*List any issues, as for the target species above* Purse seining in the Australian SBT fishery is yet to be identified as resulting in byproduct or bycatch (AFMA 2002); however, there is limited observer data to confirm levels of bycatch. The popular press (e.g., 60 minutes) reports on shark interactions from time to time, with television footage. An SBT Fishery By-catch Action Plan (BAP) was initially developed as part of a broader BAP for the Australian Tuna Fisheries. For 2004-05, a separate Tuna Purse Seine Fishery BAP is being developed to better manage bycatch issues within the purse seine fisheries for SBT and Skipjack tuna.
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 entanglement leading to damage or mortality of Threatened, Endangered and Protected (TEP) species as a result of purse seining operations. The

	Australian SBT purse seine fishery is yet to be identified as resulting in damage/death of TEP species; however, there is very little verified data to confirm this assertion. Great White sharks (*Carcharodon carcharias*) are currently protected in Commonwealth waters under the EPBC Act. The distribution of this species includes the SBT purse seine fishery waters and there are some reports of the SBT fishery interacting with this species (white sharks entering cages or harassing stock during capture and transport operations (Environment Australia 2000). Dolphins, toothed whales (pilot and killer) and seals – based on observations from predator interactions with farm cages (e.g. Hayes 1997) there is potential for marine mammals to interact with purse seine capture and transport e.g. dolphins, toothed whales and seals may attempt to prey on fish in towing pontoons and become entangled. Based on logbook data, the direct interaction between marine mammals and SBT purse seine fishing activities is believed to be low. However, there is little verified data to confirm this assessment (AFMA, 2002). Baleen whales – Humpback and Southern right whales seasonally occur in the GAB in early winter. Both species susceptible to collisions and/or entanglement in fishing gear. The Head of the Bight (GAB, SA) is considered a key southern right whale calving location (Bannister *et al* 1996). There are no known interactions between purse seine operations in the SBT fishery and marine turtles (AFMA 2002). However, no rigorous observation program has ever been in place for the SBT purse seine fishery. Limited information at present, information obtained from AFMA 2002 and literature searches of species distributions and/or instances of species-fishery interactions from elsewhere around the globe (Marchant & Higgins 1990). An observer program will provide the necessary data to enable an assessment to be made of the extent and nature of any bycatch of seabirds in the SBT purse seine sector (AFMA 2002).
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* Purse seining operations involve the transport of SBT, in towing pontoons up to 300 km to Port Lincoln (CSIRO 2000) that may potentially disrupt pelagic processes. Also involved with purse seining are various live bait and feeding vessels (CCSBT 2002b) that involve anchoring that may disturb benthic habitat. Purse seine fishing operations may require anchoring of SBT transport cages or boats during bait collection on inshore benthic habitat e.g. during fish transfer to farm cages. Feeding of SBT within transport cages occurs over inshore benthic habitat/communities where surplus feed/excrement falls to the benthos (AFMA 2002).
Community issues and interactions	*List any issues for any of the community units identified in **Scoping Document S1.2**.* No ecological community issues have yet been identified; however, concerns have been raised regarding the removal of baitfish to feed the tuna. This is managed by South Australia. The community impact of removing over 5000 tons of tuna from the GAB is unknown.
Discarding	*Summary of discarding practices by sub-fishery, including bycatch, juveniles of target species, high-grading, processing at sea.* Australia reported that there are no discards in the purse seine fishery (CCSBT 2002a).
Management: planned and those implemented	
Management Objectives	*The management objectives from the most recent management plan* **Management Objectives** ***Catch levels:*** The three original CCSBT members, Australia, Japan and New Zealand,

	agreed to several management measures being introduced against a general aim of rebuilding parental stocks to 1980 levels, by the year 2020. A total allowable catch (TAC) of 11,750 tonnes was agreed and had application from 1989 to 1997. The national allocations were: Japan 6,065 tonnes; Australia 5,265 tonnes; New Zealand 420 tonnes. From 1998, the three original members maintained voluntary catch limits. In 2001 the voluntary limits were: Japan 6432 tonnes; Australia 5,265 tonnes; New Zealand 420 tonnes. On joining the Commission in 2001, Korea agreed to limit its national annual catch to 1,140 tonnes. Taiwan has agreed to limit its annual catch to 1,140 tonnes as part of its undertakings to join the Extended Commission. A TAC and national allocations were not established at the Commission's annual meeting in October 2002. Members will work intersessionally to resolve these matters. The CCSBT acknowledged the advice of the Scientific Committee at its annual meeting in October 2002 that at a global catch of about 15,500 tonnes there was an equal probability that the stock could decline or improve. It was acknowledged that at current catch levels there is little chance that the SBT spawning stock will be rebuilt to the 1980 levels by 2020 (CCSBT 2003b). ***Trade Management*:** The CCSBT implemented a Trade Information Scheme (TIS) on 1 June 2000 to collect more accurate and comprehensive data on SBT fishing through monitoring trade. The TIS also operates to deter Illegal, Unreported and Unregulated (IUU) fishing by effectively denying access to markets for SBT. The core of the TIS is the provision for all members of the CCSBT to maintain requirements for all imports of SBT to be accompanied by a completed CCSBT Statistical Document. The Document must be endorsed by an authorised competent authority in the exporting country and includes extensive details of the shipment such as name of fishing vessel, gear type, area of catch, dates, etc. Shipments not accompanied by this form must be denied entry by the member country. Completed forms are lodged with the CCSBT Secretariat and used to maintain a database for monitoring catches and trade and supporting scientific assessment (CCSBT 2003b). ***Non-Cooperating Non-Members:*** In the recent past, significant and increasing volumes of SBT were being taken by flag of convenience vessels. This has been of major concern to the CCSBT where the stock needs to be carefully managed and where the action of these vessels undermines the conservation measures already taken by members. The Commission has sought the cooperation of these countries in supporting its management and conservation measures. They have also been advised that if cooperation is not forthcoming, the Commission will consider measures, including trade restrictive measures, to be taken against them in accordance with the Action Plan (CCSBT 2003b). ***Management Strategy:*** An initial meeting was held to steer the Commission's course on a management strategy in May 2000 in Tokyo, Japan. The Commission agreed that a procedure should be developed as a set of rules, agreed in advance, to dictate how a Total Allowable Catch for the SBT fishery would be adjusted as data becomes available. The management procedure will have three components: (1) a list of data as inputs, (2) an algorithm or model to process the data and (3) rules to translate the algorithm output into a Total Allowable Catch. A management procedure workshop was held on 3-8 March in Tokyo, which determined the structure of the operating models for the SBT fishery; identified five fisheries and the data sets required for conditioning of the model; agreed on the principles for selecting candidate management procedures; and agreed on the initial identification of objectives and related performance measures (maximizing catches, safeguarding the resource, minimising inter-annual variation in catch and effort). The development of the management procedure was continued at the 3rd Meeting of the Stock Assessment Group in September 2002 where the agenda was largely focused on management procedure issues. Matters progressed included: selection of a set of nine operating models for testing; the adoption of the median of nominal CPUE and four other candidate CPUE indices for management procedure testing; selection of a minimum set of performance statistics required to be reported for management procedure evaluation. Members are now conducting management

	procedure trials for consideration at a second workshop in April 2003 (CCSBT 2003b).
Fishery management plan	*Is there a fisheries management plan? Is it in the planning stage or implemented? What are the key features?* The SBT Management Plan 1995 is in place and has been recently reviewed to ensure reflection of current fishing practices and best risk management strategies. Fishing under the amended Management Plan commenced on 1 December 2004.
Input controls	*Summary of any input controls in the fishery, e.g. limited entry, area restrictions (zoning), vessel size restrictions and gear restrictions. Primarily focused on target species as other species are addressed below.* The number of Statutory Fishing Right (SRF) owners is regulated.
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.* The Australian domestic SBT Fishery is managed through output controls (individual transferable quotas (ITQs) allocated as Statutory Fishing Rights (SFRs) under the SBT Fishery Management Plan 1995 (the Management Plan). During 1999-2000, a TAC of 5,265 mt was determined for the Australian domestic SBT Fishery (AFMA 2003a). Fisheries monitoring is achieved by a series of logbooks and associated catch records that are required by law to be completed by fishers and fish receivers and sent to AFMA for the purposes of monitoring, compliance and research. In the purse seine fishery the Master of the catcher vessel (with quota assigned) is required to complete the Australian Purse Seine and Pole Daily Fishing Log – for farmed SBT only. The weight of dead fish is not recorded during the fishing activity; this information is monitored separately to the catch and effort data collection system (CCSBT 2002a).
Technical measures	*Summary of any technical measures in the fishery, e.g. size limits, bans on females, closed areas or seasons. Gear mesh size, mitigation measures such as TEDs. Primarily focused on target species as other species are addressed below.* There are no technical measures applied to the purse-seine fishery. In the ETBF fishery, which catches occasional SBT, seasonal area restrictions apply to minimise the risk of non-quota take of SBT by longliners off New South Wales. Access to the waters through which SBT migrate has been restricted to vessels holding SBT quota since 2000 (CCSBT 2002b, Hobday and Hartmann, 2005).
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.* No regulations currently in place for purse seine fishery regarding bycatch and byproduct, TEP, habitat, or communities, beyond those regulations that apply to all fishers (such as no take of protected species).
Initiatives and strategies	*BAPs; TEDs; industry codes of conduct, MPAs, Reserves* None
Enabling processes	*Monitoring (logbooks, observer data, scientific surveys); assessment (stock assessments); performance indicators (decision rules, processes, compliance; education; consultation process* Logbooks are kept and provided to AFMA. Compliance measures are also in place with catch monitoring at time of transfer to cages in Port Lincoln An observer program has been implemented for the purse seine sector
Other initiatives or agreements	*State, national or international conventions or agreements that impact on the management of the fishery/sub-fishery being evaluated.* Southern Bluefin Tuna (SBT) were heavily fished in the past, with the annual catch reaching 80,000 tonnes in the early 1960s. Heavy fishing resulted in a significant

	decline in the numbers of mature fish and the annual catch began to fall rapidly. In the mid 1980s it became apparent that the SBT stock was at a level where management and conservation was required. There was a need for a mechanism to limit catches. The main nations fishing SBT at the time, Australia, Japan and New Zealand, began to apply strict quotas to their fishing fleets from 1985 as a management and conservation measure to enable the SBT stocks to rebuild. On 20 May 1994 the then existing voluntary management arrangement between Australia, Japan and New Zealand was formalised when the Convention for the Conservation of Southern Bluefin Tuna, which had been signed by the three countries in May 1993, came into force. The Convention created the Commission for the Conservation of Southern Bluefin Tuna (CCSBT). The CCSBT is headquartered in Canberra, Australia. Other fishing nations were active in the SBT fishery, which reduced the effectiveness of the member's conservation and management measures. The principal non member nations were Korea, Taiwan and Indonesia. There were also a number of other fishing vessels flying flags of convenience, which operated in the fishery. As a matter of policy, the CCSBT has encouraged the membership of these countries. On 17 October 2001 the Republic of Korea joined the Commission. The Fishing Entity of Taiwan's membership of the Extended Commission became effective on 30 August 2002. Indonesia's engagement with the Commission is being pursued as a matter of urgency as the Indonesian catch, which is significant, includes mature fish taken in the only known SBT spawning ground. The Commission is developing a status of “cooperating non-member", and discussion will be held with Indonesia on participation with this status as an initial step in formal engagement with the Commission. South Africa expressed an interest in joining the CCSBT at the annual meeting in October 2002, but has not yet joined. Note 98% of global SBT catch is consumed on the Japanese sashimi market (CSIRO 1999). CCSBT member countries are engaged in a Scientific Research Program (SRP). The core components of SRP are Management Strategy Evaluation, Observer Programs, Stock Assessment and the management of impacts on Ecologically Related Species. Member countries are continuing efforts to ensure membership of the Commission includes all countries that catch SBT in significant quantities. The inclusion of Indonesia is a high priority.
Data	
Logbook data	*Verified logbook data; data summaries describe programme* Logbook data is kept according to AFMA standards, and is reconciled with catch as measured during the cage transfers. A series of logbooks and associated catch records are required by law to be completed by fishers and fish receivers and sent to AFMA for the purposes of monitoring, compliance and research. All data provided from Logbooks must be supplied to AFMA within specified time periods specific to each record. Validation of this data is undertaken as a minimum on an annual basis through an audit process by AFMA compliance staff, and sometimes on a needs basis. In the purse seine fishery the Master of the catcher vessel (with quota assigned) is required to complete the Australian Purse Seine and Pole Daily Fishing Log – for farmed SBT only. A specific permit called the Farm Transit Log is completed by the holder of the SBT carrier boat permit or representative, and provided to the monitoring company which undertakes the fish count when fish are transferred from tow cages to farm cages (CCSBT 2002b). The weight of dead fish is not recorded during the fishing activity; this information is monitored separately to the catch and effort data collection system (CCSBT 2002a).
Observer data	*Observer programme describe parameters as below* Purpose: The purpose of the Southern Bluefin Tuna Fishery Observer Program is to provide

	fisheries management, research organisations, fishing industry and the wider community with up-to-date, reliable and accurate information on the fishing catch, effort and practice in the fishery. The program will improve the quality of the data used as input to the stock assessment process and will contribute to the development of reliable indices to monitor future trends in stock size. Future trend indicators will be a critical component to facilitate setting TAC's. The program will also collect biological, environmental and technical information for improved management and understanding of the fishery's impact on the marine environment. The primary objective of the program is to place suitable seagoing observers on fishing vessels in the fishery to: 1. Observe, record and report catch and effort, bycatch, life status and fate for purse seine caught SBT; 2. Observe, record and report on the life status and fate of SBT during the tow process; 3. Monitor the vessel's normal fishing operations; 4. Monitor and record all tag recaptures; and 5. Observe, record and report all wildlife interactions with the vessel or its fishing / tow gear. Data collection: AFMA Experimental design: The CCSBT requires Australia to record and report on Australian operations targeting SBT. The targeted coverage level is 10% of catch and effort. Scope: GAB catching and tow cage operations Coverage: Established for the purse seine fleet in 2002. Experience: Senior trained observers used initially, all AFMA trained now. Training: provided by AFMA Resources: provided by AFMA Data collation: Observer data is being collated in AFMA's centralized database Data communication: confidential trip reports, collated summaries Data checking: unknown, but presumable occurs on entry to the AFMA database
Other data	*Studies, surveys* Additional data on juvenile SBT abundance comes from fishery-independent aerial survey, and an industry-supported commercial spotting index. Tagging studies have a long history, and conventional, archival and acoustic studies provide information on the fishing mortality, capture rates, movement and behavior.

S1.1 Table 1: Summary of the development of the Australian SBT fishery.

Year	Activities/Events
1930s	Trolling catches recorded off New South Wales and Tasmania. These catches declined during the war years.
mid 1950s	A small troll and pole fishery was re-established off NSW. Japan's distant longline fleet also started targeting SBT during the late 1950s.
1960s	SBT pole-and-line fishery expanded off NSW and South Australia. The first commercial catches of SBT off Western

Year	Activities/Events
	Australia were recorded in 1968 by a small troll fleet. This early fishing of SBT targeted surface schools of two to four year old fish that were processed by local canneries.[1] The expansion phase of the Japanese fishery was marked by an early peak in catch in 1961 of 77,000 tonnes, followed by a long period of increase in fishing effort lasting until the mid 1980s.[2]
1970s	Japan introduced voluntary area closures in 1971 in the Java Sea, south of Indonesia to protect one of their main fishing grounds. This are is the only known spawning ground for SBT. Japan continued to expand their SBT longline fleet and fishing grounds during the 1970s that included the waters around Australia.
Early 1980s	Australian catch rates increased steadily each year until 1982 when a record Australian catch of 21,000 tonnes was taken. The surface fishery for SBT off New South Wales collapsed in the early 1980s, when the occurrence of surface schools first declined and then virtually ceased[3] In 1983, it was recognised that catches had declined for many tuna species. Japan's global tuna longline fleet was reduced by 20% in the early 1980s. Vessels from New Zealand and South Africa also participated in the fishery. Biologists put out a warning that the global catch of SBT needed to be immediately reduced to prevent the collapse of the fishery. As a result, Japan, Australia and New Zealand applied limits of 29,000 tonnes, 21,000 tonnes, and 1,000 tonnes respectively to their total catch and informal tri-lateral arrangements were put in place. In 1984, Australia introduced a formal management plan based on individual transferable quotas (ITQs) and set its Total Allowable Catch (TAC) to 14,500 tonnes. One hundred and thirty-six individuals and companies were issued quota holdings at that time. Within three years, this number dropped to 63 quota holdings as the SBT fishery went through a rationalisation process. SA operators purchased much of the quota and as a result, the fishery became based out of Port Lincoln. In the same year, Japan would not agree to reduce its catch limit and was excluded from fishing for SBT in Australian waters south of 34°S.
Mid – Late 1980s	In 1985 Japan agreed to reduce its global catch to 23,150 tonnes. Japanese boats were then readmitted to the fishing area south of 34°S to target SBT. Also during this year, the Southern Bluefin Tuna Management Advisory Committee (SBTMAC) was formed to advise the Government on management issues relating to the SBT fishery. Progressively, over the mid to late 1980s, the Australian catch focussed on supplying the Japanese sashimi market with an increasing amount of the catch being transhipped to Japanese freezer vessels in the Great Australian Bight. Australia's TAC was reduced to 11,500 tonnes in 1986, 6,250 tonnes in 1988, and in 1989, 5,265 tonnes. The TAC reductions of the late 1980s, led to further restructuring of the fishery.
Early 1990s	The three nations signed the Convention for the Conservation of Southern Bluefin Tuna, which in turn established the Commission for the Conservation of Southern Bluefin Tuna (Commission) in 1994. It is the Commission's responsibility to review and set a TAC and determine its allocation among the member countries. Approximately half the Australian quota was taken by Australia-Japan joint venture longliners. In 1990/91 farming of SBT commenced off the South Australian coastline. The Australia-Japan joint venture arrangement was terminated in 1995. Australian catches again focused on the surface fishery with poling operations supplying the fresh chilled sashimi market and purse seiners providing SBT to farms. Longlining for other tuna and billfish species increased, with a consequent increase in longline bycatch of SBT on the east and west coasts of Australia, thereby increasing the demand for SBT quota. The impacts of SBT longlining on seabirds (particularly albatross populations) were recognised by the Commission and actions to mitigate the problem were introduced. Between 1994 and 1997 the Commission maintained the Commission TAC at 11,750 t. The national allocation to Australia remained at 5265 t during this period. SBT catches by non-members of the Commission, namely Indonesia, Korea and Taiwan, increased significantly during this period.
1998-2001	Pressure from Japan to increase the TAC has meant that the members of the Commission have not been able to agree on catch limits since 1997. As a result there has been no TAC or national allocations made by the Commission since 1997. In the absence of a Commission decision on the TAC and national allocations Australia has committed to maintain its TACs at the last agreed Commission limit of 5265 t. Japan, however, undertook a unilateral experimental fishing program in 1998 and 1999 that effectively increased its catch well beyond the previous Commission limit of 6065 t. This action resulted in an international legal case being brought against Japan by Australia and New Zealand, and Australia denying Japan's high seas longline fleet access to Australian ports. While the case failed to resolve the impasse in the Commission over the TAC the Commission has, since 2000, adopted a range of measures to facilitate consensus decision making. Port access to Japanese vessels was reinstated in 2001.

1 AFMA, 1994 Information paper on the Southern Bluefin Tuna Fishery, Canberra. 7 pp.

2 DPIE, 1990. Southern Bluefin Tuna: Scientific background to the debate. Ed. A Caton, K.McLoughlin & M.J Williams. Bureau of Rural Resources, Bulletin No 3, AGPS. Canberra. pp44

[3] Kailola, P.J, Williams, MJ. Stewart, PC, Reichelt, RE, McNee, A and Grieve, C. 1993. Australian Fisheries Resources, Bureau of Resource Sciences, Canberra , ACT p.363

4 Review of the Australian Southern Bluefin Tuna Fishery for the 1999/00 and Preliminary 2000/01 Seasons Prepared by Carolyn Robins, BRS (10 April 2001)

Year	Activities/Events
	The catch of SBT for farming purposes increased rapidly over this period. In the 2000/01 season this component utilised over 98% of the Australian TAC resulting in quota being less available for other operations.[4] (such as longlining). There is some anecdotal suggestion that there may be increased availability of SBT in the fishery off NSW in recent years. However it is uncertain whether this supports a view that the stock is rebuilding. Since 1992 there has been a progressive increase in the number of SBT taken for farming operations.
2002	The Commission now has four members, as Korea has joined. Taiwan agrees to abide by an annual catch of 1,140 tonnes. The catch level of the members is 14,030 tonnes. Action is being taken to address take outside of the member countries.

S1.1 Table 2: Primary related fisheries that occur in the region of the SBT fishery, or else capture SBT elsewhere (AFMA 2002).

Fishery	Main target species	Relationship with SBT Fishery
Eastern Tuna and Billfish Fishery	Broadbill swordfish, Yellowfin tuna, Bigeye tuna, Skipjack tuna - now separate fishery	SBT taken as byproduct in the fishery, primarily by longline. However catch must be covered by SBT quota held under the SBT fishery management plan.
Southern and Western Tuna and Billfish Fishery	Broadbill swordfish, Yellowfin tuna, Bigeye tuna, Skipjack tuna - now separate fishery	SBT taken as byproduct in the fishery, primarily by longline. However catch must be covered by SBT quota held under the SBT fishery management plan.
Small Pelagics Fishery	Jack mackerel, Yellowtail scad, Blue mackerel, Peruvian jack mackerel, Red bait	Species used as food for SBT in fish farms, and for bait in the SBT longline sector.
SA Pilchard Fishery	Pilchards	Species used as food for SBT in fish farms, and for bait in the SBT longline sector.
WA Pilchard Fishery	Pilchards	Species used as food for SBT in fish farms, and for bait in the SBT longline sector.

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
1 10 bait species	6	8	182	209 benthic 2 pelagic	2 demersal 2 pelagic

Scoping Document S2A Species

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

Target species: Southern Bluefin Tuna purse seine fishery

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

ERA species ID	Role	Taxa	Family name	Scientific name	Common name	CAAB code	Source
255	TA	Teleost	Scombridae	Thunnus maccoyii	Southern Bluefin Tuna	37441004	ERA Stage 1
511	TB	Teleost	Arripidae	Arripis georgianus	Tommy rough	37344001	ERA Stage 1
155	TB	Teleost	Emmelichthyidae	Emmelichthys nitidus	Redbait	37345001	ERA Stage 1
831	TB	Teleost	Engraulidae	Engraulis australis	Australian anchovy	37086001	ERA Stage 1
150	TB	Teleost	Carangidae	Pseudocaranx dentex	Silver Trevally	37337062	ERA Stage 1
151	TB	Teleost	Carangidae	Pseudocaranx wrighti	Skipjack trevally	37337063	Commercial Species Grouping expanded for available CAAB synonyms
825	TB	Teleost	Clupeidae	Sardinops neopilchardus	Pilchard	37085002	ERA Stage 1
210	TB	Teleost	Scombridae	Scomber australasicus	Blue Mackerel	37441001	ERA Stage 1

ERA species ID	Role	Taxa	Family name	Scientific name	Common name	CAAB code	Source
1088	TB	Teleost	Carangidae	Trachurus declivis	Jack Mackerel	37337002	ERA Stage 1
807	TB	Teleost	Carangidae	Trachurus murphyi	Peruvian Jack Mackerel	37337077	ERA Stage 1
540	TB	Teleost	Carangidae	Trachurus novaezelandiae	Yellow tail scad	37337003	ERA Stage 1

Byproduct species*:* Southern Bluefin Tuna purse seine fishery

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

ERA species ID	Taxa	Family name	Scientific name	Common name	CAAB code	Source
153	Teleost	Arripidae	Arripis trutta	Australian Salmon	37344002	ERA Stage 1
154	Teleost	Arripidae	Arripis truttaceus	Western australian salmon	37344004	ERA Stage 1
64	Teleost	Scombridae	Katsuwonus pelamis	Skipjack Tuna	37441003	ERA Stage 1
895	Teleost	Scombridae	Thunnus alalunga	Albacore	37441005	ERA Stage 1
212	Teleost	Scombridae	Thunnus albacares	Yellowfin Tuna	37441002	ERA Stage 1
62	Teleost	Scombridae	Thunnus obesus	Bigeye Tuna	37441011	ERA Stage 1

Bycatch species*:* Southern Bluefin Tuna purse seine fishery

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

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

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

Bycatch

ERA species ID	Taxa	Family name	Scientific name	Common name	CAAB code	Source
808	Chondrichthyan	Carcharhinidae	Carcharhinus obscurus	Dusky Shark	37018003	ERA Stage 1
964	Chondrichthyan	Lamnidae	Isurus oxyrinchus	Shortfinned Mako or Blue Pointer	37010001	ERA Stage 1
1039	Chondrichthyan	Carcharhinidae	Prionace glauca	Blue Shark	37018004	ERA Stage 1
851	Teleost	Istiophoridae	Makaira indica	Black Marlin	37444006	ERA Stage 1
852	Teleost	Istiophoridae	Makaira mazara	Blue Marlin	37444003	ERA Stage 1
233	Teleost	Monacanthidae	Nelusetta ayraudi	Chinaman-Leatherjacket	37465006	ERA Stage 1
884	Teleost	Istiophoridae	Tetrapturus audax	Striped marlin	37444002	ERA Stage 1
213	Teleost	Xiphiidae	Xiphias gladius	Broad Billed Swordfish	37442001	ERA Stage 1

TEP species: Southern Bluefin Tuna purse seine fishery

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

TEP species are often poorly listed by fisheries due to low frequency of direct interaction. Both direct (capture) and indirect (e.g. food source captured) interaction are considered in the ERAEF approach. A list of TEP species has been generated for each fishery and is included in the PSA workbook species list. This list has been generated using the DEH Search Tool from DEH home page *http://www.deh.gov.au/*

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

ERA species ID	Taxa	Family name	Scientific name	Common name	CAAB code	Source
313	Chondrichthyan	Odontaspididae	Carcharias taurus	Grey nurse shark	37008001	TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
315	Chondrichthyan	Lamnidae	Carcharodon carcharias	White shark	37010003	ERA Stage 1
1067	Chondrichthyan	Rhincodontidae	Rhincodon typus	Whale shark	37014001	TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
203	Marine bird	Laridae	Anous stolidus	Common noddy	40128002	TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
67	Marine bird	Laridae	Anous tenuirostris	Lesser noddy	40128003	TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
1580	Marine bird	Procellariidae	Calonectris leucomelas	streaked shearwater	40041002	TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
325	Marine bird	Laridae	Catharacta skua	Great Skua	40128005	TEP Species added ERA Stage 2, Lists provided by Jo

ERA species ID	Taxa	Family name	Scientific name	Common name	CAAB code	Source
						Dowdney.
595	Marine bird	Procellariidae	Daption capense	Cape Petrel	40041003	TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
1428	Marine bird	Diomedeidae	Diomedea amsterdamensis	Amsterdam Albatross	40040018	TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
628	Marine bird	Diomedeidae	Diomedea antipodensis	Antipodean Albatross	40040011	TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
1429	Marine bird	Diomedeidae	Diomedea dabbenena	Tristan Albatross	40040019	TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
753	Marine bird	Diomedeidae	Diomedea epomophora	Southern Royal Albatross	40040005	TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
451	Marine bird	Diomedeidae	Diomedea exulans	Wandering Albatross	40040006	ERA Stage 1
755	Marine bird	Diomedeidae	Diomedea gibsoni	Gibson's Albatross	40040010	TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
799	Marine bird	Diomedeidae	Diomedea sanfordi	Northern Royal Albatross	40040012	TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
898	Marine bird	Spheniscidae	Eudyptula minor	Little Penguin	40001008	ERA Stage 1
918	Marine bird	Hydrobatidae	Fregetta grallaria	White-bellied Storm-Petrel (Tasman Sea),	40042001	TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
917	Marine bird	Hydrobatidae	Fregetta tropica	Black-bellied Storm-Petrel	40042002	TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
314	Marine bird	Procellariidae	Fulmarus glacialoides	Southern fulmar	40041004	TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
555	Marine bird	Hydrobatidae	Garrodia nereis	Grey-backed storm petrel	40042003	TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
939	Marine bird	Procellariidae	Halobaena caerulea	Blue Petrel	40041005	TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
973	Marine bird	Laridae	Larus dominicanus	Kelp Gull	40128012	TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
974	Marine bird	Laridae	Larus novaehollandiae	Silver Gull	40128013	TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
975	Marine bird	Laridae	Larus pacificus	Pacific Gull	40128014	TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
1052	Marine bird	Procellariidae	Lugensa brevirostris	Kerguelen Petrel	40041006	TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
73	Marine bird	Procellariidae	Macronectes giganteus	Southern Giant-Petrel	40041007	TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
981	Marine bird	Procellariidae	Macronectes halli	Northern Giant-Petrel	40041008	TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
998	Marine bird	Sulidae	Morus serrator	Australasian Gannet	40047002	ERA Stage 1
556	Marine bird	Hydrobatidae	Oceanites oceanicus	Wilson's storm petrel (subantarctic)	40042004	TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
1003	Marine bird	Procellariidae	Pachyptila turtur	Fairy Prion	40041013	TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
1004	Marine bird	Hydrobatidae	Pelagodroma marina	White-faced Storm-Petrel	40042007	ERA Stage 1
1006	Marine bird	Procellariidae	Pelecanoides urinatrix	Common Diving-Petrel	40041017	TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
291	Marine bird	Phalacrocoracidae	Phalacrocorax carbo	Black cormorant	40048002	ERA Stage 1
912	Marine bird	Phalacrocoracidae	Phalacrocorax fuscescens	Black faced cormorant	40048003	ERA Stage 1
913	Marine bird	Phalacrocoracidae	Phalacrocorax melanoleucos	Little pied cormorant	40048004	ERA Stage 1

ERA species ID	Taxa	Family name	Scientific name	Common name	CAAB code	Source
915	Marine bird	Phalacrocoracidae	Phalacrocorax sulcirostris	Little black cormorant	40048005	ERA Stage 1
1008	Marine bird	Diomedeidae	Phoebetria fusca	Sooty Albatross	40040008	TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
1009	Marine bird	Diomedeidae	Phoebetria palpebrata	Light-mantled Albatross	40040009	TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
1041	Marine bird	Procellariidae	Procellaria aequinoctialis	White-chinned Petrel	40041018	TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
494	Marine bird	Procellariidae	Procellaria cinerea	Grey petrel	40041019	TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
1042	Marine bird	Procellariidae	Procellaria parkinsoni	Black Petrel	40041020	TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
1043	Marine bird	Procellariidae	Procellaria westlandica	Westland Petrel	40041021	TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
1691	Marine bird	Procellariidae	Pseudobulweria rostrata	Tahiti Petrel	40041022	TEP Species added ERA Stage 2, Lists provided by Jo Dowdney. TEP database has detailed referencing
1045	Marine bird	Procellariidae	Pterodroma cervicalis	White-necked Petrel	40041025	TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
504	Marine bird	Procellariidae	Pterodroma lessoni	White-headed petrel	40041029	TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
1046	Marine bird	Procellariidae	Pterodroma leucoptera	Gould's Petrel	40041030	TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
1047	Marine bird	Procellariidae	Pterodroma macroptera	Great-winged Petrel	40041031	TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
1048	Marine bird	Procellariidae	Pterodroma mollis	Soft-plumaged Petrel	40041032	TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
1049	Marine bird	Procellariidae	Pterodroma neglecta	Kermadec Petrel (western)	40041033	TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
1050	Marine bird	Procellariidae	Pterodroma nigripennis	Black-winged Petrel	40041034	TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
1051	Marine bird	Procellariidae	Pterodroma solandri	Providence Petrel	40041035	TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
1053	Marine bird	Procellariidae	Puffinus assimilis	Little Shearwater (Tasman Sea)	40041036	TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
1054	Marine bird	Procellariidae	Puffinus bulleri	Buller's Shearwater	40041037	TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
1055	Marine bird	Procellariidae	Puffinus carneipes	Flesh-footed Shearwater	40041038	TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
1056	Marine bird	Procellariidae	Puffinus gavia	Fluttering Shearwater	40041040	TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
1057	Marine bird	Procellariidae	Puffinus griseus	Sooty Shearwater	40041042	TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
1058	Marine bird	Procellariidae	Puffinus huttoni	Hutton's Shearwater	40041043	TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
1059	Marine bird	Procellariidae	Puffinus pacificus	Wedge-tailed Shearwater	40041045	TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
1060	Marine bird	Procellariidae	Puffinus tenuirostris	Short-tailed Shearwater	40041047	ERA Stage 1
1014	Marine bird	Laridae	Sterna albifrons	Little tern	40128022	TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
1017	Marine bird	Laridae	Sterna bergii	Crested Tern	40128025	ERA Stage 1
1018	Marine bird	Laridae	Sterna caspia	Caspian Tern	40128026	TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
1020	Marine bird	Laridae	Sterna fuscata	Sooty tern	40128028	TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
1021	Marine bird	Laridae	Sterna hirundo	Common tern	40128029	TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.

ERA species ID	Taxa	Family name	Scientific name	Common name	CAAB code	Source
1023	Marine bird	Laridae	Sterna paradisaea	Arctic tern	40128032	TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
1024	Marine bird	Laridae	Sterna striata	White-fronted Tern	40128033	TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
1032	Marine bird	Diomedeidae	Thalassarche bulleri	Buller's Albatross	40040001	TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
1031	Marine bird	Diomedeidae	Thalassarche carteri	Indian Yellow-nosed Albatross	40040014	TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
1033	Marine bird	Diomedeidae	Thalassarche cauta	Shy Albatross	40040002	TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
1034	Marine bird	Diomedeidae	Thalassarche chlororhynchos	Yellow-nosed Albatross, Atlantic Yellow-	40040003	ERA Stage 1
1035	Marine bird	Diomedeidae	Thalassarche chrysostoma	Grey-headed Albatross	40040004	TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
889	Marine bird	Diomedeidae	Thalassarche eremita	Chatham albatross	40040017	TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
1084	Marine bird	Diomedeidae	Thalassarche impavida	Campbell Albatross	40040013	TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
1085	Marine bird	Diomedeidae	Thalassarche melanophrys	Black-browed Albatross	40040007	TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
1673	Marine bird	Diomedeidae	Thalassarche nov. sp.	Pacific Albatross		TEP Species added ERA Stage 2, Lists provided by Jo Dowdney. TEP database has detailed referencing
894	Marine bird	Diomedeidae	Thalassarche salvini	Salvin's albatross	40040016	TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
216	Marine mammal	Otariidae	Arctocephalus forsteri	New Zealand Fur-seal	41131001	ERA Stage 1
253	Marine mammal	Otariidae	Arctocephalus pusillus doriferus	Australian Fur Seal	41131003	ERA Stage 1
263	Marine mammal	Otariidae	Arctocephalus tropicalis	Subantarctic fur seal	41131004	TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
256	Marine mammal	Balaenopteridae	Balaenoptera acutorostrata	Minke Whale	41112001	ERA Stage 1
1439	Marine mammal	Balaenidae	Balaenoptera bonaerensis	Antarctic Minke Whale	41112007	TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
261	Marine mammal	Balaenopteridae	Balaenoptera borealis	Sei Whale	41112002	TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
262	Marine mammal	Balaenopteridae	Balaenoptera edeni	Bryde's Whale	41112003	TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
265	Marine mammal	Balaenopteridae	Balaenoptera musculus	Blue Whale	41112004	ERA Stage 1
268	Marine mammal	Balaenopteridae	Balaenoptera physalus	Fin Whale	41112005	TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
269	Marine mammal	Ziphiidae	Berardius arnuxii	Arnoux's Beaked Whale	41120001	TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
289	Marine mammal	Balaenidae	Caperea marginata	Pygmy Right Whale	41110002	TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
612	Marine mammal	Delphinidae	Delphinus delphis	Common Dolphin	41116001	ERA Stage 1
896	Marine mammal	Balaenidae	Eubalaena australis	Southern Right Whale	41110001	ERA Stage 1
902	Marine mammal	Delphinidae	Feresa attenuata	Pygmy Killer Whale	41116002	ERA Stage 1
934	Marine mammal	Delphinidae	Globicephala macrorhynchus	Short-finned Pilot Whale	41116003	ERA Stage 1
935	Marine mammal	Delphinidae	Globicephala melas	Long-finned Pilot Whale	41116004	ERA Stage 1

ERA species ID	Taxa	Family name	Scientific name	Common name	CAAB code	Source
937	Marine mammal	Delphinidae	Grampus griseus	Risso's Dolphin	41116005	TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
295	Marine mammal	Phocidae	Hydrurga leptonyx	Leopard seal	41136001	TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
959	Marine mammal	Ziphiidae	Hyperoodon planifrons	Southern Bottlenose Whale	41120002	ERA Stage 1
968	Marine mammal	Physeteridae	Kogia breviceps	Pygmy Sperm Whale	41119001	ERA Stage 1
969	Marine mammal	Physeteridae	Kogia simus	Dwarf Sperm Whale	41119002	TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
970	Marine mammal	Delphinidae	Lagenodelphis hosei	Fraser's Dolphin	41116006	TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
832	Marine mammal	Delphinidae	Lagenorhynchus cruciger	Hourglass dolphin	41116007	TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
971	Marine mammal	Delphinidae	Lagenorhynchus obscurus	Dusky Dolphin	41116008	TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
61	Marine mammal	Delphinidae	Lissodelphis peronii	Southern Right Whale Dolphin	41116009	TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
984	Marine mammal	Balaenopteridae	Megaptera novaeangliae	Humpback Whale	41112006	ERA Stage 1
985	Marine mammal	Ziphiidae	Mesoplodon bowdoini	Andrew's Beaked Whale	41120004	TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
986	Marine mammal	Ziphiidae	Mesoplodon densirostris	Blainville's Beaked Whale	41120005	TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
987	Marine mammal	Ziphiidae	Mesoplodon gingkodens	Gingko Beaked Whale	41120006	TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
988	Marine mammal	Ziphiidae	Mesoplodon grayi	Gray's Beaked Whale	41120007	ERA Stage 1
989	Marine mammal	Ziphiidae	Mesoplodon hectori	Hector's Beaked Whale	41120008	TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
990	Marine mammal	Ziphiidae	Mesoplodon layardii	Strap-toothed Beaked Whale	41120009	ERA Stage 1
991	Marine mammal	Ziphiidae	Mesoplodon mirus	True's Beaked Whale	41120010	TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
993	Marine mammal	Phocidae	Mirounga leonina	Elephant seal	41136004	TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
1000	Marine mammal	Otariidae	Neophoca cinerea	Australian Sea-lion	41131005	ERA Stage 1
1002	Marine mammal	Delphinidae	Orcinus orca	Killer Whale	41116011	ERA Stage 1
1007	Marine mammal	Delphinidae	Peponocephala electra	Melon-headed Whale	41116012	TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
1036	Marine mammal	Physeteridae	Physeter catodon	Sperm Whale	41119003	ERA Stage 1
1044	Marine mammal	Delphinidae	Pseudorca crassidens	False Killer Whale	41116013	TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
1080	Marine mammal	Delphinidae	Stenella attenuata	Spotted Dolphin	41116015	TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
1081	Marine mammal	Delphinidae	Stenella coeruleoalba	Striped Dolphin	41116016	TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
1082	Marine mammal	Delphinidae	Stenella longirostris	Long-snouted Spinner Dolphin	41116017	TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
1083	Marine mammal	Delphinidae	Steno bredanensis	Rough-toothed Dolphin	41116018	TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
1030	Marine mammal	Ziphiidae	Tasmacetus shepherdi	Tasman Beaked Whale	41120011	TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
1494	Marine mammal	Delphinidae	Tursiops aduncus	Indian Ocean bottlenose dolphin	41116020	TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.

ERA species ID	Taxa	Family name	Scientific name	Common name	CAAB code	Source
1091	Marine mammal	Delphinidae	Tursiops truncatus	Bottlenose Dolphin	41116019	ERA Stage 1
1098	Marine mammal	Ziphiidae	Ziphius cavirostris	Cuvier's Beaked Whale	41120012	TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
541	Marine reptile	Cheloniidae	Chelonia mydas	Green turtle	39020002	TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
613	Marine reptile	Dermochelyidae	Dermochelys coriacea	Leathery turtle	39021001	ERA Stage 1
1005	Marine reptile	Hydrophiidae	Pelamis platurus	yellow-bellied seasnake	39125033	TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
105	Teleost	Syngnathidae	Acentronura australe	Southern Pygmy Pipehorse	37282034	TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
114	Teleost	Syngnathidae	Acentronura breviperula	Hairy Pygmy Pipehorse	37282035	TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
287	Teleost	Syngnathidae	Campichthys galei	Gale's Pipefish	37282039	TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
580	Teleost	Syngnathidae	Cosmocampus howensis	Lord Howe Pipefish	37282055	TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
904	Teleost	Syngnathidae	Festucalex cinctus	Girdled Pipefish	37282061	TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
914	Teleost	Syngnathidae	Filicampus tigris	Tiger Pipefish	37282064	TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
1591	Teleost	Syngnathidae	Halicampus boothae	[a pipefish]	37282107	TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
942	Teleost	Syngnathidae	Heraldia nocturna	Upside-down Pipefish	37282071	TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
1548	Teleost	Syngnathidae	Heraldia sp. 1 [in Kuiter, 2000]	Western upsidedown pipefish	37282130	TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
308	Teleost	Clinidae	Heteroclinus perspicillatus	Common weedfish	37416013	TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
944	Teleost	Syngnathidae	Hippichthys heptagonus	Madura Pipefish	37282073	TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
945	Teleost	Syngnathidae	Hippichthys penicillus	Beady Pipefish, Steep-nosed Pipefish	37282075	TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
1664	Teleost	Syngnathidae	Hippocampus abdominalis	Big-bellied / southern potbellied seahorse	37282120	TEP Species added ERA Stage 2, Lists provided by Jo Dowdney. TEP database has detailed referencing
946	Teleost	Syngnathidae	Hippocampus bleekeri	pot bellied seahorse	37282010	ERA Stage 1
947	Teleost	Syngnathidae	Hippocampus breviceps	Short-head Seahorse, Short-snouted Seaho	37282026	ERA Stage 1
950	Teleost	Syngnathidae	Hippocampus minotaur	Bullneck Seahorse	37282105	TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
548	Teleost	Syngnathidae	Hippocampus subelongatus	West Australian Seahorse	37282123	TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
1602	Teleost	Syngnathidae	Hippocampus tristis	[a pipefish]	37282117	TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
952	Teleost	Syngnathidae	Hippocampus whitei	white's seahorse	37282027	ERA Stage 1
953	Teleost	Syngnathidae	Histiogamphelus briggsii	Briggs' Crested Pipefish, Briggs' Pipefish	37282011	TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
954	Teleost	Syngnathidae	Histiogamphelus cristatus	Rhino Pipefish, Macleay's Crested Pipefish	37282081	TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
960	Teleost	Syngnathidae	Hypselognathus horridus	Shaggy Pipefish, Prickly Pipefish	37282082	TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
961	Teleost	Syngnathidae	Hypselognathus rostratus	Knife-snouted Pipefish	37282012	TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.

ERA species ID	Taxa	Family name	Scientific name	Common name	CAAB code	Source
1699	Teleost	Syngnathidae	Idiotropiscis australe	Southern Pygmy Pipehorse		TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
966	Teleost	Syngnathidae	Kaupus costatus	Deep-bodied Pipefish	37282014	TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
967	Teleost	Syngnathidae	Kimblaeus bassensis	Trawl Pipefish, Kimbla Pipefish	37282083	TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
978	Teleost	Syngnathidae	Leptoichthys fistularius	Brushtail Pipefish	37282013	TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
979	Teleost	Syngnathidae	Lissocampus caudalis	Australian Smooth Pipefish, Smooth Pipefish	37282016	TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
390	Teleost	Syngnathidae	Lissocampus fatiloquus	Prophet's Pipefish	37282084	TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
980	Teleost	Syngnathidae	Lissocampus runa	Javelin Pipefish	37282009	TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
983	Teleost	Syngnathidae	Maroubra perserrata	Sawtooth Pipefish	37282085	TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
1243	Teleost	Syngnathidae	Mitotichthys meraculus	Western Crested Pipefish	37282092	TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
994	Teleost	Syngnathidae	Mitotichthys mollisoni	Mollison's Pipefish	37282022	TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
995	Teleost	Syngnathidae	Mitotichthys semistriatus	Half-banded Pipefish	37282015	TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
996	Teleost	Syngnathidae	Mitotichthys tuckeri	Tucker's Pipefish	37282025	TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
1242	Teleost	Syngnathidae	Nannocampus subosseus	Bony-headed Pipefish	37282094	TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
1001	Teleost	Syngnathidae	Notiocampus ruber	Red Pipefish	37282095	TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
1010	Teleost	Syngnathidae	Phycodurus eques	Leafy Seadragon	37282001	ERA Stage 1
1011	Teleost	Syngnathidae	Phyllopteryx taeniolatus	Weedy Seadragon, Common Seadragon	37282002	ERA Stage 1
1061	Teleost	Syngnathidae	Pugnaso curtirostris	Pug-nosed Pipefish	37282021	TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
1070	Teleost	Syngnathidae	Solegnathus dunckeri	Duncker's Pipehorse	37282098	TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
320	Teleost	Syngnathidae	Solegnathus guentheri	Indonesian Pipefish, Gunther's Pipehorse	37282003	TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
1072	Teleost	Syngnathidae	Solegnathus robustus	Robust Spiny Pipehorse, Robust Pipehorse	37282004	TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
1073	Teleost	Syngnathidae	Solegnathus spinosissimus	spiny pipehorse	37282029	ERA Stage 1
1074	Teleost	Solenostomidae	Solenostomus cyanopterus	Blue-finned Ghost Pipefish, Robust Ghost	37281001	TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
1075	Teleost	Solenostomidae	Solenostomus paradoxus	Harlequin Ghost Pipefish, Ornate Ghost Pipefish	37281002	TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
1026	Teleost	Syngnathidae	Stigmatopora argus	Spotted Pipefish	37282017	ERA Stage 1
1027	Teleost	Syngnathidae	Stigmatopora nigra	Wide-bodied Pipefish, Black Pipefish	37282018	TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
1028	Teleost	Syngnathidae	Stipecampus cristatus	Ring-backed Pipefish	37282019	TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
1029	Teleost	Syngnathidae	Syngnathoides biaculeatus	Double-ended Pipehorse, Alligator Pipefish	37282100	TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
1089	Teleost	Syngnathidae	Trachyrhamphus	Bend Stick Pipefish, Short-tailed Pipefish	37282006	TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.

ERA species ID	Taxa	Family name	Scientific name	Common name	CAAB code	Source
			bicoarctatus			
1092	Teleost	Syngnathidae	Urocampus carinirostris	Hairy Pipefish	37282008	TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
1093	Teleost	Syngnathidae	Vanacampus margaritifer	Mother-of-pearl Pipefish	37282102	TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
1094	Teleost	Syngnathidae	Vanacampus phillipi	Port Phillip Pipefish	37282023	TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
1095	Teleost	Syngnathidae	Vanacampus poecilolaemus	Australian Long-snout Pipefish, Long-snouted Pipefish	37282024	TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
1096	Teleost	Syngnathidae	Vanacampus vercoi	Verco's Pipefish	37282103	TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.

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 within the jurisdictional area of the SBT Purse Seine Fishery. Blue denotes habitats occurring within the jurisdictional boundary of the fishery that are not subject to effort from Purse Seining. This list does not imply contact with these habitats, just that they fall within the area of the fishing effort. The ERAEF habitat number, record number, and SGF score are for database checking.

ERAEF record No.	ERAEF Habitat Number	Sub-biome	Feature	Habitat type	SGF Score	Depth (m)	Image available	Reference image location
0127	012	Inner shelf	shelf	fine sediments, unrippled, large sponges	101	25- 100	Y	SE, GAB, WA Image Collection
0911	094	inner shelf	shelf	fine sediments, unrippled, small sponges	102	25- 100	N	SE, GAB, WA Image Collection
0163	016	inner shelf	shelf	fine sediments, unrippled, mixed faunal community	103	25- 100	Y	SE, GAB, WA Image Collection
2116	203	inner shelf	shelf	Fine sediments, Unrippled, Small encrustors / erect forms (including bryozoans)	106	25- 100	Y	GAB habitat image collection: Image code 5959
0899	093	inner shelf	shelf	fine sediments, unrippled, bioturbators	109	25- 100	N	SE, GAB, WA Image Collection
0151	014	inner shelf	shelf	fine sediments, wave rippled, large sponges	111	25- 100	Y	SE, GAB, WA Image Collection
0923	095	inner shelf	shelf	fine sediments, wave rippled, no fauna	120	25- 100	N	SE, GAB, WA Image Collection
0936	096	inner shelf	shelf	fine sediments, wave rippled, small sponges	122	25- 100	N	SE, GAB, WA Image Collection

ERAEF record No.	ERAEF Habitat Number	Sub-biome	Feature	Habitat type	SGF Score	Depth (m)	Image available	Reference image location
2097	201	inner shelf	shelf	fine sediments, wave rippled, encrustors	126	25- 100	N	SE, GAB, WA Image Collection
0875	091	inner shelf	shelf	fine sediments, irregular, large sponges	131	25- 100	N	SE, GAB, WA Image Collection
0887	092	inner shelf	shelf	fine sediments, irregular, small sponges	132	25- 100	N	SE, GAB, WA Image Collection
2117	204	inner shelf	shelf	Fine sediments, Subcrop, Mixed faunal community (sponges, seawhips, ascidians)	153	25- 100	Y	GAB habitat image collection: Image code 5856
0139	013	inner shelf	shelf	coarse sediments, unrippled, large sponges	201	25- 100	Y	SE, GAB, WA Image Collection
2118	205	inner shelf	shelf	Coarse sediments, Unrippled, Small encrustors / erect forms (including bryozoans)	206	25- 100	Y	GAB habitat image collection: Image code 5843
0102	010	inner shelf	shelf	coarse sediments, current rippled, no fauna	210	25- 100	Y	SE, GAB, WA Image Collection
0994	010	inner shelf	shelf	Coarse sediments, Current rippled / directed scour, No fauna	210	25- 100	Y	GAB habitat image collection: Image code 6962
2119	206	inner shelf	shelf	Coarse sediments, Current rippled / directed scour, large sponges	211	25- 100	Y	GAB habitat image collection: Image code 7123
0863	090	inner shelf	shelf	coarse sediments, current rippled, bioturbators	219	25- 100	N	SE, GAB, WA Image Collection
0115	011	inner shelf	shelf	coarse sediments, wave rippled, large sponges	221	25- 100	Y	SE, GAB, WA Image Collection
1997	191	inner shelf	shelf	coarse sediments, wave rippled, small sponges	222	25- 100	N	SE, GAB, WA Image Collection
2086	200	inner shelf	shelf	coarse sediments, wave rippled, encrustors	226	25- 100	N	SE, GAB, WA Image Collection
0090	009	inner shelf	shelf	coarse sediments, wave rippled, sedentary	227	25- 100	Y	SE, GAB, WA Image Collection
0851	089	inner shelf	shelf	coarse sediments, irregular, encrustors	236	25- 100	N	SE, GAB, WA Image Collection
0066	006	inner shelf	shelf	coarse sediments, subcrop, large sponges	251	25- 100	Y	SE, GAB, WA Image Collection

ERAEF record No.	ERAEF Habitat Number	Sub-biome	Feature	Habitat type	SGF Score	Depth (m)	Image available	Reference image location
0006	001	inner shelf	shelf	gravel, current rippled, mixed faunal community	313	25- 100	Y	SE, GAB, WA Image Collection
0960	098	inner shelf	shelf	gravel, wave rippled, no fauna	320	25- 100	Y	SE, GAB, WA Image Collection
0948	097	inner shelf	shelf	gravel, wave rippled, bioturbators	329	25- 100	Y	SE, GAB, WA Image Collection
0078	007	inner shelf	shelf	gravel, debris flow, mixed faunal community	343	25- 100	Y	SE, GAB, WA Image Collection
2073	199	inner shelf	shelf	cobble, wave rippled, low/ encrusting mixed fauna	426	25- 100	N	SE, GAB, WA Image Collection
0054	005	inner shelf	shelf	cobble, debris flow, large sponges	441	25- 100	Y	SE, GAB, WA Image Collection
0972	099	inner shelf	shelf	Igneous rock, high outcrop, large sponges	591	25- 100	N	SE, GAB, WA Image Collection
0042	004	inner shelf	shelf	Sedimentary rock, outcrop, large sponges	671	25- 100	Y	SE, GAB, WA Image Collection
0018	002	inner shelf	shelf	Sedimentary rock, outcrop, large sponges	691	25- 100	Y	SE, GAB, WA Image Collection
0030	003	inner shelf	shelf	Sedimentary rock, outcrop, mixed faunal community	693	25- 100	Y	SE, GAB, WA Image Collection
1696	161	mid-slope	slope	mud, unrippled, small sponges	002	700- 1500	N	SE, GAB, WA Image Collection
1660	158	mid-slope	slope	mud, current rippled, bioturbators	019	700- 1500	N	SE, GAB, WA Image Collection
1684	160	mid-slope	slope	mud, irregular, sedentary	037	700- 1500	N	SE, GAB, WA Image Collection
1672	159	mid-slope	slope	mud, irregular, bioturbators	039	700- 1500	N	SE, GAB, WA Image Collection
1636	156	mid-slope	slope	fine sediments, unrippled, no fauna	100	700- 1500	N	SE, GAB, WA Image Collection
2113	156	mid-slope	Slope	Fine sediments, Unrippled, No fauna	100	700-1500	Y	GAB habitat image collection: Image code 6801

ERAEF record No.	ERAEF Habitat Number	Sub-biome	Feature	Habitat type	SGF Score	Depth (m)	Image available	Reference image location
0647	063	mid-slope	slope	fine sediments, unrippled, octocorals	105	700- 1500	Y	SE, GAB, WA Image Collection
0623	061	mid-slope	slope	fine sediments, irregular, bioturbators	139	700- 1500	Y	SE, GAB, WA Image Collection
0575	057	mid-slope	slope	fine sediments, subcrop, bioturbators	150	700- 1500	Y	SE, GAB, WA Image Collection
1600	153	mid-slope	slope	coarse sediments, unrippled, no fauna	200	700- 1500	N	SE, GAB, WA Image Collection
0635	062	mid-slope	slope	coarse sediments, unrippled, octocorals	205	700- 1500	Y	SE, GAB, WA Image Collection
1564	150	mid-slope	slope	coarse sediments, current rippled, no fauna	210	700- 1500	N	SE, GAB, WA Image Collection
1576	151	mid-slope	slope	coarse sediments, current rippled, octocorals	215	700- 1500	N	SE, GAB, WA Image Collection
2120	207	mid-slope	Slope	Coarse sediments, Current rippled / directed scour, Small encrustors / erect forms (including bryozoans)	216	700-1500	Y	GAB habitat image collection: Image code 7544
1588	152	mid-slope	slope	coarse sediments, current rippled, sedentary	217	700- 1500	N	SE, GAB, WA Image Collection
2112	152	mid-slope	Slope	Coarse sediments, Current rippled / directed scour, Sedentary: e.g. seapens	217	700-1500	Y	GAB habitat image collection: Image code 8153
2121	208	mid-slope	Slope	Coarse sediments, Highly irregular, Mixed faunal community (sponges, seawhips, ascidians)	233	700-1500	Y	GAB habitat image collection: Image code 6526
0599	059	mid-slope	slope	coarse sediments, irregular,low encrusting	236	700- 1500	Y	SE, GAB, WA Image Collection
2103	059	mid-slope	Slope	Coarse sediments, Highly irregular, Small encrustors / erect forms (including bryozoans)	236	700-1500	Y	GAB habitat image collection: Image code 6529
0587	058	mid-slope	slope	cobble, unrippled, small sponges	402	700- 1500	Y	SE, GAB, WA Image Collection
1612	154	mid-slope	slope	cobble, debris flow, crinoids	444	700- 1500	N	SE, GAB, WA Image Collection
1624	155	mid-slope	slope	slabs/ boulders, debris flow, octocorals	445	700- 1500	Y	SE, GAB, WA Image Collection

ERAEF record No.	ERAEF Habitat Number	Sub-biome	Feature	Habitat type	SGF Score	Depth (m)	Image available	Reference image location
0491	050	mid-slope	slope	cobble, debris flow, encrustors	446	700- 1500	Y	SE, GAB, WA Image Collection
2123	210	mid-slope	Slope	Cobble/ boulder, Debris flow / rubble banks, Sedentary: e.g. seapens	447	700-1500	Y	GAB habitat image collection: Image code 6665
0503	051	mid-slope	slope	cobble, outcrop, no fauna	460	700- 1500	Y	SE, GAB, WA Image Collection
0611	060	mid-slope	slope	cobble, outcrop, crinoids	464	700- 1500	Y	SE, GAB, WA Image Collection
0659	064	mid-slope	slope	Sedimentary slab and mud boulders, outcrop, crinoids	464	700- 1500	Y	SE, GAB, WA Image Collection
2124	211	mid-slope	Slope	Igneous / metamorphic rock, Subcrop, Small encrustors	556	700-1500	Y	GAB habitat image collection: Image code 6712
2125	212	mid-slope	Slope	Igneous / metamorphic rock, Subcrop, Sedentary: e.g. seapens	557	700-1500	Y	GAB habitat image collection: Image code 6680 and 6699
0527	053	mid-slope	slope	Igneous rock, low outcrop, sedentary	567	700- 1500	Y	SE, GAB, WA Image Collection
2126	213	mid-slope	Slope	Igneous / metamorphic rock, Low Outcrop, Octocorals (gold corals / seawhips)	575	700-1500	Y	GAB habitat image collection: Image code 6713
2127	214	mid-slope	Slope	Igneous / metamorphic rock, Low Outcrop, Small encrustors	576	700-1500	Y	GAB habitat image collection: Image code 6732
2128	215	mid-slope	Slope	Igneous / metamorphic rock, Low Outcrop, Sedentary: e.g. seapens	577	700-1500	Y	GAB habitat image collection: Image code 6669 and 6705
0479	049	mid-slope	slope	Igneous rock, high outcrop, bioturbators	594	700- 1500	Y	SE, GAB, WA Image Collection
1648	157	mid-slope	slope	Igneous rock, high outcrop, octocorals	595	700- 1500	N	SE, GAB, WA Image Collection
0551	055	mid-slope	slope	Sedimentary rock, unrippled, sedentary	607	700- 1500	Y	SE, GAB, WA Image Collection
1708	162	mid-slope	slope	Sedimentary rock, debris flow, crinoids	644	700- 1500	N	SE, GAB, WA Image Collection
1732	164	mid-slope	slope	Sedimentary rock, subcrop, crinoids	654	700- 1500	Y	SE, GAB, WA Image Collection

ERAEF record No.	ERAEF Habitat Number	Sub-biome	Feature	Habitat type	SGF Score	Depth (m)	Image available	Reference image location
1744	165	mid-slope	slope	Sedimentary rock, subcrop, octocorals	655	700- 1500	Y	SE, GAB, WA Image Collection
0563	056	mid-slope	slope, canyons, seamounts	Sedimentary rock, outcrop, mixed faunal community	673	700- 1500	Y	SE, GAB, WA Image Collection
0515	052	mid-slope	slope	Sedimentary rock, outcrop, octocorals	675	700- 1500	Y	SE, GAB, WA Image Collection
2107	080	mid-slope	Slope	Sedimentary rock, Low Outcrop, Small encrustors	676	700-1500	Y	GAB habitat image collection: Image code 6888
0827	084	mid-slope	seamount	Sedimentary rock, outcrop, sedentary	677	700- 1500	Y	SE, GAB, WA Image Collection
2108	084	mid-slope	Slope	Sedimentary rock, Low Outcrop, Sedentary: e.g. seapens	677	700-1500	Y	GAB habitat image collection: Image code 5702
0539	054	mid-slope	slope	Sedimentary rock, outcrop, crinoids	694	700- 1500	Y	SE, GAB, WA Image Collection
1720	163	mid-slope	slope	Sedimentary rock, high outcrop, octocorals	695	700- 1500	Y	SE, GAB, WA Image Collection
2114	163	mid-slope	Slope	Sedimentary rock, High Outcrop, Octocorals (gold corals / seawhips)	695	700-1500	Y	GAB habitat image collection: Image code 7570
1840	173	outer shelf	shelf-break	mud, unrippled, no fauna	000	100- 200, 200-700	N	SE, GAB, WA Image Collection
1887	177	outer shelf	shelf	mud, unrippled, low encrusting sponges	002	100- 200	N	SE, GAB, WA Image Collection
0984	100	outer shelf	shelf	mud, unrippled, sedentary	007	100- 200	Y	SE, GAB, WA Image Collection
1852	174	outer shelf	shelf-break	mud, unrippled, sedentary	007	100- 200, 200-700	N	SE, GAB, WA Image Collection
1896	178	outer shelf	shelf	mud, unrippled, bioturbators	009	100- 200	N	SE, GAB, WA Image Collection
1905	179	outer shelf	shelf	mud, subcrop, erect sponges	051	100- 200	N	SE, GAB, WA Image Collection
1299	125	outer shelf	shelf	mud, subcrop, small sponges	052	100- 200	Y	SE, GAB, WA Image Collection

ERAEF record No.	ERAEF Habitat Number	Sub-biome	Feature	Habitat type	SGF Score	Depth (m)	Image available	Reference image location
1914	180	outer shelf	shelf	mud, subcrop, low encrusting mixed fauna	056	100- 200	N	SE, GAB, WA Image Collection
1135	112	outer shelf	shelf	fine sediments, unrippled, no fauna	100	100- 200	Y	SE, GAB, WA Image Collection
1804	170	outer shelf	shelf-break	fine sediments, unrippled, no fauna	100	100- 200, 200-700	N	SE, GAB, WA Image Collection
1122	111	outer shelf	shelf	fine sediments, unrippled, large sponges	101	100- 200	Y	SE, GAB, WA Image Collection
1148	113	outer shelf	shelf	fine sediments, unrippled, small sponges	102	100- 200	Y	SE, GAB, WA Image Collection
1816	171	outer shelf	shelf-break	fine sediments, unrippled, octocorals	105	100- 200, 200-700	N	SE, GAB, WA Image Collection
1923	181	outer shelf	shelf	fine sediments, unrippled, encrustors	106	100- 200	N	SE, GAB, WA Image Collection
1110	110	outer shelf	shelf	fine sediments, unrippled, bioturbators	109	100- 200	Y	SE, GAB, WA Image Collection
1792	169	outer shelf	shelf-break	fine sediments, unrippled, bioturbators	109	100- 200, 200-700	N	SE, GAB, WA Image Collection
1932	183	outer shelf	shelf	fine sediments, current rippled, no fauna	110	100- 200	N	SE, GAB, WA Image Collection
1941	184	outer shelf	shelf	fine sediments, current rippled, low/ encrusting sponges	112	100- 200	N	SE, GAB, WA Image Collection
1034	104	outer shelf	shelf	fine sediments, current rippled, bioturbators	119	100- 200	Y	SE, GAB, WA Image Collection
1198	117	outer shelf	shelf	fine sediments, wave rippled, no fauna	120	100- 200	N	SE, GAB, WA Image Collection
1185	116	outer shelf	shelf	fine sediments, wave rippled, large sponges	121	100- 200	N	SE, GAB, WA Image Collection
1222	119	outer shelf	shelf	fine sediments, wave rippled, small sponges	122	100- 200	N	SE, GAB, WA Image Collection
1173	115	outer shelf	shelf	fine sediments, wave rippled, encrustors	126	100- 200	N	SE, GAB, WA Image Collection

ERAEF record No.	ERAEF Habitat Number	Sub-biome	Feature	Habitat type	SGF Score	Depth (m)	Image available	Reference image location
1210	118	outer shelf	shelf	fine sediments, wave rippled, sedentary	127	100- 200	N	SE, GAB, WA Image Collection
1161	114	outer shelf	shelf	fine sediments, wave rippled, bioturbators	129	100- 200	Y	SE, GAB, WA Image Collection
1059	106	outer shelf	shelf	fine sediments, irregular, no fauna	130	100- 200	N	SE, GAB, WA Image Collection
1046	105	outer shelf	shelf	fine sediments, irregular, large sponges	131	100- 200	N	SE, GAB, WA Image Collection
1072	107	outer shelf	shelf	fine sediments, irregular, small sponges	132	100- 200	N	SE, GAB, WA Image Collection
1780	168	outer shelf	shelf-break	fine sediments, irregular, small sponges	132	100- 200, 200-700	N	SE, GAB, WA Image Collection
1950	185	outer shelf	shelf	fine sediments, irregular, low encrusting mixed fauna	136	100- 200	N	SE, GAB, WA Image Collection
1959	187	outer shelf	shelf	fine sediments, irregular, bioturbators	139	100- 200	N	SE, GAB, WA Image Collection
1768	167	outer shelf	shelf-break	fine sediments, irregular, bioturbators	139	100- 200, 200-700	N	SE, GAB, WA Image Collection
1968	188	outer shelf	shelf	fine sediments, rubble banks, low encrusting sponges	142	100- 200	N	SE, GAB, WA Image Collection
0176	017	outer shelf	shelf	fine sediments, subcrop, large sponges	151	100- 200	Y	SE, GAB, WA Image Collection
1097	109	outer shelf	shelf	fine sediments, subcrop, small sponges	152	100- 200	Y	SE, GAB, WA Image Collection
1084	108	outer shelf	shelf	fine sediments, subcrop, mixed faunal community	153	100- 200	N	SE, GAB, WA Image Collection
1977	189	outer shelf	shelf	fine sediments, subcrop, mixed low fauna	156	100- 200	N	SE, GAB, WA Image Collection
1986	190	outer shelf	shelf	coarse sediments, unrippled, no fauna	200	100- 200	N	SE, GAB, WA Image Collection
0323	030	outer shelf	shelf	coarse sediments, unrippled, mixed faunal community	203	100- 200	Y	SE, GAB, WA Image Collection

ERAEF record No.	ERAEF Habitat Number	Sub-biome	Feature	Habitat type	SGF Score	Depth (m)	Image available	Reference image location
0274	026	outer shelf	shelf	coarse sediments, unrippled, encrustors	206	100- 200	Y	SE, GAB, WA Image Collection
0287	027	outer shelf	shelf	coarse sediments, current rippled, no fauna	210	100- 200	Y	SE, GAB, WA Image Collection
0262	025	outer shelf	shelf	coarse sediments, wave rippled, no fauna	220	100- 200	Y	SE, GAB, WA Image Collection
1022	103	outer shelf	shelf	coarse sediments, wave rippled, small sponges	222	100- 200	N	SE, GAB, WA Image Collection
1010	102	outer shelf	shelf	coarse sediments, wave rippled, encrustors	226	100- 200	N	SE, GAB, WA Image Collection
0311	029	outer shelf	shelf	coarse sediments, irregular, large sponges	231	100- 200	Y	SE, GAB, WA Image Collection
0201	019	outer shelf	shelf	coarse sediments, subcrop, large sponges	251	100- 200	Y	SE, GAB, WA Image Collection
0998	101	outer shelf	shelf	coarse sediments, subcrop, small sponges	252	100- 200	N	SE, GAB, WA Image Collection
2122	209	Outer shelf	shelf	Coarse sediments, Subcrop, Mixed faunal community	253	100- 200	Y	GAB habitat image collection: Image code 6001
2008	192	outer shelf	shelf	gravel/ pebble, current rippled, large sponges	311	100- 200	N	SE, GAB, WA Image Collection
2017	193	outer shelf	shelf	gravel/ pebble, current rippled, mixed low fauna	316	100- 200	N	SE, GAB, WA Image Collection
1235	120	outer shelf	shelf	gravel, current rippled, bioturbators	319	100- 200	N	SE, GAB, WA Image Collection
1286	124	outer shelf	shelf	gravel, wave rippled, no fauna	320	100- 200	N	SE, GAB, WA Image Collection
1273	123	outer shelf	shelf	gravel, wave rippled, large sponges	321	100- 200	N	SE, GAB, WA Image Collection
2026	194	outer shelf	shelf	gravel/ pebble, wave rippled, low encrusting sponges	322	100- 200	N	SE, GAB, WA Image Collection
2035	195	outer shelf	shelf	gravel, wave rippled, encrustors	326	100- 200	N	SE, GAB, WA Image Collection

ERAEF record No.	ERAEF Habitat Number	Sub-biome	Feature	Habitat type	SGF Score	Depth (m)	Image available	Reference image location
1260	122	outer shelf	shelf	gravel, wave rippled, encrustors	326	100- 200	N	SE, GAB, WA Image Collection
1248	121	outer shelf	shelf	gravel, wave rippled, bioturbators	329	100- 200	Y	SE, GAB, WA Image Collection
0249	024	outer shelf	shelf	gravel, irregular, encrustors	336	100- 200	Y	SE, GAB, WA Image Collection
2044	196	outer shelf	shelf	gravel, wave rippled, encrustors	346	100- 200	N	SE, GAB, WA Image Collection
0299	028	outer shelf	shelf	cobble, unrippled, large sponges	401	100- 200	Y	SE, GAB, WA Image Collection
2053	197	outer shelf	shelf	cobble, unrippled, low/ encrusting mixed fauna	406	100- 200	N	SE, GAB, WA Image Collection
2062	198	outer shelf	shelf	cobble, current rippled, low/ encrusting mixed fauna	416	100- 200	N	SE, GAB, WA Image Collection
0335	032	outer shelf	shelf	cobble, subcrop, crinoids	454	100- 200	Y	SE, GAB, WA Image Collection
0213	020	outer shelf	shelf	cobble, outcrop, crinoids	464	100- 200	Y	SE, GAB, WA Image Collection
1828	172	outer shelf	shelf-break	Igneous rock,high outcrop,no fauna	590	100- 200, 200- 700	N	SE, GAB, WA Image Collection
1311	126	outer shelf	shelf	Sedimentary rock, subcrop, large sponges	651	100- 200	Y	SE, GAB, WA Image Collection
2109	126	Outer shelf	shelf	Sedimentary rock, Subcrop, large sponges	651	100- 200	Y	GAB habitat image collection: Image code 7260
1324	127	outer shelf	shelf	Sedimentary rock, subcrop, small sponges	652	100- 200	Y	SE, GAB, WA Image Collection
1876	176	outer shelf	shelf-break	Sedimentary rock, subcrop, small sponges	652	100- 200, 200- 700	N	SE, GAB, WA Image Collection
0225	022	outer shelf	shelf	Sedimentary rock, subcrop, mixed faunal community	653	100- 200	Y	SE, GAB, WA Image Collection
1864	175	outer shelf	shelf-break	Sedimentary rock, subcrop, crinoids	654	100- 200, 200- 700	N	SE, GAB, WA Image Collection

ERAEF record No.	ERAEF Habitat Number	Sub-biome	Feature	Habitat type	SGF Score	Depth (m)	Image available	Reference image location
0237	023	outer shelf	shelf	Sedimentary rock, outcrop, large sponges	671	100- 200	Y	SE, GAB, WA Image Collection
0671	065	outer shelf	canyon	Sedimentary rock, outcrop, small sponges	672	100- 200	Y	SE, GAB, WA Image Collection
0188	018	outer shelf	shelf	Sedimentary rock, outcrop, encrustors	696	100- 200	Y	SE, GAB, WA Image Collection
1756	166	outer shelf	shelf-break	Bryozoan based commmunities	xx6	100- 200, 200-700	N	SE, GAB, WA Image Collection
2115	202	upper slope	Slope	Mud, Unrippled, No fauna	000	200-700	Y	GAB habitat image collection: Image code 5567
1504	143	upper slope	slope	mud, unrippled, large sponges	001	200- 700	N	SE, GAB, WA Image Collection
1492	142	upper slope	slope	mud, unrippled, encrustors	006	200- 700	Y	SE, GAB, WA Image Collection
1516	144	upper slope	slope	mud, unrippled, sedentary	007	200- 700	Y	SE, GAB, WA Image Collection
2110	144	upper slope	Slope	Mud, Unrippled, Sedentary	007	200-700	Y	GAB habitat image collection: Image code 5814
1480	141	upper slope	slope	mud, unrippled, bioturbators	009	200- 700	Y	SE, GAB, WA Image Collection
1468	140	upper slope	slope	mud, irregular, bioturbators	039	200- 700	Y	SE, GAB, WA Image Collection
0467	046	upper slope	slope	fine sediments, unrippled, no fauna	100	200- 700	Y	SE, GAB, WA Image Collection
1432	137	upper slope	slope	fine sediments, unrippled, small sponges	102	200- 700	N	SE, GAB, WA Image Collection
1420	136	upper slope	slope	fine sediments, unrippled, encrustors	106	200- 700	Y	SE, GAB, WA Image Collection
0791	078	upper slope	canyon	fine sediments, unrippled, sedentary	107	200- 700	Y	SE, GAB, WA Image Collection
2106	078	upper slope	Slope	Fine sediments, Unrippled, Sedentary	107	200-700	Y	GAB habitat image collection: Image code 7291

ERAEF record No.	ERAEF Habitat Number	Sub-biome	Feature	Habitat type	SGF Score	Depth (m)	Image available	Reference image location
0443	044	upper slope	slope, canyon	fine sediments, unrippled, bioturbators	109	200- 700	Y	SE, GAB, WA Image Collection
2102	044	upper slope	Slope	Fine sediments, Unrippled, Distinct infauna bioturbators	109	200-700	Y	GAB habitat image collection: Image code 5522
1396	133	upper slope	slope	fine sediments, current rippled, no fauna	110	200- 700	N	SE, GAB, WA Image Collection
0755	073	upper slope	canyon	fine sediments, irregular, encrustors	136	200- 700	Y	SE, GAB, WA Image Collection
2105	073	upper slope	Slope	Fine sediments, irregular, Small encrustors / erect forms (including bryozoans)	136	200-700	Y	GAB habitat image collection: Image code 7476
0419	041	upper slope	slope	fine sediments, irregular, bioturbators	139	200- 700	Y	SE, GAB, WA Image Collection
1408	134	upper slope	slope	fine sediments, subcrop, large sponges	151	200- 700	N	SE, GAB, WA Image Collection
0779	077	upper slope	canyon, slope	fine sediments, subcrop, small sponges	152	200- 700	Y	SE, GAB, WA Image Collection
0407	040	upper slope	slope	fine sediments, subcrop, sedentary	157	200- 700	Y	SE, GAB, WA Image Collection
0431	043	upper slope	slope	coarse sediments, unrippled, low mixed encrustors	206	200- 700	Y	SE, GAB, WA Image Collection
0455	045	upper slope	slope	coarse sediments, unrippled, sedentary	207	200- 700	Y	SE, GAB, WA Image Collection
0767	076	upper slope	canyon, slope	coarse sediments, irregular, low mixed encrustors	236	200- 700	Y	SE, GAB, WA Image Collection
0743	072	upper slope	canyon	coarse sediments, irregular, bioturbators	239	200- 700	Y	SE, GAB, WA Image Collection
1456	139	upper slope	slope	gravel, debris flow, no fauna	340	200- 700	N	SE, GAB, WA Image Collection
1444	138	upper slope	slope	gravel, debris flow, encrustors	346	200- 700	Y	SE, GAB, WA Image Collection
1360	130	upper slope	slope	cobble, debris flow, no fauna	440	200- 700	Y	SE, GAB, WA Image Collection

ERAEF record No.	ERAEF Habitat Number	Sub-biome	Feature	Habitat type	SGF Score	Depth (m)	Image available	Reference image location
1384	132	upper slope	slope	cobble, debris flow, small sponges	442	200- 700	Y	SE, GAB, WA Image Collection
1372	131	upper slope	slope	cobble, debris flow, octocorals	445	200- 700	N	SE, GAB, WA Image Collection
1348	129	upper slope	slope	cobble, debris flow, encrustors	446	200- 700	Y	SE, GAB, WA Image Collection
0707	069	upper slope	canyon	cobble, outcrop, crinoids	464	200- 700	Y	SE, GAB, WA Image Collection
0815	081	upper slope	seamount	Sedimentary rock, unrippled, no fauna	600	200- 700	Y	SE, GAB, WA Image Collection
0839	085	upper slope	seamount	Sedimentary rock, unrippled, encrustors	606	200- 700	Y	SE, GAB, WA Image Collection
0695	067	upper slope	canyon, slope	Sedimentary rock, subcrop, large sponges	651	200- 700	Y	SE, GAB, WA Image Collection
0719	070	upper slope	canyon	Sedimentary rock, subcrop, small sponges	652	200- 700	Y	SE, GAB, WA Image Collection
0347	033	upper slope	slope	Sedimentary rock, subcrop, mixed faunal community	653	200- 700	Y	SE, GAB, WA Image Collection
1552	148	upper slope	slope	Sedimentary rock, subcrop, octocorals	655	200- 700	N	SE, GAB, WA Image Collection
2111	148	upper slope	Slope	Sedimentary rock, Subcrop, Octocorals (gold corals / seawhips)	655	200-700	Y	GAB habitat image collection: Image code 7866
0383	036	upper slope	slope	Sedimentary rock, subcrop, encrustors	656	200- 700	Y	SE, GAB, WA Image Collection
0371	035	upper slope	slope	Sedimentary rock, outcrop, encrustors	666	200- 700	Y	SE, GAB, WA Image Collection
1528	145	upper slope	slope	Sedimentary rock, low outcrop, large sponges	671	200- 700	N	SE, GAB, WA Image Collection
1540	146	upper slope	slope	Sedimentary rock, low outcrop, small sponges	672	200- 700	Y	SE, GAB, WA Image Collection
2129	216	upper slope	Slope	Sedimentary rock, low outcrop, Octocorals (gold corals / seawhips)	675	200-700	Y	GAB habitat image collection: Image code 5702

ERAEF record No.	ERAEF Habitat Number	Sub-biome	Feature	Habitat type	SGF Score	Depth (m)	Image available	Reference image location
0731	071	upper slope	canyon	Sedimentary rock, outcrop, encrustors	676	200- 700	Y	SE, GAB, WA Image Collection
0803	080	upper slope	seamount	Sedimentary rock, outcrop, encrustors	676	200- 700	Y	SE, GAB, WA Image Collection
2104	071	upper slope	Slope	Sedimentary rock, Low Outcrop, Small encrustors	676	200-700	Y	GAB habitat image collection: Image code 5823
0395	039	upper slope	slope	Sedimentary rock, outcrop, crinoids	684	200- 700	Y	SE, GAB, WA Image Collection
2130	217	upper slope	Slope	Sedimentary rock, High Outcrop, Small encrustors / erect forms (including bryozoans)	686	200-700	Y	GAB habitat image collection: Image code 7726
2131	218	upper slope	Slope	Sedimentary rock, High Outcrop, Sedentary: e.g. seapens	687	200-700	Y	GAB habitat image collection: Image code 5703
0683	066	upper slope	canyon	Sedimentary rock, outcrop, crinoids	694	200- 700	Y	SE, GAB, WA Image Collection
0359	034	upper slope	slope	Sedimentary rock, outcrop, encrustors	696	200- 700	Y	SE, GAB, WA Image Collection
1336	128	upper slope	slope	Bryozoan based communities	xx6	200- 700	N	SE, GAB, WA Image Collection

WA Images not yet classified, but are to be included in this list when available.

Scoping Document S2B2. Pelagic Habitats

A list of the pelagic habitats within the jurisdictional area for the SBT Purse Seine Fishery. Shading denotes habitats occurring within the jurisdictional boundary of the fishery that are not subject to effort from Purse Seining.

ERAEF Habitat Number	Pelagic Habitat type	Depth (m)	Comments	Reference
P1	Eastern Pelagic Province - Coastal	0 – 200		dow167A1, A2, A4
P2	Eastern Pelagic Province - Oceanic	0 – > 600	this is a compilation of the range covered by Oceanic Community (1) and (2)	dow167A1, A2, A4
P4	North Eastern Pelagic Province - Oceanic	0 – > 600	this is a compilation of the range covered by Oceanic Community (1) and (2)	dow167A1, A2, A4
P5	Northern Pelagic Province - Coastal	0 – 200		dow167A1, A2, A4
P6	North Western Pelagic Province - Oceanic	0 – > 800	this is a compilation of the range covered by Oceanic Community (1) and (2)	dow167A1, A2, A4
P7	Southern Pelagic Province - Coastal	0 – 200	this is a compilation of the range covered by Coastal pelagic Tas and GAB	dow167A1, A2, A4
P8	Southern Pelagic Province - Oceanic	0 – > 600	this is a compilation of the range covered by Oceanic Communities (1), (2), and (3)	dow167A1, A2, A4
P9	Southern Pelagic Province - Seamount Oceanic	0 – > 600	this is a compilation of the range covered by Seamount Oceanic Communities (1), (2), and (3)	dow167A1, A2, A4
P10	Western Pelagic Province - Coastal	0 – 200		dow167A1, A2, A4
P11	Western Pelagic Province - Oceanic	0 – > 400	this is a compilation of the range covered by Oceanic Community (1) and (2)	dow167A1, A2, A4
P12	Eastern Pelagic Province - Seamount Oceanic	0 – > 600	this is a compilation of the range covered by Seamount Oceanic Communities (1) and (2)	dow167A1, A2, A4
P14	North Eastern Pelagic Province - Coastal	0 – 200		dow167A1, A2, A4
P15	North Eastern Pelagic Province - Plateau	0 – > 600	this is a compilation of the range covered by the Northeastern Plateau Community (1) and (2)	dow167A1, A2, A4
P16	North Eastern Pelagic Province - Seamount Oceanic	0 – > 600	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 communities that occur within the jurisdictional area of the SBT fishery (indicated by x). Shaded cells indicate the communities that exist in the province.

Demersal community	Cape	North Eastern	North Eastern Transition	Central Eastern	Central Eastern Transition	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 [1,2,4]										X									
Upper Slope 250 – 565m [3,4]																			
Mid–Upper Slope 565 – 820m [3,5]																			
Mid Slope 820 – 1100m [3,5]																			
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																			
Plateau 110- 250m[9]																			
Plateau 250 – 565m[9]																			
Plateau 565 – 820m																			
Plateau 820 – 1100m																			

[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, and [3]upper and midslope communities combined. At Heard/McDonald Is: [4]outer shelf and upper slope combined (100-500m), [5]mid and upper slopes combined into 3 trough and southern slope communities (500-100m), [9]plateaux equivalent to Shell and Western Banks (100-500m) 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 that occur within the jurisdictional area of SBT (indicated by x) although fishing activity may not necessarily occur in all. Shaded cells indicate the communities that exist in the province.

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

Heard/McDonald and Macquarie Island communities do not have coastal pelagic zones. [1] Northern Province has five coastal pelagic zones (NWS, Bonaparte, Arafura, Gulf and East Cape York). [2] Coastal pelagic zone at Heard and McDonald Is 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 No trend in biomass 1.2 Maintain biomass above a specified level 1.3 Maintain catch at specified level 1.4 Species do not approach extinction or become extinct	Biomass, numbers, density, CPUE, yield	1.1 Operational objective too general and covered by (1.2-1.4). 1.2 EMO – Rebuild parental SBT stocks to 1980 levels by the year 2020 - goal set out by CCSBT 1.3 EMO – Conservation of the species - an international management objective 1.4 Desirable for fishery to maintain catch at quota
		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 To maintain integrity of natural lifecycle - migration and reproduction. Also Economic penalty to fishery if SBT shift further from port
		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.
		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 fish size range for grow-out cages. Also Maintenance of proper functioning of population processes i.e. shoaling behaviour which may influence foraging and protection of juveniles in the GAB.
		5. Reproductive Capacity	5.1 Fecundity of the population does not change outside acceptable bounds (e.g. more than X% of reference population fecundity) 2 Recruitment to the population does not change outside acceptable bounds	Egg production of population Abundance of recruits	5.1 Ability of SBT 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.

Component	Core Objective	Sub-component	Example Operational Objectives	Example Indicators	Rationale
		6. Behaviour /Movement	6.1 Behaviour and movement patterns of the population do not change outside acceptable bounds	Presence of population across space, movement patterns within the population (e.g. attraction to bait, lights)	6.1 To maintain integrity and functioning of SBT shoal units. Also penalty to fishery if changes in shoaling or surfacing behaviour occur – fish may be difficult to locate and capture.
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 EMO - Fishing is conducted in a manner that does not threaten stocks of byproduct / bycatch species (AFMA 2002). 1.2 Increase in byproduct/bycatch not desirable for fishery, decreased efficiency of operations and/or potential for negative effects on condition of the SBT stock (AFMA 2002). 1.3 Not desirable to maintain biomass of bycatch/byproduct above certain level, the EMO for bycatch/byproduct can be achieved independent of biomass maintenance. 1.4 Not desirable to maintain bycatch/byproduct at specified level for the SBT Fishery – want to minimise bycatch/byproduct.
		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 bycatch/byproduct species.
		3. Genetic structure	3.1 Genetic diversity does not change outside acceptable bounds	Frequency of genotypes in the population, effective population size (N_e), number of spawning units	3.1 Not currently monitored. No reference levels established. No specific management objective based on the genetic structure of bycatch species.
		4. Age/size/sex structure	4.1 Age/size/sex structure does not change outside acceptable bounds (e.g. more than X% from reference structure)	Biomass, numbers or relative proportion in age/size/sex classes Biomass of spawners Mean size, sex ratio	4.1 EMO - Modification of gear selectivity and operational aspects of the SBT fishery to minimise the effects on byproduct / bycatch species (AFMA 2002).

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 Beyond the generality of the EMO "Fishing is conducted in a manner that does not threaten stocks of byproduct / bycatch species", reproductive capacity is not currently measured for bycatch/byproduct species and is largely covered by other objectives.
		6. Behaviour /Movement	6.1 Behaviour and movement patterns of the population do not change outside acceptable bounds	Presence of population across space, movement patterns within the population (e.g. attraction to bait, lights)	6.1 Purse seine capture and transport methods may attract bycatch species and alter behaviour and movement patterns, resulting in the attraction of species to fishing/tow path areas.
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 - The fishery is conducted in a manner that avoids mortality of, or injuries to, endangered, threatened or protected species (AFMA 2002). 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 The above EMO states 'must avoid mortality/injury to TEP's'.
		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 SBT Fishery because potential fishery induced changes in reproductive ability (e.g. reduction in bait fish 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 capture and transport methods may attract TEP species and alter behaviour and movement patterns, resulting in the attraction of offshore species to inshore areas e.g. great white shark. The overall effect may be to further fragment the population. Fishing operations may also influence the behaviour of calving 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 - The fishery is conducted in a manner that avoids mortality of, or injuries to, endangered, threatened or protected species (AFMA 2002).
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 The main water quality issue is likely to be related to the feeding of pilchards as SBT in tow cages are bought into port (AFMA 2002). But translocation of pilchard disease may have greatest impact on water quality in GAB.
		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.
		3. Substrate quality	3.1 Sediment quality does not change outside acceptable bounds	Sediment chemistry, stability, particle size, debris, pollutant concentrations	3.1 EMO - The fishery is conducted, in a manner that minimises the impact of fishing operations on benthic habitat (AFMA 2002) - The main sediment issues likely to be related to the feeding of pilchards as SBT in tow cages are bought into port.
		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.

Component	Core Objective	Sub-component	Example Operational Objectives	Example Indicators	Rationale
		5. Habitat structure and function	5.1 Size, shape and condition of habitat types does not vary outside acceptable bounds	Size structure, species composition and morphology of biotic habitats	5.1 Purse seining activities may result in local disruption to pelagic processes, and perhaps benthic processes.
Communities	Avoid negative impacts on the composition/function/distribution/structure of the community	1. Species composition	1.1 Species composition of communities does not vary outside acceptable bounds	Species presence/absence, species numbers or biomass (relative or absolute) Richness Diversity indices Evenness indices	1.1 EMO - The fishery is conducted, in a manner that minimises the impact of fishing operations on ecological communities (AFMA 2002).
		2. Functional group composition	2.1 Functional group composition does not change outside acceptable bounds	Number of functional groups, species per functional group (e.g. autotrophs, filter feeders, herbivores, omnivores, carnivores)	2.1 The presence/abundance of 'functional group' members may fluctuate widely, however in terms of maintenance of ecosystem processes it is important that the aggregate effect of a functional group is maintained.
		3. Distribution of the community	3.1 Community range does not vary outside acceptable bounds	Geographic range of the community, continuity of range, patchiness	3.1 Purse seining operations, namely transport of SBT back to port, may attract offshore species into the coast, i.e. moving the offshore community inshore.
		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 in the GAB potentially resulting in migratory or behavioural shifts in SBT 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. great white sharks and toothed whales.

Component	Core Objective	Sub-component	Example Operational Objectives	Example Indicators	Rationale
		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 detectable effect on bio and geochemical cycles. However, this habitat sub-component considered important in context of SBT farming where inputs (feed/excrement) are localised through time and space – SBT farm operations not considered in this ERA.

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: Southern Bluefin Tuna Fishery
Sub-fishery Name: Purse seine sub-fishery
Date completed: March 4, 2003 (updated October 2003)

Direct impact of Fishing	Fishing Activity	Score (0/1)	Documentation of Rationale
Capture	Bait collection	1	Capture of bait fish occurs to aid target fishery. (Note there is a pilchard fishery in the GAB dedicated to catching bait fish for SBT farming, also increasing amounts of imported bait fish are used in the SBT Fishery).
	Fishing	1	Actual fishing, i.e. capture of SBT due to deployment and retrieval of purse seine net including bycatch/byproduct organisms.
	Incidental behaviour	1	Potential for capture of organisms due to crew behaviour e.g. fishing with hand lines.
Direct impact without capture	Bait collection	1	Injury to bait fish that are netted during bait collection activities but which are not captured, plus the indirect effect of prey food removal on the target species.
	Fishing	1	Disorientation/injury/mortality as a result of momentary entanglement in seine net but animal able to free itself, e.g. seal/shark.
	Incidental behaviour	1	Use of firearms as deterrents for scavenging species interacting with catch during capture/transport of SBT.
	Gear loss	1	Potential lost items known to entangle animals includes netting, ropes, buoys, six pack holders etc. - requires monitoring.
	Anchoring/ mooring	1	Anchoring/mooring has direct impacts (damage or mortality) on benthic invertebrates coming into contact with anchor, chain or rope. Any interaction /incident on the sea floor occurring in the Benthic Protection Zone (of the GAB Marine Park) must be reported to National Parks (Edyvane 1998).
	Navigation/steaming	1	Steaming/navigation (including spotter planes) to find aggregations of SBT may result in collisions (e.g. seabirds or whales vessel interactions), seabird collisions with nighttime lights/navigation lights.
Addition/ movement of biological material	Translocation of species (boat launching, reballasting)	1	Transfer of bait imported from overseas (e.g. pilchards) to the South Australian SBT fishing grounds. Translocation of live and dead bait from inshore to offshore fishing grounds, plus translocation of SBT from fishing grounds to inshore farm cages (AFMA 2002). It is important to note that the risks from translocation of species (in this case most likely due to hull fouling) present the classical problem for risk assessment – a low probability event combined with a potentially high impact consequence. This introduces a lot of uncertainty about risk levels associated with such hazards. In general the risk levels for this hazard have been scored as only moderate, reflecting an assumed low probability of occurrence.
	On board processing	0	Not applicable to the 'live' purse seine SBT Fishery.
	Discarding catch	1	Discarding of species captured (dead/live) in the purse seine net and SBT not surviving transport. Some SBT are frozen and returned to port for sampling otoliths, others are discarded.
	Stock enhancement	0	Stock enhancement not currently used in the SBT fishery.
	Provisioning	1	Bait and berley is used in the SBT purse seine fishery to attract and direct shoals that is scavenged by other animals.
	Organic waste disposal	1	Disposal of organic wastes (food scraps, sewage) as a result of general fishing vessel operations.
Addition of non-biological	Debris	1	Fishing activity has been a major contributor to ocean litter in the GAB, e.g. bait straps, and bait baskets (Edyvane 1998). SBT contribution unknown.

Direct impact of Fishing	Fishing Activity	Score (0/1)	Documentation of Rationale
material	Chemical pollution	0	No chemicals or chemical pollution known to occur during processing or fishing activities of purse seining; however, this requires monitoring.
	Exhaust	1	Exhaust as a result of diesel and other engines during general fishing operations.
	Gear loss	1	Potential lost items includes netting, ropes, buoys etc. - requires monitoring.
	Navigation/ steaming	1	Purse seine operations involve several vessels navigating to and from fishing grounds including towing transport cages and spotter planes, introducing noise and visual stimuli into the environment, e.g. attraction of foraging/scavenging birds to boats. Recent FRDC work shows stress levels increases in fish exposed to engine noise (R&D News, 14(2), 2006)
	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	Bait collection in shallow waters using small purse seine may disturb sediment and sediment processes.
	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 fishery come from designated ports.
	Anchoring/ mooring	1	Purse seine nets are anchored in position and may disturb physical processes in the localised area of the chain and anchor on the sea floor. Any interaction /incident on the sea floor occurring in the Benthic Protection Zone (of the GAB Marine Park) must be reported to National Parks (Edyvane 1998).
	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 (but acknowledged to be trivial).
External Hazards (specify the particular example within each activity area)	Other capture fishery methods	1	Other fishery capture methods occur in the same region as the SBT fishery. SBT and SBT prey species are targeted by these fisheries.
	Aquaculture	1	The capture of feed species for aquaculture occurs in the coastal communities near the SBT fishery, which may lead to increasing pressure on bait fish stocks potentially resulting in localised depletion of natural prey for SBT.
	Coastal development	0	No reference to discharge of sewage or ocean dumping near the GAB Marine Park including the Benthic Protection Zone (Edyvane 1998) – near the key SBT purse seine fishing grounds.
	Other extractive activities	0	Licenses for petroleum exploration are held for the region encompassing the key purse seine SBT fishing grounds, however there is no current extraction (Bight Basin 2003). The range of the SBT fishery also encompasses a significant number of sea floor pipelines, however, as a pelagic species, interactions with pipelines is anticipated to be minimal (AFMA 2002).
	Other non-extractive activities	0	The extensive range of the SBT fishery encompasses a significant number of sea floor cables, however, as a pelagic species, interactions with cables is anticipated to be minimal (AFMA 2002).
	Other anthropogenic activities	1	A number of major shipping routes pass through the area of the SBT fishery and may potentially interact with the fish population. Tourism, including whale and seal watching, occur in the coastal communities near the SBT fishery or in adjacent fisheries (AFMA 2002).

Table 4. Examples of fishing activities. Use this table to assist the hazard identification (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 uses to fish during their down time. This does not include impacts on predator species of removing their prey through fishing.
	Gear loss	Direct impacts (damage or mortality), without capture on organisms due to gear that has been lost from the fishing boat. This includes damage/mortality to species when the lost gear contacts them or if species swallow the lost gear.
	Anchoring/ mooring	Direct impact (damage or mortality) that occurs and when anchoring or mooring. This includes damage/mortality due to physical contact of the anchor, chain or rope with organisms, e.g. An anchor damaging live coral.
	Navigation/ steaming	Direct impact (damage or mortality) without capture may occur while vessels are navigating or steaming. This includes collisions with marine organisms or birds.
Addition/ movement of biological material		Any activities that result in the addition or movement of biological material to the ecosystem of the fishery.
	Translocation of species (boat movements,	The translocation and introduction of species to the area of the fishery, through transportation of any life stage. This transport can occur through movement on boat hulls or in ballast water as boats move throughout the fishery or from outside areas into the fishery.

Direct Impact of Fishing	Fishing Activity	Examples of Activities Include
	reballasting)	
	On board processing	The discarding of unwanted sections of target after on board processing introduces or moves biological material, e.g. heading and gutting, retaining fins but discarding trunks.
	Discarding catch	The discarding of unwanted organisms from the catch can introduce or move biological material. This includes individuals of target and byproduct species due to damage (e.g. shark or marine mammal predation), size, high grading and catch limits. Also includes discarding of all non-retained bycatch species. This also includes discarding of catch resulting from incidental fishing by the crew. The discards could be alive or dead.
	Stock enhancement	The addition of larvae, juveniles or adults to the fishery or ecosystem to increase the stock or catches.
	Provisioning	The use of bait or berley in the fishery.
	Organic waste disposal	The disposal of organic wastes (e.g. food scraps, sewage) from the boats.
Addition of non-biological material		Any activities that result in non-biological material being added to the ecosystem of the fishery, this includes physical debris, chemicals (in the air and water), lost gear, noise and visual stimuli.
	Debris	Non-biological material may be introduced in the form of debris from fishing vessels or mother ships. This includes debris from the fishing process: e.g. cardboard thrown over from bait boxes, straps and netting bags lost. Debris from non-fishing activities can also contribute to this e.g. Crew rubbish – discarding or food scraps, plastics or other rubbish. Discarding at sea is regulated by MARPOL, which forbids the discarding of plastics.
	Chemical pollution	Chemicals can be introduced to water, sediment and atmosphere through: oil spills, detergents other cleaning agents, any chemicals used during processing or fishing activities.
	Exhaust	Exhaust can be introduced to the atmosphere and water through operation of fishing vessels
	Gear loss	The loss of gear will result in the addition of non-biological material, this includes hooks, line, sinkers, nets, otter boards, light sticks, buoys etc.
	Navigation /steaming	The navigation and steaming of vessels will introduce noise and visual stimuli into the environment. Boat collisions and/or sinking of vessels. Echo-sounding may introduce noise that may disrupt some species (e.g. whales, orange roughy)
	Activity /presence on water	The activity or presence of fishing vessels on the water will noise and visual stimuli into the environment.
Disturb physical processes		Any activities that will disturb physical processes, particularly processes related to water movement or sediment and hard substrate (e.g. boulders, rocky reef) processes.
	Bait collection	Bait collection may disturb physical processes if the gear contacts seafloor-disturbing sediment, or if the gear disrupts water flow patterns.

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

2.2.5 Bibliography (Step 5)

All references used in the scoping assessment are included in the References section at the end of this report.

Key documents to assist the risk assessment 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 (activities) that are identified at Step 4 Hazard Identification as occurring in the fishery are carried forward for analysis at Level 1.

In this case, 22 out of 26 possible internal activities were identified as occurring in this fishery. Only 3 out of 6 external activities were identified. Thus, a total of 25 activity-component scenarios will be considered at Level 1. This results in 125 total scenarios (of 160 possible) to be developed and evaluated using the unit list (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)) 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 the subcomponent
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 worksheet. A separate worksheet will be required for each component (target, bycatch and byproduct, and TEP species, habitat, and communities). Only those activities that scored a 1 (presence) during the scoping 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 **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.

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

2.3.1 Level 1 (SICA) Document L1.1 - Target Species 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 (from S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence score (1-2)	Rationale
Capture	Bait collection	1	4	6	Behaviour/ movement	SBT (single target species fishery)	6.1	3	2	1	Bait collection concentrated across 3 degrees in longitude ca. 180 nm => Bait collection occurs daily during approx. 3 month season => Local depletion of bait fish most likely to effect behaviour/movement of SBT, will search elsewhere for bait fish, rather than large scale shift in migration pattern i.e. geographic range shift => Intensity Moderate –severe but local, moderate at broader spatial scale => Consequence of bait collection impact likely to result in possible detectable change in behaviour /movement but minimal impact on population dynamics. Time to return to original behaviour on the scale of days to weeks => Confidence recorded as low because of insufficient knowledge on bait fish distribution and SBT foraging dynamics. (Note that there are catch records for baitfish taken as state catch and AFMA catch plus estimates of standing stock. Approx. 250 t of pilchard taken by SBT fishers per year (36,000 t by state fishery).
	Fishing	1	4	6	Population size	SBT	1.2	5	4	2	Fishing activity concentrated across 3 degrees in Longitude ca. 180 nm => Daily during 3 month season => Population size most at risk as threats to other sub-components are non-specific to the juvenile SBT in the GAB, e.g. reproductive capacity, age/size/sex structure (single juvenile cohort) not relevant. Also, population size likely to be affected before major changes in geographic range or genetic structure. Behaviour/movement unlikely to be immediately affected as long as food supply available in GAB (see bait collection impacts above) => ca. 30% of the global SBT catch comes from the GAB fishing grounds, therefore a large slice of the worlds take is from a relatively small area thus representing a very severe localised impact and frequent widespread severe impact from a global perspective => Very serious consequences now occurring, e.g. at current catch rates global SBT parental stock unlikely to recover to 1980 levels by 2020 (CCSBT) => Confidence in the consequence score was high given good scientific knowledge of SBT population size and catch rates.

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 (from S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence score (1-2)	Rationale
	Incidental behaviour	1	4	5	Population size	SBT	1.2	2	2	1	Incidental behaviour concentrated across 3 degrees in Longitude ca. 180 nm => Downtime activities considered to occur on a weekly rather than daily basis during 3 month fishing season => Incidental behaviour, resulting in capture, was considered most likely to effect population size of SBT because mortality has an immediate effect of reducing population size => If damage/death as a result of incidental behaviour does occur then perceived to occur rarely at rarely detectable levels => Consequence therefore considered to be minimal on levels of SBT stock => Confidence in consequence was low because of a lack of verified observational data on incidental behaviour in the SBT purse seine fishery.
Direct impact without capture	Bait collection	1	4	6	Behaviour/ movement	SBT	6.1	1	2	2	Bait collection concentrated across 3 degrees in Longitude ca. 180 nm => Daily during ca 3 month season => Depletion of bait fish most likely to effect behaviour/movement of SBT (see Capture / bait collection above) => Intensity - Remote likelihood of detection at any spatial or temporal scale => Consequence of bait collection impact (non-capture) likely to result in minor change in behaviour /movements patterns of SBT in GAB => Confidence recorded as high because of low potential for bait fish damage/death (independent of capture) using purse seine bait collection.
	Fishing	1	4	6	Population size	SBT	1.2	2	2	1	Fishing activity concentrated across 3 degrees in Longitude ca. 180 nm => Daily during ca 3 month fishing season => Injury/mortality to SBT as a result of momentary entanglement is expected to have highest potential risk for the Population size sub-component => Consequence minor as likelihood of SBT damage/mortality associated with momentary entanglement in purse seine gear considered low => Confidence was scored low because of a lack of observations documenting SBT purse seine interactions.
	Incidental behaviour	1	4	5	Population size	SBT	1.2	2	2	1	Incidental behaviour concentrated across 3 degrees in Longitude ca. 180 nm => Downtime activities considered to occur on a weekly rather than daily basis during 3 month fishing season => Incidental behaviour, resulting in damage or mortality but not resulting in capture, was considered most likely to effect population size of SBT because mortality has an immediate effect of reducing population size => If damage/death as a result of incidental behaviour does occur then perceived to occur rarely at rarely detectable levels => Consequence therefore considered to be minimal on levels of SBT stock => Confidence in consequence was low because of a lack of verified observational data on incidental behaviour in the SBT purse seine fishery.

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 (from S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence score (1-2)	Rationale
	Gear loss	1	4	5	Population size	SBT	1.2	1	1	1	Fishing activity concentrated across 3 degrees in Longitude ca. 180 nm gear loss possible over this scale => Gear loss considered to occur weekly during 3 month season => Lost gear resulting in damage/mortality most likely to effect population size of SBT => Intensity was scored as Minor because lost gear – SBT interactions (if they occur) are considered to be rare => Consequence considered unlikely to be detectable at the scale of the SBT stock => Confidence was scored as low because of a lack of data on interactions between SBT and lost purse seine fishing gear.
	Anchoring/ mooring	1	4	5	Population size	SBT	1.2	1	1	2	Fishing activity concentrated across 3 degrees in Longitude ca. 180 nm Anchoring/ mooring possible over this scale => Anchoring/mooring considered to occur on a weekly basis during the 3 month fishing season => Direct impact (damage or mortality) that occurs when anchoring or mooring most likely to effect Population/size of SBT => Given that SBT coming into direct contact with anchors is very remote there is negligible intensity at any spatial or temporal scale => Therefore consequence also scored as negligible => Confidence was recorded as high because it is considered very unlikely for there to be damage or mortality to SBT associated with Anchoring/mooring.
	Navigation/ steaming	1	4	6	Population size	SBT	1.2	1	1	2	Fishing activity hence Navigation/ steaming concentrated across 3 degrees in Longitude ca. 180 nm => Daily during ca 3 month season => Direct impact (damage or mortality) without capture due to Navigation/steaming was considered most likely to effect Population size of SBT => Navigation/steaming (including transport of towing cages) is a large component of the SBT purse seine operations, however detection of intensity was considered to have remote likelihood => Consequence unlikely to be detectable at the scale of the GAB SBT fishery => Confidence was scored as high because it was considered unlikely for there to be strong interactions between Navigation/steaming and damage or mortality of highly mobile SBT.

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 (from S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence score (1-2)	Rationale
Addition/ movement of biological material	Translocation of species	1	4	6	Behaviour/ movement	SBT	6.1	2	2	1	Fishing activity concentrated across 3 degrees in Longitude ca. 180 nm Translocation of species possible over this scale => Daily during ca 3 month season => Viral disease potentially transmitted from imported bait fish which may result in local depletion of pilchards in GAB as occurred in 1995 (30% of adult pilchards affected over 6000 km) and 1998/1999 (see Gaughan 2002; Hayes 1997), this is most likely to effect behaviour/movement of SBT, i.e. they will may search elsewhere for baitfish, rather than undergo a large scale shift in migratory geographic range (note that the abundance of sardines may increase as a result of pilchard death, Bernoth CCEAD Joint Pilchard Scientific Working Group, Oct. 2002) => Intensity considered minor as use of imported bait, infected with disease, considered unlikely given Biosecurity Risk Assessment, plus AQIS Import Risk Assessment => Consequence of bait fish depletion via viral disease may result in possible detectable change in behaviour/ movement but minimal impact on population dynamics. Time taken to return to original behaviour/ movement on the scale of days to weeks => Confidence recorded as low because of insufficient knowledge on potential spread of bait fish disease from imported species. (Note There has been a Biosecurity Risk Assessment on Pilchards, plus an AQIS Import Risk Assessment).
	On board processing	0									
	Discarding catch	1	4	6	Behaviour/ movement	SBT	6.1	1	1	2	Fishing activity concentrated across 3 degrees in longitude ca. 180 nm Discarding catch possible over this scale => Discarding considered to occur daily during ca 3 month season => Discarding of bait, bycatch or SBT (that have died during seining or transport) poses greatest risk to the Behaviour/movement of SBT => Intensity was scored as negligible because the likelihood of impact was considered very remote at any spatial or temporal scale => Therefore consequence was also negligible => Confidence was recorded as high because SBT were considered very unlikely to interact with discarded catch.
	Stock enhancement	0									

Direct impact of Fishing	Fishing Activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (from S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence score (1-2)	Rationale
	Provisioning	1	4	6	Behaviour/ movement	SBT	6.1	1	2	1	Fishing activity concentrated across 3 degrees in longitude ca. 180 nm Provisioning possible over this scale => Daily during ca. 3 month season => Provisioning (the use of bait and berley) is expected to pose highest potential risk for the Behaviour/movement sub-component of the SBT target species => Provisioning aggregates SBT into a feeding frenzy, those fish attracted but not caught in purse seine are considered of remote likelihood to be adversely affected (aggregation during feeding frenzy a natural process) => Provisioning is considered to have Minor consequence for SBT, rarely detectable change in behaviour/ movement. Time to return to original behaviour/ movement on the scale of days => Confidence in the consequence score was low because of a lack of observational data on interactions between non-caught SBT and provisioning and/or feeding of SBT in transport cages.
	Organic waste disposal	1	4	6	Behaviour/ movement	SBT	6.1	1	1	2	Fishing activity concentrated across 3 degrees in longitude ca. 180 nm Organic waste disposal possible over this scale => Daily during ca. 3 month season => Disposal of organic waste was expected to pose greatest potential risk for the Behaviour/movement of SBT resulting in either attraction e.g. food scraps or repulsion e.g. raw sewage => Intensity was scored as negligible because although the hazard was considered over a large range/scale, each disposal event was considered to only effect a small < 1 nm area and because SBT are highly mobile strong avoidance ability was expected at the scale of 1 nm => Consequence was also considered negligible i.e. any consequence on the SBT in the GAB unlikely to be detectable => Confidence in the consequence score was high because general fishing waste disposal was considered unlikely to impact on behaviour/ movement of the highly mobile SBT.
Addition of non-biological material	Debris	1	4	6	Population size	SBT	1.2	1	1	1	Fishing activity concentrated across 3 degrees in Longitude ca. 180 nm Debris possible over this scale => Daily during 3 month season => Debris resulting in damage/mortality most likely to effect population size of SBT => Intensity was scored as Minor because debris – SBT interactions (if they occur) are considered to be rare => Consequence was considered negligible on SBT stock because damage/mortality due to debris was considered rare => Confidence was scored as low because of a lack of data on interactions between SBT and debris.
	Chemical pollution	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 (from S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence score (1-2)	Rationale
	Exhaust	1	4	6	Behaviour/ movement	SBT	6.1	1	1	2	Fishing activity hence exhaust emissions concentrated across 3 degrees in longitude ca. 180 nm => Daily during ca. 3 month season => Exhaust emission was expected to pose greatest potential risk for the Behaviour/movement of SBT resulting in repulsion => Intensity was scored as negligible because although the hazard was considered over a large range/scale, exhaust considered to only impact a small < 1 nm area and because SBT are highly mobile strong avoidance ability was expected at the scale of 1 nm => Consequence was also considered negligible i.e. any consequence on the SBT in the GAB unlikely to be detectable => Confidence in the consequence score was considered high because localised exhaust unlikely to impact on behaviour/movement of highly mobile SBT.
	Gear loss	1	4	5	Behaviour/ movement	SBT	6.1	1	1	1	Fishing activity concentrated across 3 degrees in Longitude ca. 180 nm Gear loss possible over this scale => Gear loss considered to occur weekly during 3 month season => Lost gear not resulting in damage/mortality most likely to effect behaviour /movement of SBT in the GAB => Intensity was scored as Minor because lost gear – SBT interactions (if they occur) are considered to be rare => Consequence considered minor on SBT stock => Confidence was scored as low because of a lack of data on interactions between SBT and lost purse seine fishing gear.
	Navigation/ steaming	1	4	6	Behaviour/ movement	SBT	6.1	1	1	2	Fishing activity hence Navigation/steaming concentrated across 3 degrees in Longitude ca. 180 nm => Daily during ca 3 month season => Navigation/steaming most likely to effect Behaviour/movement of SBT => Navigation/steaming (including transport of towing cages) is a large component of the SBT purse seine operations, however there is remote likelihood of impact on SBT over the spatial scale of the fishery => Consequence unlikely to be detectable at the scale of the GAB SBT fishery => Confidence was recorded as high because it is considered unlikely for there to be strong interactions between Navigation/steaming and SBT Behaviour/movement.

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 (from S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence score (1-2)	Rationale
	Activity/ presence on water	1	4	6	Behaviour/ movement	SBT	6.1	1	1	2	Activity/presence on water concentrated across 3 degrees in longitude ca. 180 nm => Daily during ca. 3 month season => Activity/presence on water of purse seine fishing vessels was expected to pose greatest potential risk for the Behaviour/movement of SBT resulting in disruption to feeding and/or movement => Intensity was scored as negligible because although the hazard was considered over a large range/scale, vessel presence considered to only impact a small < 1 nm area and because SBT are highly mobile strong avoidance ability was expected at the scale of 1 nm => Consequence was also considered negligible with any consequence of vessel presence impacts unlikely to be detectable for SBT in the GAB => Confidence in the consequence score was considered high because localised vessel presence/activity unlikely to impact and have consequences for the behaviour/movement of highly mobile SBT.
Disturb physical processes	Bait collection	1	4	6	Behaviour/ movement	SBT	6.1	1	1	2	Bait collection activity concentrated across 3 degrees in Longitude ca. 180 nm => Daily during ca 3 month season => Physical disturbance to sediments during bait collection seining most likely to effect behaviour/movement of SBT => Intensity - Remote likelihood of impact at any spatial or temporal scale because bait collection carried out inshore, if performed offshore (deeper water) decreased likelihood of sediment disturbance, Impact therefore scored Negligible => Consequence therefore Negligible => Confidence recorded as high because likelihood of SBT behaviour/movement being altered by gear-sediment interactions considered very remote.
	Fishing	1	4	6	Behaviour/ movement	SBT	6.1	1	1	2	Fishing activity concentrated across 3 degrees in longitude ca. 180 nm => Daily during ca. 3 month season => Disturbance of physical processes via purse seine fishing was expected to pose greatest potential risk for the Behaviour/movement of SBT resulting in momentary disruption to feeding and/or movement => Intensity was scored as negligible because although the hazard was considered over a large range/scale, fishing considered to only impact physical processes over a small < 1 nm area => Consequence was also considered negligible with any consequence of water column disturbance unlikely to be detectable for SBT in the GAB => Confidence in the consequence score was considered high because localised disruption of water column unlikely to impact and have consequences for the behaviour/movement of highly mobile SBT.
	Boat launching	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 (from S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence score (1-2)	Rationale
	Anchoring/ mooring	1	4	5	Behaviour/ movement	SBT	6.1	1	1	2	Fishing activity concentrated across 3 degrees in Longitude ca. 180 nm Anchoring/mooring possible over this scale => Anchoring/mooring considered to occur on a weekly basis during the 3 month fishing season => Anchoring/mooring most likely to effect Behaviour/movement of SBT => Intensity- Given that anchoring/mooring is rare there is remote likelihood of impact at any spatial or temporal scale => Consequence unlikely to be detectable at the scale of the SBT stock => Confidence was recorded as high because it is considered unlikely for there to be strong interactions between Anchoring/mooring and SBT.
	Navigation/steaming	1	4	6	Behaviour/ movement	SBT	6.1	1	1	2	Fishing activity hence Navigation/ steaming concentrated across 3 degrees in Longitude ca. 180 nm => Daily during ca 3 month season => Disturbance to pelagic physical processes due to Navigation/steaming of fishing vessels was expected to pose greatest potential risk for the Behaviour/movement of SBT resulting in disruption to feeding and/or migration => Intensity was scored as negligible because although the hazard was considered over a large range/scale, Navigation/ steaming considered to only impact a small < 1 nm area and because SBT are highly mobile strong avoidance ability was expected at the scale of 1 nm => Consequence was also considered negligible with any impact of Navigation/ steaming unlikely to be detectable for SBT in the GAB => Confidence in the consequence score was considered high because Navigation/ steaming unlikely to impact and have consequences for the behaviour/movement of highly mobile SBT
External hazards (specify the particular example within each activity area)	Other fisheries	1	6	6	Population size	SBT	1.2	3	3	1	Recreational fishing activity occurs across GAB and Tasmania scale > 1000 nm => Daily during ca 3 month season => Capture of SBT in the recreational sector poses risk to SBT population size (especially if recreationally caught fish are not accounted for in quota estimates) => There is potential for severe localised and widespread impacts on population size if rates of recreationally caught SBT are high and not accounted for in quota estimates => The consequence was scored as moderate because if SBT is being caught in excess of quota very serious consequences are now occurring with long time periods needed to restore population size to the level accepted by the CCSBT => Confidence was recorded as low because recreational catch is unknown.

Direct impact of Fishing	Fishing Activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (from S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence score (1-2)	Rationale
	Aquaculture	1	4	6	Behaviour/ movement	SBT	6.1	3	4	1	Bait collection for aquaculture concentrated across 3 degrees in Longitude ca. 180 nm => Daily during ca 3 month season => Local depletion of bait fish most likely to effect behaviour/movement of SBT, will search elsewhere for bait fish, rather than large scale shift in migration pattern i.e. geographic range shift => Intensity moderate –severe but local impact, moderate at broader spatial scale => Consequence of aquaculture feed collection impact likely to result in wider and long term change in behaviour /movements patterns of SBT in GAB => Confidence recorded as low because of insufficient knowledge on bait fish distribution and SBT foraging.
	Coastal development	0									
	Other extractive activities	0									
	Other non extractive activities	0									
	Other anthropogenic activities	1	6	6	Behaviour/ movement	SBT	6.1	1	1	2	Shipping activity concentrated across the GAB ca 1000 nm => Daily shipping activity => Navigation/steaming of ships was expected to pose greatest potential risk for the Behaviour/movement of SBT resulting in disruption to feeding and/or migration => Intensity was scored as negligible because although the hazard was considered over a large range/scale, ship steaming considered to only impact a small < 1 nm area and because SBT are highly mobile strong avoidance ability was expected at the scale of 1 nm => Consequence was also considered negligible with any consequence of shipping impacts unlikely to be detectable for SBT in the GAB => Confidence in the consequence score was considered high because shipping unlikely to impact and have consequences for the behaviour/movement of highly mobile SBT.

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

Direct impact of Fishing	Fishing Activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (from S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence score (1-2)	Rationale
Capture	Bait collection	1	4	6	Behaviour/ movement	skipjack tuna Yellowfin tuna Albacore tuna Bigeye tuna	6.1	3	2	1	Bait collection concentrated across 3 degrees in Longitude ca. 180 nm => Daily during ca 3 month season => Local depletion of bait fish most likely to effect behaviour/movement of bycatch/byproduct tuna species, will search elsewhere for bait fish, rather than large scale shift in migration pattern i.e. geographic range shift => Intensity – Moderate, severe but local impact, moderate at broader spatial scale => Consequence of bait collection impact likely to result in possible detectable change in behaviour /movement of bycatch species but minimal impact on population dynamics. Time to return to original behaviour on the scale of days to weeks => Confidence recorded as low because of insufficient knowledge on bait fish distribution and foraging of bycatch/byproduct tuna species.
	Fishing	1	4	6	Population size	Skipjack tuna	1.2	2	2	1	Fishing activity concentrated across 3 degrees in Longitude ca. 180 nm => Daily during 3 month season => Population size of bycatch species was considered most at risk because damage/death is a direct impact on population size, also population size likely to be affected before major changes in geographic range or genetic structure. => Intensity was scored as Minor given that fishers claim that bycatch is essentially non-existent using highly selective purse seine methods => Consequence was also scored as minor because it was considered that any perceived impact would have minimal effect on stock structure of bycatch species => Confidence in the consequence score was very low given a lack of independently verified bycatch observational data, verification of the frequency of bycatch resulting from SBT purse seine fishing is essential and the here-derived consequences for bycatch species are of little meaning without rigorous observational data.
	Incidental behaviour	1	4	5	Population size	Skipjack tuna	1.2	2	2	1	Incidental behaviour concentrated across 3 degrees in Longitude ca. 180 nm => Downtime activities considered to occur on a weekly rather than daily basis during 3 month fishing season => Incidental behaviour, resulting in capture, was considered most likely to effect population size of bycatch/byproduct species because mortality has an immediate effect of reducing population size => If damage/death as a result of incidental behaviour does occur then perceived to occur rarely at rarely detectable levels => Consequence therefore considered to be minimal on levels of SBT bycatch/byproduct stock => Confidence in consequence was low because of a lack of verified observational data on incidental behaviour in the SBT purse seine fishery.

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 (from S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence score (1-2)	Rationale
Direct impact without capture	Bait collection	1	4	6	Behaviour/ movement	skipjack tuna Yellowfin tuna Albacore tuna	6.1	1	2	2	Bait collection concentrated across 3 degrees in Longitude ca. 180 nm => Daily during ca 3 month season => Depletion of bait fish most likely to effect behaviour/movement of SBT (see Capture / bait collection above) => Intensity -Remote likelihood of detection at any spatial or temporal scale => Consequence of bait collection impact (non-capture) likely to result in minor change in behaviour /movements patterns of SBT in GAB => Confidence recorded as high because of low potential for bait fish damage/death (independent of capture) using purse seine bait collection.
	Fishing	1	4	6	Population size	Shortfin mako shark	1.2	2	2	1	Fishing activity concentrated across 3 degrees in Longitude ca. 180 nm => Daily during ca 3 month fishing season => Disorientation/injury/mortality to bycatch species as a result of momentary entanglement was expected to have highest potential risk for the Population size sub-component => Consequence minor as likelihood of bycatch mortality associated with momentary entanglement in purse seine gear considered low => Confidence was scored low (considered very low) because of a lack of verified observations of purse seine bycatch interactions.
	Incidental behaviour	1	4	5	Population size	Skipjack tuna Yellowfin tuna Albacore tuna Shortfin mako shark	1.2	2	2	1	Incidental behaviour concentrated across 3 degrees in Longitude ca. 180 nm => Downtime activities considered to occur on a weekly rather than daily basis during 3 month fishing season => Incidental behaviour, resulting in damage or mortality but not resulting in capture, was considered most likely to effect population size of SBT bycatch species because mortality has an immediate effect of reducing population size => If damage/death as a result of incidental behaviour does occur then perceived to occur rarely at rarely detectable levels => Consequence therefore considered to be minimal on levels of SBT bycatch stock => Confidence in consequence was low because of a lack of verified observational data on incidental behaviour in the SBT purse seine fishery.
	Gear loss	1	4	5	Population size	Shortfin mako shark	1.2	1	1	1	Fishing activity concentrated across 3 degrees in Longitude ca. 180 nm, Gear loss possible over this scale => Gear loss considered to occur weekly during 3 month season => Lost gear resulting in damage/mortality most likely to effect population size of bycatch species => Intensity was scored as Minor because lost gear – bycatch species interactions (if they occur) are considered to be very rare as a percentage of mortality across the population => Consequence considered unlikely to be detectable at the scale of bycatch species stock => Confidence was scored as low because of a lack of data on interactions between bycatch species and lost purse seine fishing gear.

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 (from S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence score (1-2)	Rationale
	Anchoring/ mooring	1	4	5	Population size	Dusky shark Blue shark Shortfin mako shark	1.2	1	1	2	Fishing activity concentrated across 3 degrees in Longitude ca. 180 nm Anchoring/ mooring possible over this scale => Anchoring/mooring considered to occur on a weekly basis during the 3 month fishing season => Direct impact (damage or mortality) that occurs when anchoring or mooring most likely to effect Population/size of bycatch species => Given that anchoring/mooring is rare and that chances of bycatch species coming into direct contact with anchors and death resulting are very remote, anchoring/mooring impact was considered negligible => Therefore consequence was also scored as negligible => Confidence was recorded as high because it is considered very unlikely for there to be mortal/damaging interactions between Anchoring/mooring and bycatch species.
	Navigation/ steaming	1	4	6	Population size	Blue marlin Black marlin Striped marlin	1.2	2	2	1	Navigation/ steaming concentrated across 3 degrees in Longitude ca. 180 nm => Daily during ca 3 month season => Direct impact (damage or mortality) without capture due to Navigation/steaming was considered most likely to effect Population size of bycatch species (note bycatch interactions with transport pontoons likely to result in entanglement and capture) => Navigation/steaming (including transport of towing cages) is a large component of the SBT purse seine operations, it was considered that there is likely to be Minor impact on bycatch species over the spatial scale of the fishery => Consequence was considered Minor with minimal consequence on stock structure and dynamics => Confidence was scored as low because of a lack of observational accounts on the nature of interactions between Navigation/steaming and bycatch species.
Addition/ movement of biological material	Translocation of species	1	4	6	Behaviour/ movement	skipjack tuna	6.1	2	2	1	Fishing activity concentrated across 3 degrees in Longitude ca. 180 nm Translocation of species possible over this scale => Daily during ca 3 month season => Viral disease potentially transmitted from imported bait fish which may result in local depletion of pilchards in GAB as occurred in 1995 (30% of adult pilchards affected over 6000 km) and 1998/1999 (see Gaughan 2002; Hayes 1997), this is most likely to effect behaviour/movement of tuna species, i.e. they will may search elsewhere for baitfish, rather than undergo a large scale shift in migratory geographic range (note that the abundance of sardines may increase as a result of pilchard death, CCEAD 2002) => Intensity considered minor as use of imported bait, infected with disease, considered unlikely given Biosecurity Risk Assessment, plus AQIS Import Risk Assessment => Consequence of bait fish depletion via viral disease may result in possible detectable change in behaviour/ movement but minimal impact on population dynamics. Time taken to return to original behaviour/ movement on the scale of days to weeks => Confidence recorded as low because of insufficient knowledge on potential spread of bait fish disease from imported species. (Note There has been a Biosecurity Risk Assessment on Pilchards, plus an AQIS Import Risk Assessment).

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 (from S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence score (1-2)	Rationale
	On board processing	0									
	Discarding catch	1	4	6	Population size	Sharks (Dusky shark Blue shark Shortfin mako shark)	1.2	3	2	1	Fishing activity concentrated across 3 degrees in longitude ca. 180 nm Discarding catch possible over this scale=> Discarding catch considered to occur daily during ca 3 month season => Discarding of bycatch or SBT that have died during seining or transport poses greatest risk to Behaviour/movement of bycatch shark species => The intensity was considered Moderate because sharks may be attracted to or follow vessels discarding catch, while impact on behaviour/movement was considered to occur at local scale close to the vessel, continual discarding may cause larger scale movements of offshore shark bycatch species to inshore coastal areas => The consequence was scored as Minor because inshore movements considered to have minimal consequence for population dynamics, i.e. sharks will again return to offshore habitat => Confidence was recorded as low because of a lack of verified observational data on discards and behaviour of bycatch species in the vicinity of SBT purse seine operations.
	Stock enhancement	0									
	Provisioning	1	4	6	Behaviour/ movement	Yellowfin tuna	6.1	1	2	1	Fishing activity concentrated across 3 degrees in longitude ca. 180 nm Provisioning possible over this scale=> Daily during ca. 3 month season => Provisioning (the use of bait and berley) is expected to pose highest potential risk for the Behaviour/movement sub-component of the bycatch species => Provisioning potentially aggregates bycatch species into a feeding frenzy, those fish attracted but not caught in purse seine are considered of remote likelihood to be adversely affected (aggregation during feeding frenzy a natural process), however, there is a lack of data on interactions between 'non-caught' bycatch species and provisioning (also lack of information regarding possible disease transfer from bait fish, e.g. exotic species, to SBT) => Provisioning is considered to have minimal consequence on bycatch species stock structure and/or dynamics => Confidence in the consequence score was low because of a lack of data on interactions between non-caught bycatch species and provisioning (also lack of information regarding possible disease transfer from bait fish, e.g. exotic species, to bycatch species).

Direct impact of Fishing	Fishing Activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (from S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence score (1-2)	Rationale
	Organic waste disposal	1	4	6	Behaviour/ movement	Dusky shark Blue shark Shortfin mako shark	6.1	2	2	1	Fishing activity concentrated across 3 degrees in longitude ca. 180 nm Organic waste disposal possible over this scale => Daily during ca. 3 month season => Disposal of organic waste was expected to pose greatest potential risk for the Behaviour/movement of bycatch species especially scavenging sharks resulting in attraction to food scraps => Intensity was scored as Minor because the hazard was considered to occur rarely and detectable impact considered rare => Consequence was also considered Minor with minimal consequence on dynamics of bycatch species => Confidence in the consequence score was low because of a lack of observational data on potential interactions between seine vessel waste disposal and shark species.
Addition of non-biological material	Debris	1	4	6	Population size	Dusky shark Blue shark Shortfin mako shark	1.2	1	1	1	Fishing activity concentrated across 3 degrees in Longitude ca. 180 nm Debris possible over this scale => Daily during 3 month season => Debris resulting in damage/mortality most likely to effect population size of bycatch species => Intensity was scored as Minor because debris – bycatch interactions (if they occur) are considered to be rare => Consequence was considered negligible on bycatch stock because damage/mortality due to debris was considered rare => Confidence was scored as low because of a lack of data on interactions between bycatch species and debris.
	Chemical pollution	0									
	Exhaust	1	4	6	Behaviour/ movement	Blue marlin Black marlin Striped marlin	6.1	1	1	2	Fishing activity concentrated across 3 degrees in longitude ca. 180 nm Exhaust possible over this scale => Daily during ca. 3 month season => Exhaust emission was expected to pose greatest potential risk for the Behaviour/movement of bycatch species resulting in repulsion from exhaust source => Intensity was scored as negligible because although the hazard was considered over a large range/scale, exhaust considered to only impact a small < 1 nm area and because SBT purse seine bycatch species are highly mobile strong avoidance ability was expected at the scale of 1 nm => Consequence was also considered negligible i.e. any consequence on the bycatch species in the GAB unlikely to be detectable => Confidence in the consequence score was considered high because localised exhaust unlikely to impact on behaviour/movement of highly mobile species.
	Gear loss	1	4	5	Behaviour/ movement	Dusky shark Blue shark Shortfin mako shark	6.1	1	2	1	Fishing activity concentrated across 3 degrees in Longitude ca. 180 nm Gear loss possible over this scale => Gear loss considered to occur weekly during 3 month season => Lost gear not resulting in damage/mortality most likely to effect behaviour /movement of bycatch species in the GAB => Intensity was scored as Minor because lost gear – bycatch species interactions (if they occur) are considered to be rare => Consequence considered minor on stocks of bycatch species => Confidence was scored as low because of a lack of data on interactions between bycatch species and lost purse seine fishing gear.

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 (from S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence score (1-2)	Rationale
	Navigation/ steaming	1	4	6	Behaviour/ movement	skipjack tuna	6.1	2	2	1	Navigation/steaming concentrated across 3 degrees in Longitude ca. 180 nm => Daily during ca 3 month season => Navigation/steaming (not resulting in damage or mortality) most likely to effect Behaviour/movement of bycatch species => Navigation/steaming (including transport of towing cages) is a large component of the SBT purse seine operations, however it was considered that any impact would be rare => Consequence e.g. movement of bycatch species inshore, considered to have minimal consequence on the stock structure and dynamics of bycatch species => Confidence was recorded as low because there is a lack of information on interactions between Navigation/steaming and Behaviour/movement of bycatch species.
	Activity/ presence on water	1	4	6	Behaviour/ movement	skipjack tuna	6.1	1	1	2	Activity/ presence on water concentrated across 3 degrees in longitude ca. 180 nm => Daily during ca. 3 month season => Activity/ presence on water of purse seine fishing vessels was expected to pose greatest potential risk for the Behaviour/movement of bycatch species resulting in disruption to feeding and/or movement => Intensity was scored as negligible because although the hazard was considered over a large range/scale, vessel presence considered to only impact a small < 1 nm area and because SBT bycatch species are highly mobile, strong avoidance ability was expected at the scale of 1 nm => Consequence was also considered negligible with any consequence of vessel presence impacts unlikely to be detectable for SBT in the GAB => Confidence in the consequence score was considered high because localised vessel presence/activity unlikely to impact and have consequences for the behaviour/movement of highly mobile SBT bycatch species.
Disturb physical processes	Bait collection	1	4	6	Behaviour/ movement	skipjack tuna	6.1	1	1	2	Bait collection activity concentrated across 3 degrees in Longitude ca. 180 nm => Daily during ca 3 month season => Physical disturbance to sediments during bait collection seining most likely to effect behaviour/movement of skipjack tuna => Remote likelihood of impact at any spatial or temporal scale because bait collection carried out inshore, if performed offshore (deeper water) decreased likelihood of sediment disturbance, Impact therefore scored Negligible => Consequence therefore Negligible => Confidence recorded as high because likelihood of skipjack tuna behaviour/movement being altered by gear-sediment interactions considered very remote.

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 (from S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence score (1-2)	Rationale
	Fishing	1	4	6	Behaviour/ movement	skipjack tuna	6.1	1	1	2	Fishing activity concentrated across 3 degrees in longitude ca. 180 nm => Daily during ca. 3 month season => Disturbance of physical processes via purse seine fishing was expected to pose greatest potential risk for the Behaviour/movement of bycatch species resulting in momentary disruption to feeding and/or movement => Intensity was scored as negligible because although the hazard was considered over a large range/scale, fishing considered to only impact physical processes over a small < 1 nm area => Consequence was also considered negligible with any consequence of water column disturbance due to fishing unlikely to have a detectable effect on SBT bycatch species in the GAB => Confidence in the consequence score was considered high because localised disruption of water column unlikely to impact and have consequences for the behaviour/movement of highly mobile SBT bycatch species.
	Boat launching	0									
	Anchoring/ mooring	1	4	5	Behaviour/ movement	skipjack tuna	6.1	1	1	2	Fishing activity concentrated across 3 degrees in Longitude ca. 180 nm Anchoring/ mooring possible over this scale=> Anchoring/ mooring considered to occur on a weekly basis during the 3 month fishing season => Anchoring/mooring most likely to effect Behaviour/movement of SBT bycatch species => Given that anchoring/mooring is rare there is remote likelihood of impact at any spatial or temporal scale => Consequence unlikely to be detectable at the scale of bycatch stocks => Confidence was recorded as high because it is considered unlikely for there to be strong interactions between Anchoring/mooring and SBT bycatch species.
	Navigation/steaming	1	4	6	Behaviour/ movement	Dusky shark Blue shark Shortfin mako shark	6.1	1	1	2	Navigation/ steaming concentrated across 3 degrees in Longitude ca. 180 nm => Daily during ca 3 month season => Disturbance to pelagic physical processes due to Navigation/steaming of fishing vessels was expected to pose greatest potential risk for the Behaviour/movement of sharks resulting in disruption to feeding and/or migration => Intensity was scored as negligible because although the hazard was considered over a large range/scale, Navigation/ steaming considered to only impact a small < 1 nm area and because sharks are highly mobile strong avoidance ability was expected at the scale of 1 nm => Consequence was also considered negligible with any impact of Navigation/ steaming unlikely to be detectable for sharks in the GAB => Confidence in the consequence score was considered high because Navigation/ steaming unlikely to impact and have consequences for the behaviour/movement of highly mobile sharks.

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 (from S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence score (1-2)	Rationale
External hazards (specify the particular example within each activity area)	Other capture fishery methods -Skipjack Tuna Fishery	1	4	6	Population size	skipjack tuna	1.2	4	4	2	Fishing activity concentrated across 1000 nm => Daily during ca 3 month season => Capture of skipjack tuna in the commercial Skipjack Tuna Fishery poses greatest risk to the population size sub-component of this species => Commercial fishing for skipjack tuna was considered a severe impact on population size that occurs reasonably often at broad spatial scale => Consequence was scored as severe because there is potential for long term decline in catches => Confidence was recorded as low because there is currently no formal stock assessment for skipjack tuna in the Indian Ocean and the potential for increasing skipjack catches in the WCPO may not necessarily extend to the ETBF (AFMA 2003b).
	Aquaculture - SBT - Kingfish / mulloway	1	4	6	Behaviour/ movement	skipjack tuna	6.1	3	4	1	Collection of bait for aquaculture concentrated across 3 degrees in Longitude ca. 180 nm => Daily during ca 3 month season => Local depletion of bait fish most likely to effect behaviour/movement of bycatch tuna species, will search elsewhere for bait fish, rather than large scale shift in migration pattern i.e. geographic range shift => Moderate –severe but local impact, moderate at broader spatial scale => Consequence of aquaculture feed collection impact likely to result in wider and long term change in behaviour /movements patterns of tuna species in GAB => Confidence recorded as low because of insufficient knowledge on bait fish distribution and tuna foraging.
	Coastal development	0									
	Other extractive activities	0									
	Other non extractive activities	0									
	Other anthropogenic activities - shipping - tourism	1	6	6	Behaviour/ movement	Blue marlin, Black marlin, Striped marlin	6.1	1	1	2	Shipping activity concentrated across the GAB ca 1000 nm => Daily shipping activity => Navigation/steaming of ships was expected to pose greatest potential risk for the Behaviour/movement of SBT bycatch species e.g. marlins resulting in disruption to feeding and/or migration => Intensity was scored as negligible because although the hazard was considered over a large range/scale, ship steaming considered to only impact a small < 1 nm area and because SBT bycatch species are highly mobile strong avoidance ability was expected at the scale of 1 nm => Consequence was also considered negligible with any consequence of shipping impacts unlikely to be detectable for SBT in the GAB => Confidence in the consequence score was considered high because shipping unlikely to impact and have consequences for the behaviour/movement of highly mobile species.

2.3.1 Level 1 (SICA) Document L1.3 - TEP Species Component

Direct impact of Fishing	Fishing Activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (from S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence score (1-2)	Rationale
Capture	Bait collection	1	4	6	Behaviour/ movement	Seabirds (Albatross, short-tailed shearwater, Crested tern, Australian gannet)	6.1	3	3	1	Bait collection concentrated across 3 degrees in Longitude ca. 180 nm => Daily during ca 3 month season => Local depletion of bait fish most likely to effect behaviour/movement of TEP species e.g. seabirds , will search elsewhere for bait fish, rather than large scale shift in migration pattern i.e. geographic range shift => Moderate –severe but local intensity, moderate at broader spatial scale => Consequence of bait collection - likely to result in possible detectable change in behaviour/ movements patterns of seabirds in GAB => Confidence recorded as low because of insufficient knowledge on bait fish distribution and seabird dynamics.
	Fishing	1	4	6	Population size	white shark	1.1	2	3	1	Fishing activity concentrated across 3 degrees in Longitude ca. 180 nm => Daily during 3 month season => Population size of white sharks considered most at risk from direct damage/mortality due to purse seine fishing =>White sharks were chosen as the unit of analysis because there are known interactions for this fishery and the shark is listed as vulnerable and is protected in South Australian waters. => intensity considered minor => Consequence considered moderate as possible minimal impact on population size/dynamics => Confidence in the consequence score was low because although white sharks are known to interact with SBT purse seine fishing activities (Environment Australia 2000) there is little verified data to confirm numbers and outcomes of interactions.
	Incidental behaviour	1	4	5	Population size	white shark	1.1	2	2	1	Fishing activity concentrated across 3 degrees in Longitude ca. 180 nm Incidental behaviour possible over this scale => Downtime activities considered to occur on a weekly rather than daily basis during 3 month fishing season => Incidental behaviour, resulting in capture, was considered most likely to effect population size of white shark because mortality has an immediate effect of reducing population size => White shark chosen for analysis because jaws are valuable and may be targeted => Intensity considered minor as capture of white shark during 'incidental behaviour' considered to occur rarely => Consequence considered minor as low intensity not likely to affect recruitment levels and the capacity for the population to rebuild => Confidence in consequence was low because of a lack of verified observational data on incidental behaviour in the SBT purse seine fishery.

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 (from S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence score (1-2)	Rationale
Direct impact without capture	Bait collection	1	4	6	Behaviour/ movement	dolphins (common & bottlenose)	6.1	2	2	1	Bait collection concentrated across 3 degrees in Longitude ca. 180 nm => Daily during ca 3 month season => Local depletion (damage/mortality) or dispersal of bait fish most likely to effect behaviour/movement of dolphins, they will search elsewhere for bait fish, as opposed to a large scale shift in migration pattern => Intensity Minor – severe but local impact, moderate at broader spatial scale => Consequence of bait collection impact (non-capture) not considered to result in detectable change in behaviour /movements patterns of TEP species => Confidence recorded as low because of insufficient knowledge on non-captured bait fish distribution with respect to bait collection activities and foraging patterns of dolphins.
	Fishing	1	4	6	Population size	white shark	1.1	3	4	1	Fishing activity concentrated across 3 degrees in Longitude ca. 180 nm => Daily during ca 3 month fishing season => Disorientation/injury/mortality to white shark species as a result of momentary entanglement was expected to have highest potential risk for the Population size sub-component => the white shark was again chosen for analysis because of known interactions and susceptibility of this animal to momentary entanglement and difficulty of disentangling => Any death of a rare slow growing, long-lived animal with low levels of reproduction was considered a severe impact at a broad spatial scale => Consequence considered severe as impact likely to affect recruitment levels and the capacity for the population to increase => Confidence in the consequence score was low because although white sharks are known to interact with SBT purse seine fishing activities there is little verified data to confirm numbers and outcomes of interactions.
	Incidental behaviour	1	4	5	Population size	Australian sea-lion	1.1	2	2	1	Fishing activity concentrated across 3 degrees in Longitude ca. 180 nm Incidental behaviour possible over this scale => Downtime activities considered to occur on a weekly rather than daily basis during 3 month fishing season => Incidental behaviour, resulting in damage or mortality but not resulting in capture, was considered most likely to effect population size because mortality has an immediate effect of reducing population size => The Australian sea-lion was chosen because considered vulnerable to firearms used during downtime => Damage/death as a result of incidental behaviour was perceived to be rarely detectable at population level => Consequence therefore considered to be minimal on population size of Australian sea-lions => Confidence in consequence was low because of a lack of verified observational data on incidental behaviour in the SBT purse seine fishery.

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 (from S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence score (1-2)	Rationale
	Gear loss	1	4	5	Population size	Seals (Australian sea-lion & fur seal, New Zealand fur seal)	1.1	1	1	1	Fishing activity concentrated across 3 degrees in Longitude ca. 180 nm Gear loss possible over this scale => gear loss considered to occur weekly during 3 month season => Lost gear resulting in damage/mortality most likely to effect population size of TEP species => Seals were implicated because of known interactions with lost fishing gear => Intensity was scored as Negligible because lost gear seal interactions were considered to be very rare as a percentage of mortality across the population => Consequence considered unlikely to be detectable at the scale of bycatch species stock => Confidence was scored as low because of a lack of data on interactions between TEP species and lost purse seine fishing gear.
	Anchoring/ mooring	1	4	5	Population size	Southern right whale	1.1	1	1	2	Fishing activity concentrated across 3 degrees in Longitude ca. 180 nm Anchoring/mooring possible over this scale => Anchoring/mooring considered to occur on a weekly basis during the 3 month fishing season => Direct impact (damage or mortality) that occurs when anchoring or mooring most likely to effect Population/size of TEP species => Southern right whale was chosen for analysis because slow moving animal considered most likely to interact with anchor/mooring ropes => given that anchoring/mooring is rare and that chances of bycatch species coming into direct contact with anchors and death resulting are very remote, anchoring/mooring impact was considered negligible => Therefore consequence was also scored as negligible => Confidence was recorded as high because it is considered very unlikely for there to be mortal/damaging interactions between Anchoring/mooring and TEP species.
	Navigation/ steaming	1	4	6	Population size	Southern right whale	1.1	2	1	1	Navigation/steaming concentrated across 3 degrees in Longitude ca. 180 nm => Daily during ca 3 month season => Direct impact (damage or mortality) without capture due to Navigation/steaming was considered most likely to effect Population size of TEP species => The southern right whale was chosen for analysis because it is slow moving and vulnerable to collisions with vessels => Even though Navigation/steaming (including transport of towing cages) is a large component of the SBT purse seine operations, it was considered that collisions would occur rarely => Consequence Negligible i.e. unlikely to be detectable at the scale of the GAB SBT fishery => Confidence was scored as low because there is a lack of observational data on Navigation/steaming and damage or mortality of TEP species in the SBT purse seine fishery.

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 (from S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence score (1-2)	Rationale
Addition/ movement of biological material	Translocation of species	1	4	6	Reproductive capacity	Seabirds (Albatross, short-tailed shearwater, Crested tern, Australian gannet, little penguin)	5.1	2	4	1	Fishing activity concentrated across 3 degrees in Longitude ca. 180 nm Translocation of species possible over this scale => Daily during ca 3 month season => Viral disease potentially transmitted from imported bait fish which may result in local depletion of pilchards in GAB as occurred in 1995 (30% of adult pilchards affected over 6000 km) and 1998/1999 (see Gaughan 2002; Hayes 1997), this is most likely to effect reproductive capacity of sea bird species, i.e. local depletion of preferred prey species may result in reduced reproductive success due to insufficient food for chicks => Intensity considered minor as use of imported bait, infected with disease, considered unlikely given Biosecurity Risk Assessment, plus AQIS Import Risk Assessment => Consequence major as there is likely to be detectable changes in reproductive capacity, impact on population dynamics at maximum sustainable level, long-term recruitment dynamics not adversely damaged. => Confidence recorded as low because the link between imported bait fish and mass pilchard death is unclear (CCEAD 2002). However, there are known effects of mass pilchard death on seabird populations: data on little penguins shows a decline in the number of penguins returning to breeding sites since the 1995 mass pilchard death, plus there has been a change in penguin diet, which prior to 1995 included a significant quantity of pilchard (CCEAD 2002).
	On board processing	0									
	Discarding catch	1	4	6	Behaviour/ movement	white shark	6.1	3	3	1	Fishing activity concentrated across 3 degrees in Longitude ca. 180 nm Discarding catch possible over this scale => Daily during ca 3 month season => Discarding of target species, bycatch (death during seining or transport) poses greatest risk to behaviour/movement of TEP species => The white shark was chosen for analysis because as a scavenger it may eat discards and follow fishing vessels inshore => There is potential for moderate impact on the distribution of white sharks, i.e. population may move inshore increasing intraspecific competition => The consequence was scored as Moderate because aggregation of white sharks inshore increase chances of negative anthropogenic or intraspecific interactions => Confidence was recorded as low because of a lack of verified observational data on discarding and white shark behaviour.
	Stock enhancement	0									

Direct impact of Fishing	Fishing Activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (from S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence score (1-2)	Rationale
	Provisioning	1	4	6	Interactions with fishery	Seabirds (Albatross, short-tailed shearwater, Crested tern, Australian gannet)	7.3	1	1	2	Fishing activity concentrated across 3 degrees in longitude ca. 180 nm Provisioning possible over this scale => Daily during ca. 3 month season => Provisioning (the use of bait and berley) is expected to create interactions between the fishery and TEP species => Seabirds were chosen because they were considered to be readily attracted toward fishing vessels dispensing bait => Intensity was scored as negligible because there was remote likelihood of seabirds being adversely affected (aggregation during feeding frenzy a natural process) => Provisioning in its own right was considered to have minimal consequence on TEP species stock structure and/or dynamics, however, provisioning is likely to increase chances of other negative interactions e.g. collision or entanglement => Confidence in the consequence score was high because provisioning essentially activates a natural process of aggregation and involves natural feed.
	Organic waste disposal	1	4	6	Behaviour/ movement, Interactions with fishery	Seabirds (Albatross, short-tailed shearwater, Crested tern, Australian gannet)	6.1	1	2	1	Fishing activity concentrated across 3 degrees in longitude ca. 180 nm Organic waste disposal possible over this scale => Daily during ca. 3 month season => Disposal of organic waste was expected to pose greatest potential risk for the Behaviour/movement of TEP species => Seabirds were chosen because they were considered to be readily attracted toward fishing vessels dispensing organic waste => Intensity was scored as negligible because there was remote likelihood of seabirds being adversely affected (aggregation during feeding frenzy a natural process) => Organic waste disposal in its own right was considered to have minimal consequence on seabirds, however, it was considered that disposal of organic waste is likely to increase chances of other negative interactions e.g. collision or entanglement => Confidence in the consequence score was high because organic waste disposal, at the scale of fishing boat disposal, considered unlikely to have detectable impacts on seabirds.

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 (from S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence score (1-2)	Rationale
Addition of non-biological material	Debris	1	4	6	Population size	Seabirds (Albatross, short-tailed shearwater, Crested tern, Australian gannet)	1.1	2	1	1	Fishing activity concentrated across 3 degrees in Longitude ca. 180 nm Debris possible over this scale =>Debris may be lost daily during 3 month season => Debris resulting in damage/mortality most likely to effect population size of TEP species => Seabirds were chosen for analysis because they were considered vulnerable to debris e.g. six pack holders =>Intensity was scored as Minor because debris – seabird interactions are considered to be rare => Consequence was considered negligible on seabirds because damage/mortality due to debris from SBT purse seine fishing vessels was considered unlikely to be detectable at the population level => Confidence was scored as low because of a lack of data on interactions between seabirds and debris originating from SBT purse seine fishing operations.
	Chemical pollution	0									
	Exhaust	1	4	6	Population size	Little penguin	1.1	1	1	2	Fishing activity hence exhaust concentrated across 3 degrees in longitude ca. 180 nm => Exhaust emissions occur daily during ca. 3 month season => Exhaust was expected to pose greatest potential risk for the population size sub-component of TEP species => The little penguin was chosen for analysis because this species was considered vulnerable to oil slicks as a result of exhaust emissions => Intensity was scored as negligible because although the hazard was considered over a large range/scale, exhaust considered to only impact a small < 1 nm area and because little penguins are highly mobile strong avoidance was expected at the scale of 1 nm => Consequence was also considered negligible i.e. any consequence on little penguins in the GAB unlikely to be detectable => Confidence in the consequence score was considered high because localised exhaust unlikely to impact on behaviour/movement of little penguins.
	Gear loss	1	4	5	Behaviour/ movement	white shark	6.1	2	2	1	Fishing activity concentrated across 3 degrees in Longitude ca. 180 nm Gear loss possible over this scale => Gear loss considered to occur weekly during 3 month season => Lost gear not resulting in damage/mortality most likely to effect behaviour /movement of TEP species in the GAB => The white shark was chosen for analysis because it was considered to be attracted to or bite floating gear => Intensity was scored as Minor because lost gear - shark interactions are considered to be rare => Consequence considered minor on behaviour/movement of species => Confidence was scored as low because of a lack of data on interactions between white sharks and lost purse seine fishing gear.

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 (from S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence score (1-2)	Rationale
	Navigation/ steaming	1	4	6	Behaviour/ movement	Humpback whale	6.1	2	2	1	Navigation/steaming concentrated across 3 degrees in Longitude ca. 180 nm => Daily during ca 3 month season => Navigation/steaming not resulting in damage or mortality) most likely to effect Behaviour/movement of TEP species => The humpback whale was chosen for analysis because noise and visual stimuli from fishing operations may disrupt calving => Navigation/steaming (including transport of towing cages) is a large component of the SBT purse seine operations, however, it was considered that any impact would be rare => Consequence was considered minor for humpback whale populations => Confidence was recorded as low because there is a lack of information on interactions between non-collision effects of Navigation/steaming and Behaviour/movement of whales.
	Activity/ presence on water	1	4	6	Interactions with fishery	Southern right whale	7.3	2	2	1	Fishing activity/ presence concentrated across 3 degrees in longitude ca. 180 nm => Daily during ca. 3 month season => Activity/presence on water of purse seine fishing vessels was considered to create interactions with TEP species => Intensity was scored as Minor because the presence of fishing vessels introduces sound waves that may impact on whale behaviour=> Consequence was also considered Minor, any effects of vessel presence unlikely to be detectable for southern right whales in the GAB => Confidence in the consequence score was considered low because potential impacts of vessel presence/activity on whale behaviour/movement unknown.
Disturb physical processes	Bait collection	1	4	6	Population size	Syngnathids (seahorses, seadragons, pipefish)	1.1	2	2	1	Bait collection activity concentrated across 3 degrees in Longitude ca. 180 nm => Daily during ca 3 month season => Physical disturbance to sediments during bait collection seining most likely to effect Population size of Syngnathid species by disturbing inshore benthic processes => Intensity considered Minor, i.e. bait collection considered to rarely interact with Syngnathid habitat => Consequence scored as Minor because bait collection may indirectly affect stock levels and reduce capacity to increase => Confidence recorded as low because of lack of information on bait collection and Syngnathid 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 (from S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence score (1-2)	Rationale
	Fishing	1	4	6	Behaviour/ movement	Southern right whale	6.1	1	1	2	Fishing activity concentrated across 3 degrees in longitude ca. 180 nm => Daily during ca. 3 month season => Disturbance of physical processes via purse seine fishing was expected to pose greatest potential risk for the Behaviour/movement of TEP species resulting in momentary disruption to feeding and/or movement => southern right whale was chosen for analysis because it is a slow moving animal => Intensity was scored as negligible because although the hazard was considered over a large range/scale, fishing considered to only impact physical processes over a small < 1 nm area => Consequence was also considered negligible with any consequence of water column disturbance due to fishing unlikely to have a detectable effect on southern right whales in the GAB => Confidence in the consequence score was considered high because localised disruption of water column unlikely to impact and have consequences for the behaviour/movement of the southern right whale.
	Boat launching	0									
	Anchoring/ mooring	1	4	5	Behaviour/ movement	Southern right whale	6.1	1	1	2	Fishing activity concentrated across 3 degrees in Longitude ca. 180 nm => Anchoring/mooring considered to occur on a weekly basis during the 3 month fishing season => Anchoring/mooring disturbance of physical processes most likely to effect Behaviour/movement of TEP species => The southern right whale was chosen because it is slow moving => Intensity of anchoring/mooring was considered negligible on physical processes that may effect southern right whales => Consequence was also considered negligible => Confidence was recorded as high because it was considered unlikely for there to be any interactions between Anchoring/mooring, physical processes and the southern right whale.
	Navigation/steaming	1	4	6	Behaviour/ movement	white shark	6.1	1	1	2	Navigation/ steaming concentrated across 3 degrees in Longitude ca. 180 nm => Daily during ca 3 month season => Disturbance to pelagic physical processes due to Navigation/steaming of fishing vessels was expected to pose greatest potential risk for the Behaviour/movement of white sharks resulting in disruption to feeding and/or migration => Intensity was scored as negligible because although the hazard was considered over a large range/scale, Navigation/ steaming considered to only impact a small < 1 nm area => Consequence was also considered negligible with any impact of Navigation/ steaming unlikely to be detectable for white sharks in the GAB => Confidence in the consequence score was considered high because Navigation/ steaming unlikely to impact and have consequences for the behaviour/movement of highly mobile white sharks.

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 (from S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence score (1-2)	Rationale
External hazards (specify the particular example within each activity area)	Other fisheries	1	6	6	Population size	Wandering albatross	1.1	4	4	2	Fishing activity concentrated across >1000 nm => Daily during fishing season => Other capture fishery methods were considered to pose greatest risk to the population size sub-component for TEP species => The wandering albatross was chosen for analysis because there are known interactions between albatross and long-line tuna fisheries => Long-line impact on albatross was considered a Major impact on population size that occurs reasonably often at broad spatial scale => Consequence was scored as Major because serious consequences are believed to be now occurring => Confidence was recorded as high because of extensive observational data on albatross long-line fishery interactions.
	Aquaculture	1	4	6	Population size	Seabirds (Albatross, short-tailed shearwater, Crested tern, Australian gannet)	1.1	3	4	1	Collection of bait for aquaculture concentrated across 3 degrees in Longitude ca. 180 nm => Daily during ca 3 month season => Local depletion of bait fish most likely to effect population size of TEP species, will need to search elsewhere for bait fish, rather than large scale shift in migration pattern i.e. geographic range shift => Seabirds were chosen for analysis because reproductive success and in turn population size known to diminish with reduced food availability => Moderate –severe but local impact, moderate at broader spatial scale => Consequence of aquaculture feed collection impact likely to result in wider and long term change population size of seabirds in GAB => Confidence recorded as low because of insufficient knowledge on dynamics between bait fish and seabirds.
	Coastal development	0									
	Other extractive activities	0									
	Other non extractive activities	0									
	Other anthropogenic activities	1	6	6	Behaviour/ movement	white shark	6.1	3	3	1	Tourism concentrated across the GAB ca 1000 nm => Daily tourism activity during peak season => Induced behavioural/movement changes expected to pose greatest potential risk for TEP species => The white shark was chosen for analysis because tourism practices may lead to changes in behaviour and movement => Intensity was scored as Moderate because shark cage dives may influence feeding behaviour of white sharks across broader spatial scale and result in increased 'potentially dangerous' interactions with fishing and non-fishing vessels => Consequence was also considered moderate => Confidence in the consequence score was considered low due to a lack of data on behavioural changes.

2.3.1 Level 1 (SICA) Document 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 (from S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence score (1-2)	Rationale
Capture	Bait collection	1	4	6	Substrate quality	Fine sediments, current rippled, large sponges, inner-shelf	3.1	3	2	1	Operators use live and frozen (thawed) baits as berley to attract schools for capture by purse seine. Fresh baits obtained (daily) by individual operators using small purse seine, in inshore state waters across 3 degrees of longitude (ca. 180 nm). Nets occasionally bottom contact. Substrate quality at risk if seines disturb the benthos, resulting in capture of sediments and attached fauna, and resuspension of fine sediments disturbing water quality. Habitat structure may be altered with repeated disturbance of habitats, in commonly targeted areas. Higher relief areas are avoided to reduce net damage. Intensity: moderate, possibly locally severe in high energy/ current prone areas. Consequence; Minor in Commonwealth waters, impact greatest in near shore zones (State waters). Hand purse seine deemed to have a lighter footprint, and impacted faunas expected to recover quickly, which will depend on frequency of interaction. Productivity in these naturally disturbed zones is considered high. Confidence: low, insufficient knowledge on live bait fish distribution.
	Fishing	1	4	6	Habitat structure and Function	Southern (Coastal) Pelagic Province	5.1	1	1	2	Fishing activity concentrated across 3 degrees in Longitude ca. 180nm, daily during 3 month season. Pelagic habitat structure may be altered by mechanical action of seine net considered to mix water column and disrupt column structure temporarily. Capture of fluid habitat not considered destructive. No contact with benthos occurs during capture of surface schooling pelagic fish. Intensity: Negligible because pelagic habitat structure/mixed layer depth considered to quickly return to pre-disturbed structure. Therefore Consequence: Negligible. Confidence: high, pelagic habitat considered resistant to purse seine fishing operations.
	Incidental behaviour	1	4	5	Habitat Structure and Function	Coarse sediments subcropping rock, large sponges,inner-shelf	5.1	1	1	1	Incidental behaviour possible over the scale of the fishery. Downtime activities considered to occur on a weekly basis during 3 month fishing season. Incidental behaviour considered to have potential for damage in 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: Negligible. 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 (from S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence score (1-2)	Rationale
Direct impact without capture	Bait collection	1	4	5	Substrate quality	Fine sediments, current rippled, large sponges, inner-shelf	3.1	3	2	1	Whether capture or not, the effect is the same for habitats interacting with gear. Substrate quality may be altered temporarily from impact of net during bait collection, as re-suspension of fine sediments create turbidity until settle out. Intensity: moderate, likely to be locally severe in high energy/ current prone areas, influencing sediments to settle elsewhere, or potentially smother fragile filter feeding species in the process. Consequence; Minor in Commonwealth waters, i.e. it was considered impact would be greatest in near shore zones not within the jurisdiction of this fishery. Confidence: low no observer data on habitat interactions with gear.
	Fishing	1	4	6	Habitat structure and Function	Southern (Coastal) Pelagic Province	5.1	1	1	2	Whether capture or not, the effect is the same for habitats interacting with gear. Fishing considered unlikely to adversely impact pelagos. Intensity: Negligible because pelagic habitat structure e.g. mixed layer depth, considered to quickly return to pre-disturbed structure. Therefore consequence considered Negligible. Confidence: high because pelagic habitat considered resistant to purse seine fishing operations.
	Incidental behaviour	1	4	6	Habitat Structure and Function	Coarse sediments subcropping rock, large sponges, inner-shelf	5.1	1	1	1	Incidental behaviour possible over the scale of the fishery. Downtime activities considered to occur on a weekly basis during 3 month fishing season. Incidental behaviour considered to have potential for damage in 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: Negligible. Confidence: low because of a lack of verified data on locations and types of downtime activities.
	Gear loss	1	4	5	Habitat structure and Function	Coarse sediments, subcropping rock, mixed faunal community, inner-shelf	5.1	1	2	1	Gear loss possible over 180nm. Gear loss considered to occur on a weekly rather than daily basis during 3 month fishing season. The Southern (coastal) Pelagic habitat was determined most at risk to gear loss involving floating objects. Lost gear may change habitat structure by virtue of creating new structure, and altering the function of water as habitat. Gear that sinks is most likely to damage fragile erect mixed faunal communities. Intensity: Negligible, considered low volume of gear loss. Consequence: Negligible; Risk of heavy nets remaining floating seems unlikely for long, other gear may persist longer in the pelagos, eventually to be washed ashore or sink. Gear eventually forms habitat. Confidence: low because of a lack of verified data on gear loss events and volumes.

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 (from S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence score (1-2)	Rationale
	Anchoring/ mooring	1	4	5	Habitat structure and Function	Fine sediments, current rippled, mixed faunal community, inner-shelf	5.1	2	2	1	Anchoring/ mooring possible over the entire scale of fishing activity, on a weekly basis during 3 month fishing season. Anchoring more common in shallower water, and may be concentrated in preferred locations which may increase interactions with sensitive reef structures in those areas. Habitat structure and function was considered most at risk to physical damage (destructive change in morphology) as a result of anchoring. Intensity: Minor, actual area of anchoring/mooring small. Consequence: Minor, because anchoring/mooring activities considered to be detectable however occur in a highly disturbed zone of rapid regeneration capacity. Confidence: low, lack of verified data on anchoring/mooring activities and locations.
	Navigation/ steaming	1	4	5	Substrate quality	Fine sediments, current rippled, mixed faunal community, inner-shelf	3.1	3	2	1	Navigation/steaming occur on a daily basis during 3 month fishing season. Substrate quality of Inner shelf benthic habitats considered most at risk from fish feeding activities as fish transport cages are towed into Port Lincoln. Feeding during transport of towing pontoons may result in accumulation of feed on the benthos leading to altered sediment chemistry. Intensity: moderate, it was considered there was a possibility for severe localised benthic accumulation of feed leading to anoxic bottom sediments over frequently towed routes. Consequence: Minor. This effect was considered to only be detectable at very localised scales, and may not persist for longer than days with scavenging activity. Some damage to attached fauna may occur as feed settles, but expected to be negligible unless volumes large. Confidence: low because of a lack of information on interactions between tow cages and the benthos, and breakdown times of accumulated feed.
Addition/ movement of biological material	Translocation of species	1	4	5	Habitat Structure and Function	Southern (Coastal) Pelagic Province	5.1	2	1	2	Translocation of species may occur in the SBT fishery with the use of fresh and frozen baits used as berley to attract schools during purse seining offshore, feeding during towing, and for fish feed in inshore cages. Introduced bait species (frozen imported pilchards for farm feed) have been known to spread pathogens to local bait species resulting in significant mortality in SA and WA populations of pilchards in the past. Feeding SBT with foreign pilchards occurs on a daily basis during 3 month fishing season, water quality was considered most likely to be impacted by feeding SBT foreign pilchards that may contain diseases that are transferred to the pelagic habitat and on to local pilchards, i.e. water quality decreases as disease load increases. Intensity with respect to water quality was

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 (from S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence score (1-2)	Rationale
											considered Minor because of low viral persistence time. Consequence: Negligible because time for habitat to recover on scale of hours. Confidence in consequence score was high because viral persistence (outside host organism) generally on scale of hours.
	On board processing	0									
	Discarding catch	1	4	6	Substrate quality	Fine sediments, current rippled, mixed faunal community, inner-shelf	5.1	2	2	1	Discarding catch possible over entire scale of fishing activity (~180 nm) and considered to occur on a daily basis during 3 month fishing season. Substrate quality was considered most likely to be impacted by fish feeding activities as fish transport cages are towed into Port Lincoln. Benthic habitats on fine sediments of the Inner shelf determined most at risk because discarding during transport of towing pontoons may result in accumulation of carcasses on the benthos leading to altered sediment chemistry (anoxia, increased nutrient load). Intensity: Moderate because it was considered there was a possibility for severe localised benthic accumulation of carcasses. Consequence: Minor because impacts were considered to only be detectable at very localised scales. Confidence: low because of a lack of information on interactions between discards and the benthos.
	Stock enhancement	0									
	Provisioning	1	4	6	Water quality	Southern (Coastal) Pelagic Province	1.1	2	1	2	Fishing activity concentrated across 3 degrees in longitude ca. 180 nm. Baiting SBT with foreign pilchards occurs on a daily basis during 3 month fishing season. Water quality was considered most likely to be impacted by baiting, i.e. water quality temporarily altered by introduced nutrient load. Intensity: Minor because of low persistence time of bait as is rapidly consumed or sinks through water column. Consequence: Negligible, time for pelagic habitat to recover on scale of minutes- hours. Confidence: high reasonable consideration.
	Organic waste disposal	1	4	5	Water quality	Southern (Coastal) Pelagic Province	1.1	1	1	2	Organic waste disposal considered to occur daily over scale of fishery activity. Organic waste volumes considered temporarily alter Water quality in the Southern (coastal) pelagic habitat. Intensity: Negligible because the load of organic waste was considered to be small and quickly dispersed through the

Direct impact of Fishing	Fishing Activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (from S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence score (1-2)	Rationale
											water column, or taken up by scavengers. Consequence: therefore also negligible. Confidence: high because general organic waste disposal from fishing boats not likely/known to cause impacts when disposed in open water.
Addition of non-biological material	Debris	1	4	6	Water quality	Southern (Coastal) Pelagic Province	1.1	1	1	2	Debris resulting from purse seine fishing operations considered to occur daily during ca. 3 month season, impacting the pelagos as safe habitat. Debris volumes considered small, losses should be incidental as boats are covered by MARPOL regulations prohibiting intentional disposal of debris at sea. Intensity: Negligible because the volume of debris was considered to be small and quickly dispersed. Consequence therefore also negligible. Confidence low because the volume of debris generated by the fishery is unknown.
	Chemical pollution	0									
	Exhaust	1	4	6	Air quality	Southern (Coastal) Pelagic Province	2.1	1	1	2	Fishing activity hence exhaust emissions concentrated across 3 degrees in longitude ca. 180 nm. Exhaust emissions occur daily during ca. 3 month season. Exhaust was considered to pose greatest risk for Air quality over the Southern (Coastal) Pelagic Province. Intensity: Negligible because the load of exhaust (which may be momentarily high) was considered to be small and quickly dispersed. Consequence was therefore also negligible. Confidence: high because general exhaust emissions associated with fishing vessels was considered unlikely to cause significant impacts on air quality.
	Gear loss	1	4	6	Habitat structure and Function	Fine sediments, current rippled, mixed faunal community, inner-shelf	5.1	1	1	1	Lost gear may change habitat structure by virtue of creating new structure, and remaining in deeper waters if irretrievable until broken down or assimilated. Intensity: Negligible, considering the low volume of gear loss. Consequence: Negligible, risk of heavy nets remaining floating seems unlikely for long, other gear may persist longer in the pelagos, eventually to be washed ashore or sink. Gear eventually forms habitat. Confidence: low because of a lack of verified data on gear loss events and volumes, and probability of encounter with this form of benthic habitat.
	Navigation/ steaming	1	4	6	Water quality	Southern (Coastal) Pelagic Province	1.1	1	1	2	Navigation/steaming were considered to influence water quality of the pelagic habitat by adding emissions, noise and vibration, during the passage of the vessel and gear through water column. Intensity: Negligible, considered unlikely that there would be any persistent effects on pelagic habitat structure. Consequence: Negligible. Confidence: high because negative 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 (from S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence score (1-2)	Rationale
											between Navigation/steaming and pelagic habitat was considered very unlikely.
	Activity/ presence on water	1	4	6	Water quality	Southern (Coastal) Pelagic Province	1.1	2	1	2	Activity/presence on water of purse seine fishing vessels was considered to influence pelagic habitat quality by disturbing structure through the addition of noise and visual stimuli. Presence of vessels also creates a new temporary habitat for species (i.e. birds, mammals, predators) attracted to operations. Intensity: Minor, because the stimuli provided by vessel and fishing operations is removed as soon as activity ceases. Consequence was therefore scored Negligible as habitat returns to pre-disturbed state almost immediately. Confidence: high because vessel presence highly unlikely to form a significant habitat in the GAB.
Disturb physical processes	Bait collection	1	4	6	Substrate quality	Fine sediments, current rippled, mixed faunal community, inner-shelf	3.1	3	2	2	Bait collection most likely to affect Substrate and Water quality in the inner shelf 'soft' bottom habitats supporting a diversity of fauna. Seines may disturb the benthos and result in capture of fauna and disturbance of sediments. Water quality is reduced temporarily in fine sediments, potentially smothering filter feeding fauna dependent on current flows, and disrupting substrate processes for burrowing bioturbators. The intensity was scored as 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 impact would have minimal consequence for habitats existing in regions of high natural disturbance (currents, tides, storm swell). Confidence: low the effect of transient and relatively light bottom contact in inner shelf depths, not known.
	Fishing	1	4	6	Habitat structure and Function	Southern (Coastal) Pelagic Province	5.1	1	1	2	Fishing activity likely to temporarily alter pelagic habitat dynamics during the course of purse seine operations. Habitat structure was considered because mechanical action of seine net perceived to mix water column and disrupt column structure. Intensity: negligible because pelagic habitat structure e.g. mixed layer depth, considered to quickly return to pre-disturbed structure. Therefore consequence considered Negligible. Confidence: high because large amounts of mixing naturally occur in pelagic habitat and any impact probably not detectable above levels of natural variability.
	Boat launching	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 (from S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence score (1-2)	Rationale
	Anchoring/ mooring	1	4	6	Habitat structure and Function	Fine sediments, current rippled, mixed faunal community, inner-shelf	5.1	1	1	2	Anchoring likely to be more common in shallower water, and may be concentrated in preferred locations which may increase interactions with sensitive reef structures in those areas. Disturbance of physical processes supporting benthic habitat function was considered transient and inconsequential as a result of anchoring, unless heavily trafficked. Intensity: Minor, actual area of anchoring/mooring small. Consequence: Minor, anchoring/mooring activities considered to be detectable however occur in a highly disturbed zone of rapid regeneration capacity. Confidence: low because of a lack of verified data on anchoring/mooring activities and locations.
	Navigation/steaming	1	4	6	Habitat structure and Function	Southern (Coastal) Pelagic Province	5.1	1	1	2	Navigation/steaming of fishing vessels was expected to pose greatest potential risk for pelagic physical processes in the Southern (coastal) Pelagic Province. Intensity: negligible because although the hazard was considered over a large range/scale, intensity of Navigation/ steaming considered over a small < 1 nm area. Consequence: considered negligible with time for fluid habitat to recover was thought to be on the scale of hours. Confidence in the consequence score was considered high because Navigation/ steaming unlikely to have lasting impact.
External Impacts (specify the particular example within each activity area)	Other capture fishery methods -Long-lining - Purse seining Fisheries - Skipjack Tuna Fishery - Eastern Tuna & Billfish Fishery - Southern & Western Tuna & Billfish Fishery - Small Pelagics Fishery -SA Pilchard Fishery -WA Pilchard	1	4	6	Habitat structure and Function	Fine sediments, current rippled, mixed faunal community, inner-shelf	5.1	2	2	1	All fishing activity concentrated across > 1000nm, on a daily basis. Other Commonwealth fisheries operating in this area include the GAB trawl fishery which uses demersal methods therefore does not interact with the SBT Purse seine fishery. The SPF purse seine has little effort in this region at present. Other jurisdictional boundaries include SKJ, SWTBF; no effort occurs in this region. Other fisheries were considered most likely to effect the structure and function of the pelagos, by interfering with water quality. Trawl methods are concentrated in outer shelf areas. The intensity was scored as Minor on the pelagic habitat due to the fluid nature of water. Consequence: Minor, considered that impact would have minimal consequence for habitat structure, detectable impact but time to recovery on scale of hours to days. Confidence: low because of insufficient knowledge or observational data on interaction between habitat structure and other fisheries.

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 (from S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence score (1-2)	Rationale
	Fishery										
	Aquaculture capture of feed species for -SBT -Kingfish / mulloway				Substrate quality	Fine sediments, current rippled, mixed faunal community, inner-shelf	3.1	3	2	1	Bait collection and feeding most likely to effect Substrates associated with this industry. The habitat considered most at risk was the inshore benthic, bait collecting seines may disturb the benthos and result in capture of sediments. Feeding may lead to localised accumulations on the seafloor. The intensity was scored as Moderate –i.e. the impact was considered to be potentially severe at local scales but moderate at broader spatial scale. Consequence was scored as Minor, i.e. it was considered impact would have minimal consequence for habitats if gear not demersal. Confidence: low for bait collection operations, high for feeding associated with aquaculture, well monitored.
	Coastal development	0									
	Other extractive activities	0									
	Other non extractive activities	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 (from S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence score (1-2)	Rationale
	Other anthropogenic activities - Shipping - Tourism	1	6	6	Habitat structure and Function	Southern (Coastal) Pelagic Province	5.1	2	2	1	Navigation/ steaming associated with shipping and recreational use of this region overlaps with SBT activity. Navigation/steaming occurs on a daily basis. Habitat function considered most likely to be impacted by noise generated by navigation and steaming, and physical passage of vessels in the way of marine mammals. Intensity: Minor because stimuli short-lived and water column disturbance likely to cause temporary changes to pelagic function as habitat, and occurs in a restricted location. Consequence: Minor, if no TEP interactions occur, and detectable impact on scale of hours to days. Confidence: low, effects of anthropogenic activities poorly monitored.

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

Direct impact of Fishing	Fishing Activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (from S2.1)	Intensity Score (1-6)	**Consequence Score (1-6)**	Confidence score (1-2)	Rationale
Capture	Bait collection	1	4	6	Functional group composition	Southern Coastal GAB (pelagic)	2.1	3	2	1	Bait collection concentrated across 3 degrees in longitude ca. 180 nm => Bait collection considered to occur daily during ca 3 month season => Bait collection most likely to effect Functional group composition, i.e. bait collection may reduce the bait fish functional group from the Southern Coastal GAB pelagic community => The intensity was scored as Moderate –i.e. the impact was considered to be potentially severe at local scales but moderate at broader spatial scale => Consequence of bait collection impact likely to result in minor changes in relative abundance of community constituents up to 5% => Confidence was recorded as low because of insufficient knowledge on bait fish trophic dynamics.
	Fishing	1	4	6	Functional group composition	Southern Coastal GAB (pelagic)	2.1	3	3	1	Fishing activity concentrated across 3 degrees in longitude ca. 180 nm => Fishing considered to occur daily during ca 3 month season => SBT purse seine fishing most likely to effect Functional group composition, i.e. removal of the dominant member of the tuna functional group from the Southern Coastal GAB pelagic community in the GAB => The intensity was scored as Moderate – i.e. the impact was considered to be potentially severe at local scales but moderate at broader spatial scale => Consequence was scored as Moderate, i.e. it was considered that fishing would have detectable changes to the ecosystem without a major change in function => Confidence was recorded as low because of insufficient knowledge of trophic interactions.
	Incidental behaviour	1	4	5	Species composition	Southern Coastal GAB (pelagic)	1.1	2	2	1	Fishing activity concentrated across 3 degrees in longitude ca. 180 nm Incidental possible over this scale => Downtime activities considered to occur on a weekly rather than daily basis during 3 month fishing season => The Southern Coastal GAB pelagic community was determined most at risk to capture as a result of incidental behaviour because downtime activities were considered to have greatest potential damage on large, rare top order predators i.e. sharks => The intensity was scored as Minor –i.e. the impact was considered to occur rarely => Consequence was scored as Minor, i.e. it was considered that capture of large sharks would have minor changes in relative abundance of community constituents => Confidence in the consequence score was low because of a lack of verified data on 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 (from S2.1)	Intensity Score (1-6)	**Consequence Score (1-6)**	Confidence score (1-2)	Rationale
Direct impact without capture	Bait collection	1	4	6	Functional group composition	Southern Coastal GAB (pelagic)	2.1	2	2	1	Bait collection concentrated across 3 degrees in longitude ca. 180 nm => Bait collection considered to occur daily during ca 3 month season => Bait collection activities (not resulting in capture) most likely to effect Functional group composition, i.e. damage/mortality bait collection may impact the bait fish functional group from the Southern Coastal GAB pelagic community => The intensity was scored as 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 was scored as Minor because it was considered that damage or mortality to non-caught bait fish is unlikely to have strong impacts on the bait fish functional group in its own right => Confidence was recorded as low because of insufficient knowledge on effects of bait collection purse seine on non-captured individuals.
	Fishing	1	4	6	Functional group composition	Southern Coastal GAB (pelagic)	2.1	2	2	1	Fishing activity concentrated across 3 degrees in longitude ca. 180 nm => Fishing considered to occur daily during ca 3 month season => SBT 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 GAB pelagic community in the GAB => The intensity was scored as 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 was scored as Minor because it was considered that damage or mortality to non-caught tunas is unlikely to have strong impacts on the tuna functional group in its own right => Confidence was recorded as low because of insufficient knowledge on effects of purse seine net on non-captured individuals.

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 (from S2.1)	Intensity Score (1-6)	**Consequence Score (1-6)**	Confidence score (1-2)	Rationale
	Incidental behaviour	1	4	5	Species composition	Southern Coastal GAB (pelagic)	1.1	2	2	1	Fishing activity concentrated across 3 degrees in longitude ca. 180 nm Incidental behaviour possible over this scale => Downtime activities considered to occur on a weekly rather than daily basis during 3 month fishing season => The Southern Coastal GAB pelagic community was determined most at risk to non-capture incidental behaviour. Downtime activities were considered to have greatest potential non-capture damage or mortality of large, rare top order predators i.e. sharks => The intensity was scored as Minor –i.e. the impact was considered to occur rarely => Consequence was scored as Minor, i.e. it was considered that non-capture but damage to large sharks would result in minor changes in relative abundance of community constituents => Confidence in the consequence score was low because of a lack of verified data on downtime activities and insufficient knowledge of trophic interactions.
	Gear loss	1	4	5	Species composition	Southern Coastal GAB (pelagic)	1.1	1	1	1	Fishing activity concentrated across 3 degrees in longitude ca. 180 nm Gear loss possible over this scale => Gear loss events considered to occur on a weekly rather than daily basis during 3 month fishing season => The Southern Coastal GAB pelagic community was determined most at risk to gear loss => Gear loss was considered to have greatest community level impact by effecting relatively large, rare top order predators i.e. sharks => The impact was scored as Negligible –i.e. the likelihood of impact was considered remote => Therefore, consequence was scored as Negligible => Confidence in the consequence score was 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 (from S2.1)	Intensity Score (1-6)	**Consequence Score (1-6)**	Confidence score (1-2)	Rationale
	Anchoring/ mooring	1	4	5	Species composition	Southern Inner shelf Eyre; Outer shelf	1.1	2	2	1	Fishing activity concentrated across 3 degrees in longitude ca. 180 nm Anchoring/mooring possible over this scale => Anchoring/mooring events considered to occur on a weekly rather than daily basis during 3 month fishing season => Functional group composition for the Southern Inner and Outer Shelf communities was considered most at risk to physical damage from anchoring/mooring => The intensity was scored as Minor –i.e. the impact of Anchoring/mooring was considered to occur rarely and mostly on soft sediments in GAB => Consequence Minor - Minimal consequence for community structure => Confidence was recorded as low because of insufficient knowledge on anchoring/mooring locations.
	Navigation/ steaming	1	4	6	Species composition	Southern Coastal GAB (pelagic)	1.1	3	3	1	Navigation/steaming concentrated across 3 degrees in longitude ca. 180 nm => Navigation/steaming occurs on a daily basis during 3 month fishing season => The Southern Coastal GAB pelagic community was considered most at risk to Navigation/steaming => Navigation/steaming was considered to have greatest community level impact by effecting relatively large, rare top order predators i.e. sharks => The intensity was scored as Moderate –i.e. white sharks known to interact with cage towing operations either damage or mortality => Consequence was scored as Moderate, i.e. it was considered that damage or mortality of large sharks would have detectable changes to the ecosystem without a major change in function => Confidence in consequence score was low because of a lack of information on interactions between tow cages and sharks plus insufficient knowledge on 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 (from S2.1)	Intensity Score (1-6)	**Consequence Score (1-6)**	Confidence score (1-2)	Rationale
Addition/ movement of biological material	Translocation of species	1	4	6	Functional group composition	Southern Coastal GAB (pelagic)	2.1	3	3	1	Fishing activity concentrated across 3 degrees in longitude ca. 180 nm Translocation of species possible over this scale => Baiting / feeding considered to occur daily during ca 3 month season => Translocation of foreign bait species and associated diseases most likely to effect Functional group composition, i.e. disease may effectively remove the bait fish functional group from the Southern Coastal community => The intensity was scored as Moderate –i.e. the impact was considered to be potentially severe at local scales but moderate at broader spatial scale => Consequence was scored as Moderate, i.e. it was considered that bait disease would have detectable changes to the ecosystem without a major change in function => Confidence recorded as low because the link between imported bait fish and mass pilchard death is unclear. However, there are known ecological effects of mass pilchard death, including effects on seabirds (e.g. number of penguins returning to breeding sites since the 1995 mass pilchard death, plus there has been a change in penguin diet, which prior to 1995 included a significant quantity of pilchard), plus it has been suggested that there are positive feedbacks as a result of increased food availability for opportunistic feeders such as rock lobster and New Zealand fur seals (CCEAD 2002). Impacts on large, long lived predators such as marine mammals and seabirds may not be seen for some time due to lag effects in biological systems (CCEAD 2002). Note there has been an increase in the abundance of some pilchard competitors such as anchovies (*Engralis australis*) (CCEAD 2002).
	On board processing	0									

Direct impact of Fishing	Fishing Activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (from S2.1)	Intensity Score (1-6)	**Consequence Score (1-6)**	Confidence score (1-2)	Rationale
	Discarding catch	1	4	6	Distribution of community	Southern Coastal GAB (pelagic)	3.1	2	2	1	Fishing activity concentrated across 3 degrees in longitude ca. 180 nm Discarding catch possible over this scale => Discarding catch considered to occur on a daily basis during 3 month fishing season => The Southern Coastal Pelagic community was believed most at risk to discarded catch because most discarding thought to occur here, discarded catch was considered to have greatest community level impact on distribution by increasing relative abundance of large, rare top order predators i.e. sharks => The intensity was scored as Minor –i.e. thought to occur rarely => Consequence was scored as Minor because only minor changes in relative abundance of constituents perceived to occur => Confidence in consequence score was low because of a lack of sufficient knowledge on trophic dynamics.
	Stock enhancement	0									
	Provisioning	1	4	6	Distribution of community	Southern Coastal GAB (pelagic)	3.1	2	2	1	Fishing activity concentrated across 3 degrees in longitude ca. 180 nm Provisioning possible over this scale => Provisioning considered to occur on a daily basis during 3 month fishing season => The Southern Coastal GAB pelagic community was believed most at risk to provisioning because only habitat where provisioning occurs, provisioning was considered to have greatest community level impact on distribution by increasing relative abundance of scavenging species e.g. large, rare top order predators or seabirds locally => The intensity was scored as Minor –i.e. thought to occur rarely => Consequence was scored as Minor because only minor changes in relative abundance of constituents perceived to occur and not persistent=> Confidence in consequence score was low

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 (from S2.1)	Intensity Score (1-6)	**Consequence Score (1-6)**	Confidence score (1-2)	Rationale
	Organic waste disposal	1	4	6	Distribution of community	Southern Coastal GAB (pelagic)	3.1	2	2	1	Fishing activity concentrated across 3 degrees in longitude ca. 180 nm Organic waste disposal possible over this scale => Organic waste disposal considered to occur on a daily basis during 3 month fishing season => The Southern Coastal GAB pelagic community where organic waste considered most likely dumped, organic waste was considered to have greatest community level impact on distribution by increasing relative abundance of scavenging species e.g. large, rare top order predators or seabirds => The intensity was scored as Minor –i.e. thought to occur rarely => Consequence was scored as Minor because only minor changes in relative abundance of constituents perceived to occur => Confidence in consequence score was low because of a lack of insufficient knowledge on trophic dynamics.
Addition of non-biological material	Debris	1	4	6	Species composition	Southern Coastal GAB (pelagic)	1.1	2	2	1	Fishing activity concentrated across 3 degrees in longitude ca. 180 nm Debris possible over this scale => Debris resulting from purse seine fishing operations considered to occur daily during ca. 3 month season => The Southern Coastal GAB pelagic community considered most likely to accumulate debris (e.g. floating plastics), debris was considered to have greatest community level impact on species composition by decreasing relative abundance of susceptible species e.g. seabirds => The intensity was scored as Minor –i.e. thought to occur rarely => Consequence was scored as Minor because considered only a minor change to relative abundance of seabird unlikely to change outside natural variation => Confidence in the consequence score was low because the volume of debris generated and species susceptibility unknown.
	Chemical pollution	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 (from S2.1)	Intensity Score (1-6)	**Consequence Score (1-6)**	Confidence score (1-2)	Rationale
	Exhaust	1	4	6	Distribution of community	Southern Coastal GAB (pelagic)	3.1	2	2	1	Fishing activity hence exhaust concentrated across 3 degrees in longitude ca. 180 nm => Exhaust resulting from purse seine fishing operations considered to occur daily during ca. 3 month season => 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 further offshore or along shore => The intensity was scored as Minor –i.e. thought to occur rarely and at very localised scale => Consequence considered only Minor change to local abundance of susceptible species – unlikely to change outside natural variation => Confidence in the consequence score was low because relative species susceptibility to exhaust was unknown.
	Gear loss	1	4	5	Distribution of community	Southern Inner shelf Eyre; Outer shelf	3.1	1	1	1	Fishing activity concentrated across 3 degrees in longitude ca. 180 nm Gear loss possible over this scale => Gear loss events considered to occur on a weekly rather than daily basis during 3 month fishing season => The Southern inner and outer shelf communities was considered most likely to interact lost gear => Gear loss was considered to have greatest community level impact by creating new benthic habitat and changing distribution => The intensity was scored as Negligible –i.e. the likelihood of impact was considered remote => Therefore, consequence was scored as Negligible => Confidence in the consequence score was 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 (from S2.1)	Intensity Score (1-6)	**Consequence Score (1-6)**	Confidence score (1-2)	Rationale
	Navigation/ steaming	1	4	6	Distribution of community	Southern Coastal GAB (pelagic)	3.1	2	2	1	Navigation/steaming concentrated across 3 degrees in longitude ca. 180 nm => Navigation/steaming occurs on a daily basis during 3 month fishing season => Most Navigation/steaming considered to occur in the Southern Coastal GAB pelagic community => Navigation/steaming was considered to have greatest community level impact by affecting Distribution of community => The intensity was scored as Minor –i.e. predators may follow caged tuna inshore, however detectable community level impact considered rarely detectable => Consequence was scored as Minor, because top-order predators are inherently rare in system and minor distribution change perceived to result in only minor changes in relative abundance of other constituents => Confidence in consequence score was low because of a lack of information on interactions between tow cages and predators plus insufficient knowledge on trophic dynamics.
	Activity/ presence on water	1	4	6	Distribution of community	Southern Coastal GAB (pelagic)	3.1	1	1	2	Fishing activity/ presence on water concentrated across 3 degrees in longitude ca. 180 nm => Activity/ presence on water occurs on a daily basis during 3 month fishing season => Most Activity/ presence on water considered to occur in the Southern Coastal GAB 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 => Therefore consequence also scored 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.

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 (from S2.1)	Intensity Score (1-6)	**Consequence Score (1-6)**	Confidence score (1-2)	Rationale
Disturb physical processes	Bait collection	1	4	6	Distribution of community	Southern Inner shelf Eyre; Outer shelf	3.1	2	2	1	Bait collection concentrated across 3 degrees in longitude ca. 180 nm => Bait collection considered to occur daily during ca 3 month season => Bait collection most likely to affect distribution due to disturbances of sediments=> The intensity was scored as Minor – i.e. the impact was considered to occur rarely or in few restricted locations and impact even at these scales rare => Consequence was scored as Minor, i.e. it was considered any impact would have minimal consequence for community, i.e. only minor change in relative abundance of other constituents => Confidence was recorded as low because of insufficient knowledge or observational data on bait collection operations associated with the SBT purse seine fishery.
	Fishing	1	4	6	Distribution of community	Southern Coastal GAB (pelagic)	3.1	1	1	2	Fishing activity concentrated across 3 degrees in longitude ca. 180 nm => Fishing considered to occur daily during ca 3 month season => Disruption of physical processes as a result of SBT purse seine fishing most likely to effect distribution of the Southern Coastal GAB pelagic community => The intensity was scored as Negligible because disturbance localized => Consequence scored as Negligible because remote likelihood of impact at any spatial or temporal scale => Confidence was recorded as high because considered very unlikely for there to be community level impacts associated with disturbance of pelagic processes from seine netting.
	Boat launching	0									
	Anchoring/ mooring	1	4	5	Distribution of community	Southern Inner shelf Eyre; Outer shelf	3.1	1	1	2	Fishing activity concentrated across 3 degrees in longitude ca. 180 nm Anchoring/mooring possible over this scale => Anchoring/mooring occur on a weekly rather than daily basis during 3 month fishing season => Anchoring/mooring events considered to disrupt physical processes and most likely impact the distribution of the Southern inner and outer shelf communities => The intensity was scored as Negligible –i.e. remote likelihood of detection at any spatial or temporal scale => Consequence Negligible – any change in distribution of communities unlikely to be detectable against natural variation.=> Confidence was recorded as high because of low frequency of anchoring and small local intensity of any impact.

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 (from S2.1)	Intensity Score (1-6)	**Consequence Score (1-6)**	Confidence score (1-2)	Rationale
	Navigation/steaming	1	4	6	Distribution of community	Southern Coastal GAB (pelagic)	3.1	2	2	1	Navigation/steaming concentrated across 3 degrees in longitude ca. 180 nm => Navigation/steaming occurs on a daily basis during 3 month fishing season => The Southern Coastal GAB pelagic community was considered most at risk to physical disturbance due to Navigation/steaming => Physical disturbance was considered to have greatest community level impact by effecting the behaviour and distribution of relatively large, rare top order predators i.e. sharks => The intensity was scored as Minor –i.e.=> Consequence was scored as Minor, i.e. it was considered that impact on sharks would have rarely detectable changes to the ecosystem => Confidence in consequence score was low because of a lack of information on interactions between Navigation/ steaming and shark behaviour plus insufficient knowledge on trophic interactions
External hazards (specify the particular example within each activity area)	Other fisheries	1	6	6	Functional group composition	Southern Coastal GAB (pelagic)	2.1	3	3	1	Fishing activity concentrated across >1000 nm => Fishing considered to occur daily during ca 3 month season => Other fisheries most likely to effect Functional group composition, i.e. removal of the tuna functional group from the Southern Coastal GAB pelagic community in the GAB => The intensity was scored as Moderate –i.e. the impact was considered to be potentially severe at local scales but moderate at broader spatial scale => Consequence was scored as Moderate, i.e. it was considered that fishing would have detectable changes to the ecosystem without a major change in function => Confidence was recorded as low because of insufficient knowledge of trophic dynamics.
	Aquaculture	1	4	6	Functional group composition	Southern Coastal GAB (pelagic)	2.1	3	3	1	Capture of bait for aquaculture concentrated across 3 degrees in longitude ca. 180 nm => Capture of feed species considered to occur daily during ca 3 month season => Capture of feed/bait fish species most likely to effect Functional group composition, i.e. capture of feed species may remove the bait fish functional group from the Southern Coastal GAB pelagic community => The intensity was scored as Moderate –i.e. the impact was considered to be potentially severe at local scales but moderate at broader spatial scale => Consequence was scored as Moderate, i.e. it was considered that capture of bait species would have detectable changes to the ecosystem without a major change in function => Confidence was recorded as low because of insufficient knowledge on bait fish trophic dynamics.

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 (from S2.1)	Intensity Score (1-6)	**Consequence Score (1-6)**	Confidence score (1-2)	Rationale
	Coastal development	0									
	Other extractive activities	0									
	Other non extractive activities	0									
	Other anthropogenic activities	1	6	6	Distribution of community	Southern Coastal GAB (pelagic)	3.1	2	2	1	Shipping and boating concentrated across 3 degrees in longitude ca. 180 nm => Shipping occurs on a daily basis during 3 month fishing season => Distribution of The Southern Coastal GAB Pelagic community was considered most at risk from attraction of large predators e.g. sharks to rubbish being discarded. The intensity was scored as Minor – shipping subject to MARPOL regulations controlling discarding of wastes=> Consequence was scored as Minor, i.e. it was considered that impact on scavengers would have rarely detectable changes to the ecosystem and not persistent => Confidence in consequence score was low because of a lack of information on interactions

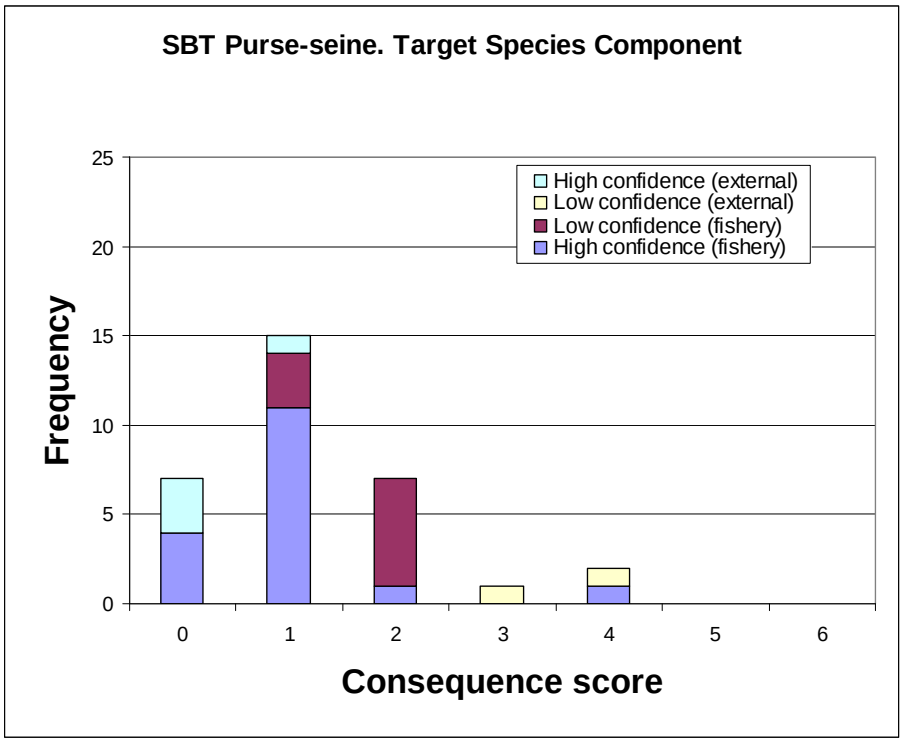
2.3.11 Summary of SICA results

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).

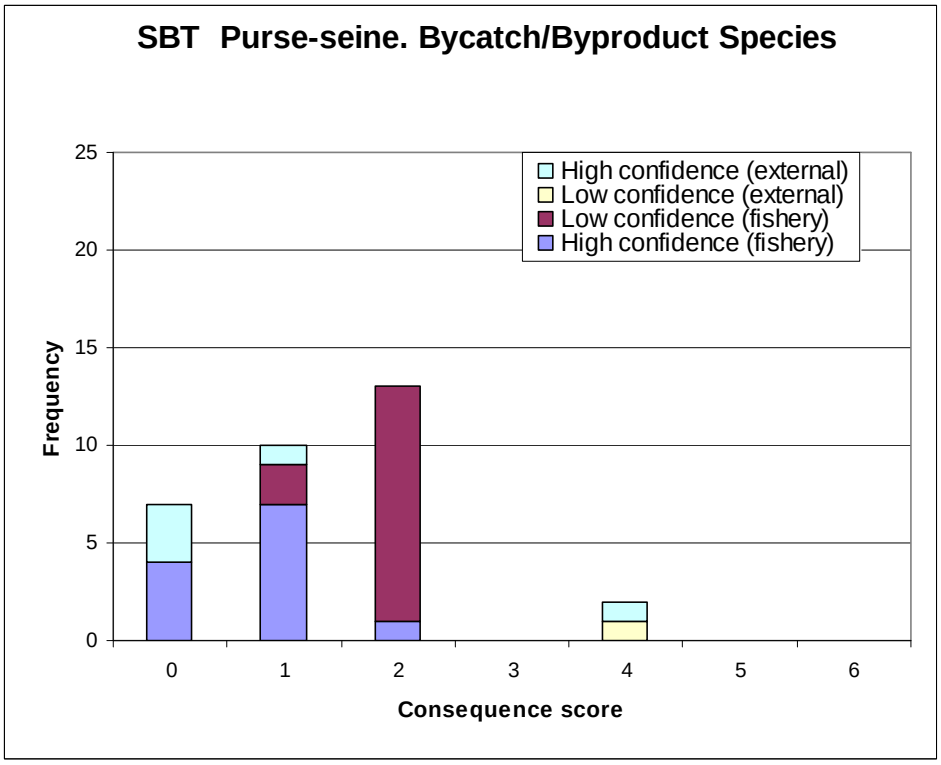
Level 1 (SICA) Document L1.6. Summary table of consequence scores for all activity/component combinations.

Direct impact	Activity	Target species	Byproduct and bycatch species	TEP species	Habitats	Communities
Capture	Bait collection	2	2	**3**	2	2
	Fishing	**4**	2	**3**	1	**3**
	Incidental behaviour	2	2	2	1	2
Direct impact without capture	Bait collection	2	2	2	2	2
	Fishing	2	2	**4**	1	2
	Incidental behaviour	2	2	2	1	2
	Gear loss	1	1	1	2	1
	Anchoring/ mooring	1	1	1	2	2
	Navigation/ steaming	1	2	1	2	**3**
Addition/ movement of biological material	Translocation of species	2	2	**4**	1	**3**
	On board processing	0	0	0	0	0
	Discarding catch	1	2	**3**	2	2
	Stock enhancement	0	0	0	0	0
	Provisioning	2	2	1	1	2
	Organic waste disposal	1	2	2	1	2
Addition of non-biological material	Debris	1	1	1	1	2
	Chemical pollution	0	0	0	0	0
	Exhaust	1	1	1	1	2
	Gear loss	1	2	2	1	1
	Navigation/ steaming	1	2	2	1	2
	Activity/ presence on water	1	1	2	1	1
Disturb physical processes	Bait collection	1	1	2	2	2
	Fishing	1	1	1	1	1
	Boat launching	0	0	0	0	0
	Anchoring/ mooring	1	1	1	1	1
	Navigation/steaming	1	1	1	1	2
Note: external hazards are not considered at Level 2 in the PSA analysis						
External hazards (specify the particular example within each activity area)	Other fisheries	3	4	4	2	3
	Aquaculture	4	4	4	2	3
	Coastal development	0	0	0	0	0
	Other extractive activities	0	0	0	0	0
	Other non extractive activities	0	0	0	0	0
	Other anthropogenic activities	1	1	3	2	2

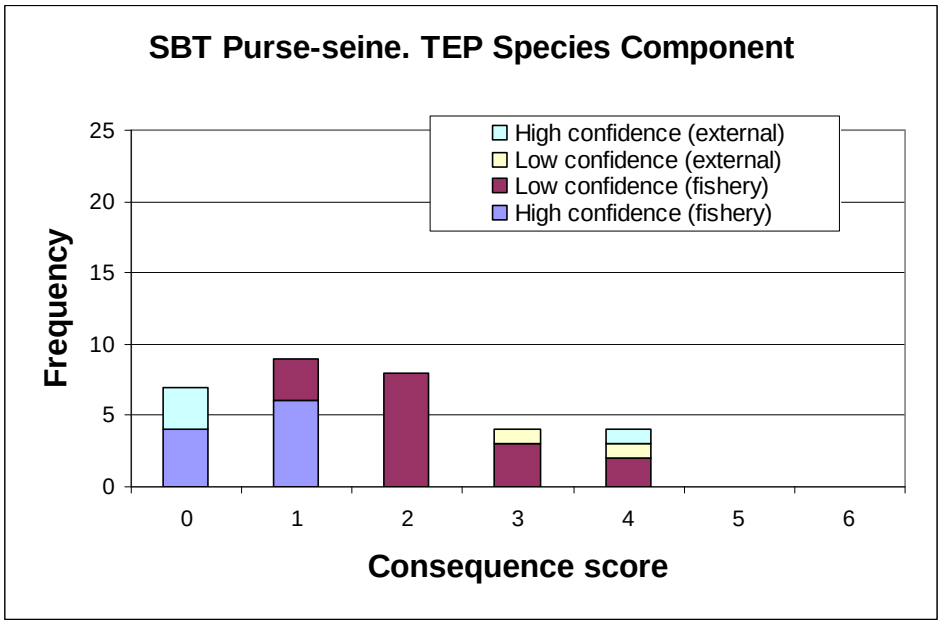
Target species: Frequency of consequence score differentiated between high and low confidence, and internal fishery activities and the external stressors.



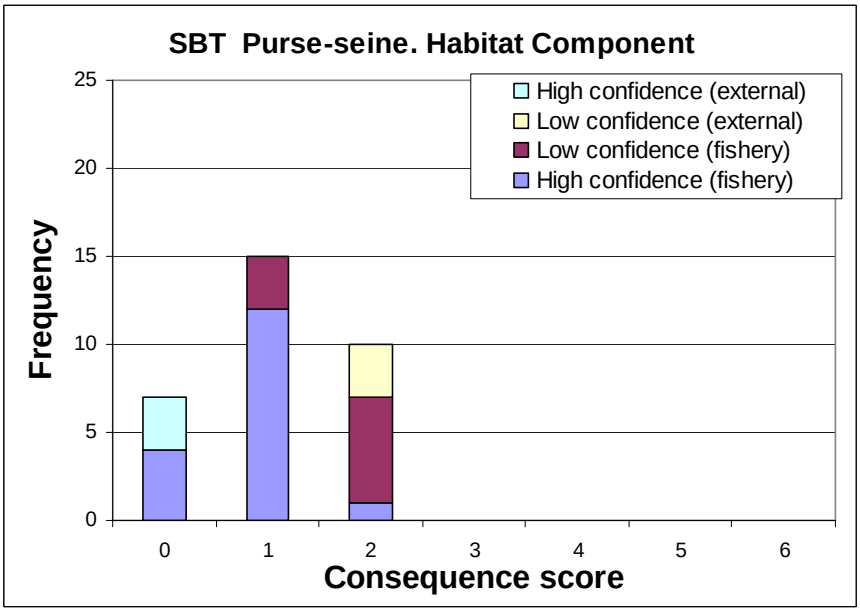
Byproduct and bycatch species: Frequency of consequence score differentiated between high and low confidence, and internal fishery activities and the external stressors



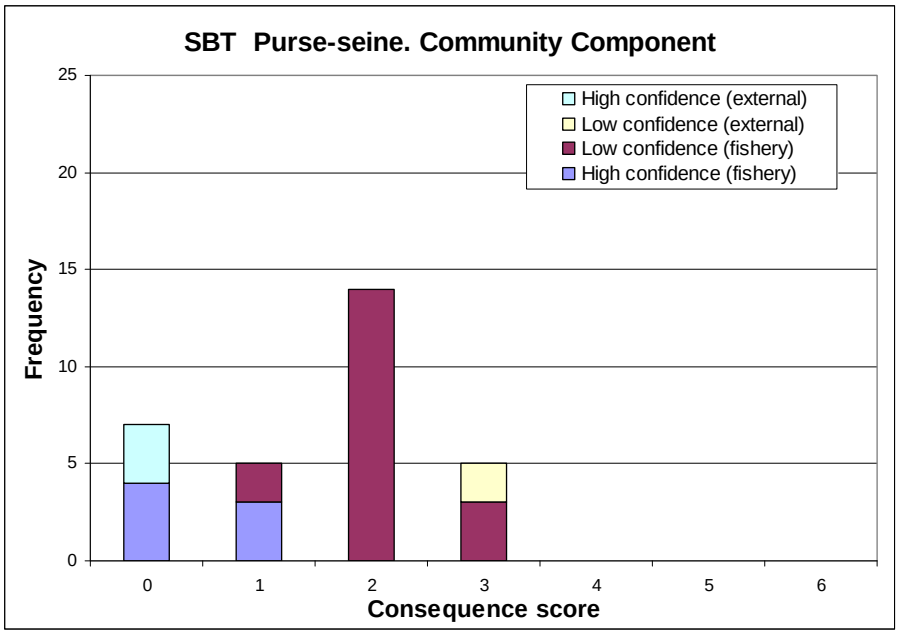
TEP species: Frequency of consequence score differentiated between high and low confidence, and internal fishery activities and the external stressors.



Habitats: Frequency of consequence score differentiated between high and low confidence, and internal fishery activities and the external stressors.



Communities: Frequency of consequence score differentiated between high and low confidence, and internal fishery activities and the external stressors.



2.3.12 Evaluation/discussion of Level 1

This section provides a brief discussion of the results of the Level 1 analysis. Full details and rationale for the scores are provided in the SICA tables earlier in this section.

There were 25 of the 32 possible activity scenarios identified as leading to some form of impact in the SBT purse-seine sub-fishery (i.e., the activities occurred in the SBT fishery). Of the 25 'impact causing activities' across five components (125 scenarios), only nine SBT scenarios (plus nine out of 30 external to the fishery) were identified as having an impact of moderate or above (see **Level 1 (SICA) Document L1.6**). These nine scenarios occurred across three components. The three components with at least one scenario with a score of 3 or above were the target species (one), TEP species (five), and communities (two). The four unique (because an activity could impact more than one area) impact-causing activities involved in these nine scenarios were

- Fishing (direct and indirect impacts on 3 components, Target, TEP and communities)
- Translocation of species (impact on TEP species and communities)
- Discarding catch (impact on TEP species)
- Navigation and steaming (impact on communities)

The significant external hazards to the species, habitats and communities relevant to the SBT fishery were external fishing, and aquaculture, and tourism. International fisheries also place significant pressure on the target species; aquaculture operations (including grow-out cages at Port Lincoln) remove large amounts of tuna prey species, while tourism operators may also be changing the behaviour of white sharks.

Management actions may be taken which would eliminate the risk of a particular activity; this remains an alternative to Level 2 for some of the component activities.

2.3.13 Components to be examined at Level 2

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

- *Target species*
- *TEP species*
- *Communities*

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

- *Bycatch and byproduct species*
- *Habitats*

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 to direct impacts of fishing only, which in all assessments to date 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 denoted as "risk". A measure of absolute risk requires some direct measure of abundance or mortality rate for the unit in question, and this information is generally lacking at Level 2.

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

Species

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

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

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

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

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

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

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

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

Habitats

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

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

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**.

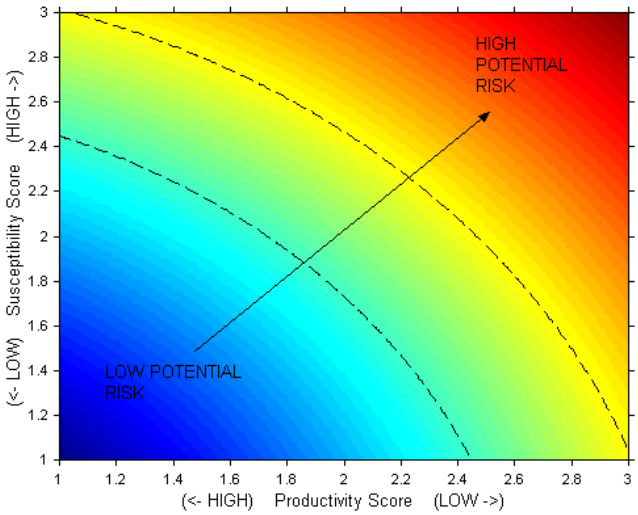


Figure 13. The axes on which risk of the ecological units is plotted. The *x*-axis includes attributes that influence the productivity of a unit, or its ability to recover after impact from fishing. The *y*-axis includes attributes that influence the susceptibility of the unit to impacts from fishing.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

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

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

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

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

No species identified in the scoping stage were excluded from the SBT PSA analysis. Sometimes species are excluded on the basis of additional information.

ERA species ID	Taxa	Scientific name	CAAB code	Family name	Common name	Explanation for why taxa excluded

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

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

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

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

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

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

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

Observer data and observer expert knowledge are important sources of information in the PSA analyses, particularly for the bycatch and TEP components. The level of observer data for this fishery is regarded as medium. There has been an AFMA-run observer program on catch and tow vessels since summer of 2003/04. The targeted coverage level is 10% of catch and effort. These data have been used in the assessment of the interaction with bycatch and TEP species in the Level 2 analysis.

Summary of Species PSA results

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

Target and bait species *SBT trawl 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?	PSA risk category	High/Med risk category (Refer 2.4.8)	Comments
Target													
Teleost													
Teleost	Thunnus maccoyii	Southern Bluefin Tuna	5,115,883	N	0	0	2.00	3.00	3.61	Y	High	Spatial uncertainty	Override: Availability increased: Juveniles move through capture area (A. Hobday)
Target bait													
Teleost													
807	Trachurus murphyi	Peruvian Jack Mackerel	0	N	0	0	1.29	2.33	2.66	N	Med	Spatial uncertainty	
155	Emmelichthys nitidus	Redbait	0	N	1	0	1.57	1.67	2.29	N	Low		
150	Pseudocaranx dentex	Silver Trevally	0	N	0	0	1.57	1.67	2.29	N	Low		
210	Scomber australasicus	Blue Mackerel	0	N	0	0	1.29	1.67	2.10	N	Low		
1088	Trachurus declivis	Jack Mackerel	0	N	0	0	1.29	1.67	2.10	N	Low		
540	Trachurus novaezelandiae	Yellow tail scad	0	N	0	0	1.29	1.67	2.10	N	Low		
825	Sardinops neopilchardus	Pilchard	0	N	0	0	1.00	1.67	1.94	N	Low		
831	Engraulis australis	australian anchovy	0	N	0	0	1.29	1.44	1.93	N	Low		
511	Arripis georgianus	Tommy rough	0	N	0	0	1.43	1.22	1.88	N	Low		
151	Pseudocaranx wrighti	Skipjack trevally	0	N	0	0	1.43	1.22	1.88	N	Low		

TEP species *SBT trawl 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?	PSA 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	1.44	3.07	Y	Med	Low overlap	Overide: Encounterability: inshore distribution (distribution data)
1067	Rhincodon typus	Whale shark	0	N	0	0	2.71	1.44	3.07	N	Med	Low overlap	
Marine bird													
628	Diomedea antipodensis	Antipodean Albatross	0	N	1	0	2.86	1.15	3.08	Y	Med	Low attribute score	Override: Selectivity: Purse-seine net, open at top for bird escape (Expert, A. Hobday)
1429	Diomedea dabbenena	Tristan Albatross	0	N	1	0	2.86	1.15	3.08	Y	Med	Low attribute score	Override: Selectivity: Purse-seine net, open at top for bird escape (Expert, A. Hobday)

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?	PSA risk category	High/Med risk category (Refer 2.4.8)	Comments
755	Diomedea gibsoni	Gibson's Albatross	0	N	1	0	2.86	1.15	3.08	Y	Med	Low attribute score	Override: Selectivity: Purse-seine net, open at top for bird escape (Expert, A. Hobday)
889	Thalassarche eremita	Chatham albatross	0	Y	3	1	2.86	1.15	3.08	Y	Med	Missing data	Override: Selectivity: Purse-seine net, open at top for bird escape (Expert, A. Hobday)
1084	Thalassarche impavida	Campbell Albatross	0	N	1	0	2.71	1.15	2.95	Y	Med	Low attribute score	Override: Selectivity: Purse-seine net, open at top for bird escape (Expert, A. Hobday)
1054	Puffinus bulleri	Buller's Shearwater	0	N	3	0	2.57	1.22	2.85	Y	Med	Low attribute score	Override: Selectivity: Purse-seine net, open at top for bird escape (Expert, A. Hobday)
1673	Thalassarche nov. sp.	Pacific Albatross	0	N	1	1	2.57	1.22	2.85	Y	Med	Low attribute score	Override: Selectivity: Purse-seine net, open at top for bird escape (Expert, A. Hobday)
1428	Diomedea amsterdamensis	Amsterdam Albatross	0	N	1	0	2.57	1.15	2.82	Y	Med	Low attribute score	Override: Selectivity: Purse-seine net, open at top for bird escape (Expert, A. Hobday)

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753	Diomedea epomophora	Southern Royal Albatross	0	N	1	0	2.57	1.15	2.82	Y	Med	Low attribute score	Override: Selectivity: Purse-seine net, open at top for bird escape (Expert, A. Hobday)
451	Diomedea exulans	Wandering Albatross	0	N	1	0	2.57	1.15	2.82	Y	Med	Low attribute score	Override: Selectivity: Purse-seine net, open at top for bird escape (Expert, A. Hobday)
799	Diomedea sanfordi	Northern Royal Albatross	0	N	1	0	2.57	1.15	2.82	Y	Med	Low attribute score	Override: Selectivity: Purse-seine net, open at top for bird escape (Expert, A. Hobday)
912	Phalacrocorax fuscescens	Black faced cormorant	0	N	1	0	2.57	1.15	2.82	Y	Med	Low attribute score	Override: Selectivity: Purse-seine net, open at top for bird escape (Expert, A. Hobday)
1045	Pterodroma cervicalis	White-necked Petrel	0	N	3	0	2.57	1.15	2.82	Y	Med	Low attribute score	Override: Selectivity: Purse-seine net, open at top for bird escape (Expert, A. Hobday)
894	Thalassarche salvini	Salvin's albatross	0	N	3	0	2.57	1.15	2.82	Y	Med	Low attribute score	Override: Selectivity: Purse-seine net, open at top for bird escape (Expert, A. Hobday)

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?	PSA risk category	High/Med risk category (Refer 2.4.8)	Comments
1580	Calonectris leucomelas	Streaked shearwater	0	Y	3	1	2.57	1.07	2.79	Y	Med	Missing data	Override: Selectivity: Purse-seine net, open at top for bird escape (Expert, A. Hobday)
1051	Pterodroma solandri	Providence Petrel	0	N	3	0	2.57	1.07	2.79	Y	Med	Low attribute score	Override: Selectivity: Purse-seine net, open at top for bird escape (Expert, A. Hobday)
917	Fregetta tropica	Black-bellied Storm-Petrel	0	N	3	0	2.43	1.22	2.72	Y	Med	Low attribute score	Override: Selectivity: Purse-seine net, open at top for bird escape (Expert, A. Hobday)
314	Fulmarus glacialoides	Southern fulmar	0	N	1	1	2.43	1.22	2.72	Y	Med	Low attribute score	Override: Selectivity: Purse-seine net, open at top for bird escape (Expert, A. Hobday)
1052	Lugensa brevirostris	Kerguelen Petrel	0	N	3	0	2.43	1.22	2.72	Y	Med	Low attribute score	Override: Selectivity: Purse-seine net, open at top for bird escape (Expert, A. Hobday)
1042	Procellaria parkinsoni	Black Petrel	0	N	2	0	2.43	1.22	2.72	Y	Med	Low attribute score	Override: Selectivity: Purse-seine net, open at top for bird escape (Expert, A. Hobday)

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1043	Procellaria westlandica	Westland Petrel	0	N	2	0	2.43	1.22	2.72	Y	Med	Low attribute score	Override: Selectivity: Purse-seine net, open at top for bird escape (Expert, A. Hobday)
1033	Thalassarche cauta	Shy Albatross	0	N	1	0	2.43	1.22	2.72	Y	Med	Low attribute score	Override: Selectivity: Purse-seine net, open at top for bird escape (Expert, A. Hobday)
918	Fregetta grallaria	White-bellied Storm-Petrel (Tasman Sea),	0	N	3	0	2.43	1.15	2.69	Y	Med	Low attribute score	Override: Selectivity: Purse-seine net, open at top for bird escape (Expert, A. Hobday)
939	Halobaena caerulea	Blue Petrel	0	N	3	0	2.43	1.15	2.69	Y	Med	Low attribute score	Override: Selectivity: Purse-seine net, open at top for bird escape (Expert, A. Hobday)
1003	Pachyptila turtur	Fairy Prion	0	N	3	0	2.43	1.15	2.69	Y	Med	Low attribute score	Override: Selectivity: Purse-seine net, open at top for bird escape (Expert, A. Hobday)
1009	Phoebetria palpebrata	Light-mantled Albatross	0	N	1	0	2.43	1.15	2.69	Y	Med	Low attribute score	Override: Selectivity: Purse-seine net, open at top for bird escape (Expert, A. Hobday)

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1046	Pterodroma leucoptera	Gould's Petrel	0	Y	4	0	2.43	1.15	2.69	Y	Med	Missing data	Override: Selectivity: Purse-seine net, open at top for bird escape (Expert, A. Hobday)
1047	Pterodroma macroptera	Great-winged Petrel	0	N	2	0	2.43	1.15	2.69	Y	Med	Low attribute score	Override: Selectivity: Purse-seine net, open at top for bird escape (Expert, A. Hobday)
1048	Pterodroma mollis	Soft-plumaged Petrel	0	N	3	0	2.43	1.15	2.69	Y	Med	Low attribute score	Override: Selectivity: Purse-seine net, open at top for bird escape (Expert, A. Hobday)
1055	Puffinus carneipes	Flesh-footed Shearwater	0	N	1	0	2.43	1.15	2.69	Y	Med	Low attribute score	Override: Selectivity: Purse-seine net, open at top for bird escape (Expert, A. Hobday)
1059	Puffinus pacificus	Wedge-tailed Shearwater	0	N	1	0	2.43	1.15	2.69	Y	Med	Low attribute score	Override: Selectivity: Purse-seine net, open at top for bird escape (Expert, A. Hobday)
1060	Puffinus tenuirostris	Short-tailed Shearwater	0	N	1	0	2.43	1.15	2.69	Y	Med	Low attribute score	Override: Selectivity: Purse-seine net, open at top for bird escape (Expert, A. Hobday)

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1032	Thalassarche bulleri	Buller's Albatross	0	N	1	0	2.43	1.15	2.69	Y	Med	Low attribute score	Override: Selectivity: Purse-seine net, open at top for bird escape (Expert, A. Hobday)
1035	Thalassarche chrysostoma	Grey-headed Albatross	0	N	1	0	2.43	1.15	2.69	Y	Med	Low attribute score	Override: Selectivity: Purse-seine net, open at top for bird escape (Expert, A. Hobday)
1085	Thalassarche melanophrys	Black-browed Albatross	0	N	1	0	2.43	1.15	2.69	Y	Med	Low attribute score	Override: Selectivity: Purse-seine net, open at top for bird escape (Expert, A. Hobday)
325	Catharacta skua	Great Skua	0	N	1	0	2.43	1.07	2.66	Y	Med	Low attribute score	Override: Availability: likely not in area, Selectivity: Purse-seine net, open at top for bird escape (Expert, A. Hobday)
555	Garrodia nereis	Grey-backed storm petrel	0	Y	3	1	2.43	1.07	2.66	Y	Med	Missing data	Override: Selectivity: Purse-seine net, open at top for bird escape (Expert, A. Hobday)

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1050	Pterodroma nigripennis	Black-winged Petrel	0	N	3	0	2.43	1.07	2.66	Y	Med	Low attribute score	Override: Selectivity: Purse-seine net, open at top for bird escape (Expert, A. Hobday)
1053	Puffinus assimilis	Little Shearwater (Tasman Sea)	0	N	3	0	2.43	1.07	2.66	Y	Med	Low attribute score	Override: Selectivity: Purse-seine net, open at top for bird escape (Expert, A. Hobday)
998	Morus serrator	Australasian Gannet	0	N	1	0	2.29	1.30	2.63	Y	Low		Override: Selectivity: Purse-seine net, open at top for bird escape (Expert, A. Hobday)
1041	Procellaria aequinoctialis	White-chinned Petrel	0	N	1	0	2.29	1.22	2.59	Y	Low		Override: Selectivity: Purse-seine net, open at top for bird escape (Expert, A. Hobday)
1691	Pseudobulweria rostrata	Tahiti Petrel	0	N	1	1	2.29	1.22	2.59	Y	Low		Override: Selectivity: Purse-seine net, open at top for bird escape (Expert, A. Hobday)
898	Eudyptula minor	Little Penguin	0	N	1	0	2.14	1.44	2.58	N	Low		

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595	Daption capense	Cape Petrel	0	N	1	0	2.29	1.15	2.56	Y	Low		Override: Selectivity: Purse-seine net, open at top for bird escape (Expert, A. Hobday)
73	Macronectes giganteus	Southern Giant-Petrel	0	N	1	0	2.29	1.15	2.56	Y	Low		Override: Selectivity: Purse-seine net, open at top for bird escape (Expert, A. Hobday)
981	Macronectes halli	Northern Giant-Petrel	0	N	1	0	2.29	1.15	2.56	Y	Low		Override: Selectivity: Purse-seine net, open at top for bird escape (Expert, A. Hobday)
291	Phalacrocorax carbo	Black cormorant	0	N	1	0	2.29	1.15	2.56	Y	Low		Override: Selectivity: Purse-seine net, open at top for bird escape (Expert, A. Hobday)
913	Phalacrocorax melanoleucos	Little pied cormorant	0	N	1	0	2.29	1.15	2.56	Y	Low		Override: Selectivity: Purse-seine net, open at top for bird escape (Expert, A. Hobday)
915	Phalacrocorax sulcirostris	Little black cormorant	0	N	1	0	2.29	1.15	2.56	Y	Low		Override: Selectivity: Purse-seine net, open at top for bird escape (Expert, A. Hobday)

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1008	Phoebetria fusca	Sooty Albatross	0	N	1	0	2.29	1.15	2.56	Y	Low		Override: Selectivity: Purse-seine net, open at top for bird escape (Expert, A. Hobday)
494	Procellaria cinerea	Grey petrel	0	N	1	0	2.29	1.15	2.56	Y	Low		Override: Selectivity: Purse-seine net, open at top for bird escape (Expert, A. Hobday)
504	Pterodroma lessoni	White-headed petrel	0	N	1	0	2.29	1.15	2.56	Y	Low		Override: Selectivity: Purse-seine net, open at top for bird escape (Expert, A. Hobday)
1049	Pterodroma neglecta	Kermadec Petrel (western)	0	N	2	0	2.29	1.15	2.56	Y	Low		Override: Selectivity: Purse-seine net, open at top for bird escape (Expert, A. Hobday)
1031	Thalassarche carteri	Indian Yellow-nosed Albatross	0	N	1	0	2.29	1.15	2.56	Y	Low		Override: Selectivity: Purse-seine net, open at top for bird escape (Expert, A. Hobday)
1034	Thalassarche chlororhynchos	Yellow-nosed Albatross, Atlantic Yellow-	0	N	1	0	2.29	1.15	2.56	Y	Low		Override: Selectivity: Purse-seine net, open at top for bird escape (Expert, A. Hobday)

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203	Anous stolidus	Common noddy	0	N	1	0	2.29	1.07	2.53	Y	Low		Override: Selectivity: Purse-seine net, open at top for bird escape (Expert, A. Hobday)
975	Larus pacificus	Pacific Gull	0	N	1	0	2.29	1.07	2.53	Y	Low		Override: Availability: Likely inshore, Selectivity: Purse-seine net, open at top for bird escape (Expert, A. Hobday)
1057	Puffinus griseus	Sooty Shearwater	0	N	1	0	2.29	1.07	2.53	Y	Low		Override: Selectivity: Purse-seine net, open at top for bird escape (Expert, A. Hobday)
1017	Sterna bergii	Crested Tern	0	N	1	0	2.29	1.07	2.53	Y	Low		Override: Selectivity: Purse-seine net, open at top for bird escape (Expert, A. Hobday)
1018	Sterna caspia	Caspian Tern	0	N	1	0	2.29	1.07	2.53	Y	Low		Override: Selectivity: Purse-seine net, open at top for bird escape (Expert, A. Hobday)

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1056	Puffinus gavia	Fluttering Shearwater	0	N	2	0	2.14	1.22	2.47	Y	Low		Override: Selectivity: Purse-seine net, open at top for bird escape (Expert, A. Hobday)
1058	Puffinus huttoni	Hutton's Shearwater	0	N	2	0	2.14	1.22	2.47	Y	Low		Override: Selectivity: Purse-seine net, open at top for bird escape (Expert, A. Hobday)
1021	Sterna hirundo	Common tern	0	N	1	0	2.14	1.22	2.47	Y	Low		Override: Selectivity: Purse-seine net, open at top for bird escape (Expert, A. Hobday)
1023	Sterna paradisaea	Arctic tern	0	N	1	0	2.14	1.22	2.47	Y	Low		Override: Selectivity: Purse-seine net, open at top for bird escape (Expert, A. Hobday)
67	Anous tenuirostris	Lesser noddy	0	N	2	0	2.14	1.07	2.40	Y	Low		Override: Availability: likely not in area, Selectivity: Purse-seine net, open at top for bird escape (Expert, A. Hobday)

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973	Larus dominicanus	Kelp Gull	0	N	1	0	2.14	1.07	2.40	Y	Low		Override: Availability: Likely inshore, Selectivity: Purse-seine net, open at top for bird escape (Expert, A. Hobday)
974	Larus novaehollandiae	Silver Gull	0	N	3	0	2.14	1.07	2.40	Y	Low		Override: Availability: Likely inshore, Selectivity: Purse-seine net, open at top for bird escape (Expert, A. Hobday)
1020	Sterna fuscata	Sooty tern	0	N	1	0	2.14	1.07	2.40	Y	Low		Override: Selectivity: Purse-seine net, open at top for bird escape (Expert, A. Hobday)
1014	Sterna albifrons	Little tern	0	N	1	0	2.00	1.22	2.34	Y	Low		Override: Selectivity: Purse-seine net, open at top for bird escape (Expert, A. Hobday)
1024	Sterna striata	White-fronted Tern	0	N	1	0	2.00	1.15	2.31	Y	Low		Override: Selectivity: Purse-seine net, open at top for bird escape (Expert, A. Hobday)

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556	Oceanites oceanicus	Wilson's storm petrel (subantarctic)	0	N	1	0	2.00	1.07	2.27	Y	Low		Override: Selectivity: Purse-seine net, open at top for bird escape (Expert, A. Hobday)
1004	Pelagodroma marina	White-faced Storm-Petrel	0	N	1	0	2.00	1.07	2.27	Y	Low		Override: Selectivity: Purse-seine net, open at top for bird escape (Expert, A. Hobday)
1006	Pelecanoides urinatrix	Common Diving-Petrel	0	N	1	0	1.86	1.30	2.26	Y	Low		Override: Selectivity: Purse-seine net, open at top for bird escape (Expert, A. Hobday)
Marine mammal													
902	Feresa attenuata	Pygmy Killer Whale	0	N	0	0	2.86	1.30	3.14	Y	Med	Low attribute score	Override: PCM: Release of live animals possible (Expert, A. Hobday)
934	Globicephala macrorhynchus	Short-finned Pilot Whale	0	N	0	0	2.86	1.30	3.14	Y	Med	Low attribute score	Override: PCM: Release of live animals possible (Expert, A. Hobday)

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935	Globicephala melas	Long-finned Pilot Whale	0	N	0	0	2.86	1.30	3.14	Y	Med	Low attribute score	Override: PCM: Release of live animals possible (Expert, A. Hobday)
989	Mesoplodon hectori	Hector's Beaked Whale	0	N	0	0	2.86	1.30	3.14	Y	Med	Low attribute score	Override: PCM: Release of live animals possible (Expert, A. Hobday)
991	Mesoplodon mirus	True's Beaked Whale	0	N	0	0	2.86	1.30	3.14	Y	Med	Low attribute score	Override: PCM: Release of live animals possible (Expert, A. Hobday)
1002	Orcinus orca	Killer Whale	0	N	0	0	2.86	1.30	3.14	Y	Med	Low attribute score	Override: PCM: Release of live animals possible (Expert, A. Hobday)
1494	Tursiops aduncus	Indian Ocean bottlenose dolphin	0	N	1	0	2.86	1.30	3.14	Y	Med	Low attribute score	Override: PCM: Release of live animals possible (Expert, A. Hobday)
1091	Tursiops truncatus	Bottlenose Dolphin	0	N	0	0	2.86	1.30	3.14	Y	Med	Low attribute score	Override: PCM: Release of live animals possible (Expert, A. Hobday)

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1098	Ziphius cavirostris	Cuvier's Beaked Whale	0	N	0	0	2.86	1.30	3.14	Y	Med	Low attribute score	Override: PCM: Release of live animals possible (Expert, A. Hobday)
1030	Tasmacetus shepherdi	Tasman Beaked Whale	0	N	1	0	2.86	1.15	3.08	Y	Med	Low attribute score	Override: PCM: Release of live animals possible (Expert, A. Hobday)
937	Grampus griseus	Risso's Dolphin	0	N	0	0	2.86	1.10	3.06	Y	Med	Low attribute score	Override: PCM: Release of live animals possible (Expert, A. Hobday)
959	Hyperoodon planifrons	Southern Bottlenose Whale	0	N	1	0	2.86	1.10	3.06	Y	Med	Low attribute score	Override: PCM: Release of live animals possible (Expert, A. Hobday)
985	Mesoplodon bowdoini	Andrew's Beaked Whale	0	N	1	0	2.86	1.10	3.06	Y	Med	Low attribute score	Override: PCM: Release of live animals possible (Expert, A. Hobday)
986	Mesoplodon densirostris	Blainville's Beaked Whale	0	N	0	0	2.86	1.10	3.06	Y	Med	Low attribute score	Override: PCM: Release of live animals possible (Expert, A. Hobday)

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987	Mesoplodon gingkodens	Gingko Beaked Whale	0	N	1	0	2.86	1.10	3.06	Y	Med	Low attribute score	Override: PCM: Release of live animals possible (Expert, A. Hobday)
988	Mesoplodon grayi	Gray's Beaked Whale	0	N	1	0	2.86	1.10	3.06	Y	Med	Low attribute score	Override: PCM: Release of live animals possible (Expert, A. Hobday)
990	Mesoplodon layardii	Strap-toothed Beaked Whale	0	N	1	0	2.86	1.10	3.06	Y	Med	Low attribute score	Override: PCM: Release of live animals possible (Expert, A. Hobday)
1044	Pseudorca crassidens	False Killer Whale	0	N	1	0	2.86	1.10	3.06	Y	Med	Low attribute score	Override: PCM: Release of live animals possible (Expert, A. Hobday)
268	Balaenoptera physalus	Fin Whale	0	N	0	0	2.86	1.05	3.04	Y	Med	Low attribute score	Override: PCM: Release of live animals possible (Expert, A. Hobday)
269	Berardius arnuxii	Arnoux's Beaked Whale	0	N	0	0	2.86	1.05	3.04	Y	Med	Low attribute score	Override: PCM: Release of live animals possible (Expert, A. Hobday)

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968	Kogia breviceps	Pygmy Sperm Whale	0	N	0	0	2.86	1.05	3.04	Y	Med	Low attribute score	Override: PCM: Release of live animals possible (Expert, A. Hobday)
1036	Physeter catodon	Sperm Whale	0	N	0	0	2.86	1.05	3.04	Y	Med	Low attribute score	Override: PCM: Release of live animals possible (Expert, A. Hobday)
256	Balaenoptera acutorostrata	Minke Whale	0	N	0	0	2.86	1.02	3.04	Y	Med	Low attribute score	Override: PCM: Release of live animals possible (Expert, A. Hobday)
1439	Balaenoptera bonaerensis	Antarctic Minke Whale	0	N	1	0	2.86	1.02	3.04	Y	Med	Low attribute score	Override: PCM: Release of live animals possible (Expert, A. Hobday)
261	Balaenoptera borealis	Sei Whale	0	N	0	0	2.86	1.02	3.04	Y	Med	Low attribute score	Override: PCM: Release of live animals possible (Expert, A. Hobday)
262	Balaenoptera edeni	Bryde's Whale	0	N	0	0	2.86	1.02	3.04	Y	Med	Low attribute score	Override: PCM: Release of live animals possible (Expert, A. Hobday)

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289	Caperea marginata	Pygmy Right Whale	0	N	1	0	2.71	1.10	2.93	Y	Med	Low attribute score	Override: PCM: Release of live animals possible (Expert, A. Hobday)
295	Hydrurga leptonyx	Leopard seal	0	N	0	0	2.71	1.10	2.93	Y	Med	Low attribute score	Override: Availability: Distribution rare this far north. PCM: Release of live animals possible (Expert, A. Hobday)
969	Kogia simus	Dwarf Sperm Whale	0	N	0	0	2.71	1.10	2.93	Y	Med	Low attribute score	Override: PCM: Release of live animals possible (Expert, A. Hobday)
970	Lagenodelphis hosei	Fraser's Dolphin	0	N	1	0	2.71	1.10	2.93	Y	Med	Low attribute score	Override: PCM: Release of live animals possible (Expert, A. Hobday)
832	Lagenorhynchus cruciger	Hourglass dolphin	0	N	1	1	2.71	1.10	2.93	Y	Med	Low attribute score	Override: PCM: Release of live animals possible (Expert, A. Hobday)
61	Lissodelphis peronii	Southern Right Whale Dolphin	0	N	1	0	2.71	1.10	2.93	Y	Med	Low attribute score	Override: PCM: Release of live animals possible (Expert, A. Hobday)

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1081	Stenella coeruleoalba	Striped Dolphin	0	N	0	0	2.71	1.10	2.93	Y	Med	Low attribute score	Override: PCM: Release of live animals possible (Expert, A. Hobday)
1083	Steno bredanensis	Rough-toothed Dolphin	0	N	0	0	2.71	1.10	2.93	Y	Med	Low attribute score	Override: PCM: Release of live animals possible (Expert, A. Hobday)
993	Mirounga leonina	Elephant seal	0	N	0	0	2.71	1.07	2.92	Y	Med	Low attribute score	Override: Availability: Distribution rare this far north. PCM: Release of live animals possible (Expert, A. Hobday)
896	Eubalaena australis	Southern Right Whale	0	N	0	0	2.71	1.05	2.91	Y	Med	Low attribute score	Override: PCM: Release of live animals possible (Expert, A. Hobday)
984	Megaptera novaeangliae	Humpback Whale	0	N	0	0	2.71	1.05	2.91	Y	Med	Low attribute score	Override: PCM: Release of live animals possible (Expert, A. Hobday)
1007	Peponocephala electra	Melon-headed Whale	0	N	1	0	2.57	1.10	2.80	Y	Med	Low attribute score	Override: PCM: Release of live animals possible (Expert, A. Hobday)

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1080	Stenella attenuata	Spotted Dolphin	0	N	1	0	2.57	1.10	2.80	Y	Med	Low attribute score	Override: PCM: Release of live animals possible (Expert, A. Hobday)
265	Balaenoptera musculus	Blue Whale	0	N	0	0	2.57	1.02	2.77	Y	Med	Low attribute score	Override: PCM: Release of live animals possible (Expert, A. Hobday)
216	Arctocephalus forsteri	New Zealand Fur-seal	0	N	0	0	2.43	1.10	2.67	Y	Med	Low attribute score	Override: PCM: Release of live animals possible (Expert, A. Hobday)
1082	Stenella longirostris	Long-snouted Spinner Dolphin	0	N	0	0	2.43	1.10	2.67	Y	Med	Low attribute score	Override: PCM: Release of live animals possible (Expert, A. Hobday)
1000	Neophoca cinerea	Australian Sea-lion	0	N	0	0	2.43	1.07	2.66	Y	Med	Low attribute score	Override: PCM: Release of live animals possible (Expert, A. Hobday)
253	Arctocephalus pusillus doriferus	Australian Fur Seal	0	N	0	0	2.29	1.30	2.63	Y	Low		Override: PCM: Release of live animals possible (Expert, A. Hobday)

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263	Arctocephalus tropicalis	Subantarctic fur seal	0	N	0	0	2.29	1.15	2.56	Y	Low		Override: PCM: Release of live animals possible (Expert, A. Hobday)
612	Delphinus delphis	Common Dolphin	0	N	0	0	2.29	1.10	2.54	Y	Low		Override: PCM: Release of live animals possible (Expert, A. Hobday)
971	Lagenorhynchus obscurus	Dusky Dolphin	0	N	0	0	2.29	1.10	2.54	Y	Low		Override: Availability: distribution unlikley, PCM: Release of live animals possible (Expert, A. Hobday)
Marine reptile													
541	Chelonia mydas	Green turtle	0	N	1	0	2.43	1.67	2.95	Y	Med	Low attribute score	Override: PCM: Release of live animals possible (Expert, A. Hobday)
1005	Pelamis platurus	Yellow-bellied seasnake	0	N	3	0	2.71	1.07	2.92	Y	Med	Low attribute score	Override: PCM: Release of live animals possible (Expert, A. Hobday)

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613	Dermochelys coriacea	Leathery turtle	0	N	1	0	2.57	1.22	2.85	Y	Med	Low attribute score	Override: Availability: Distribution rare this far north. PCM: Release of live animals possible (Expert, A. Hobday)
Teleost													
308	Heteroclinus perspicillatus	Common weedfish	0	N	3	0	2.29	1.07	2.53	Y	Low		Overide: Selectivity: Can swim out through mesh (A. Hobday), Encounterability: most inshore or demersal (A. Hobday)
1074	Solenostomus cyanopterus	Blue-finned Ghost Pipefish, Robust Ghost	0	N	3	0	2.14	1.07	2.40	Y	Low		Overide: Selectivity: Can swim out through mesh (A. Hobday), Encounterability: most inshore or demersal (A. Hobday)
1075	Solenostomus paradoxus	Harlequin Ghost Pipefish, Ornate Ghost Pipefish	0	N	3	0	2.14	1.07	2.40	Y	Low		Overide: Selectivity: Can swim out through mesh (A. Hobday), Encounterability: most inshore or demersal (A. Hobday)

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983	Maroubra perserrata	Sawtooth Pipefish	0	N	0	0	1.57	1.07	1.90	Y	Low		Overide: Selectivity: Can swim out through mesh (A. Hobday), Encounterability: most inshore or demersal (A. Hobday)
1010	Phycodurus eques	Leafy Seadragon	0	N	0	0	1.57	1.07	1.90	Y	Low		Overide: Selectivity: Can swim out through mesh (A. Hobday), Encounterability: most inshore or demersal (A. Hobday)
1011	Phyllopteryx taeniolatus	Weedy Seadragon, Common Seadragon	0	N	0	0	1.57	1.07	1.90	Y	Low		Overide: Selectivity: Can swim out through mesh (A. Hobday), Encounterability: most inshore or demersal (A. Hobday)
105	Acentronura australe	Southern Pygmy Pipehorse	0	N	0	0	1.43	1.07	1.79	Y	Low		Overide: Selectivity: Can swim out through mesh (A. Hobday), Encounterability: most inshore or demersal (A. Hobday)

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114	Acentronura breviperula	Hairy Pygmy Pipehorse	0	N	0	0	1.43	1.07	1.79	Y	Low		Overide: Selectivity: Can swim out through mesh (A. Hobday), Encounterability: most inshore or demersal (A. Hobday)
287	Campichthys galei	Gale's Pipefish	0	N	0	0	1.43	1.07	1.79	Y	Low		Overide: Selectivity: Can swim out through mesh (A. Hobday), Encounterability: most inshore or demersal (A. Hobday)
580	Cosmocampus howensis	Lord Howe Pipefish	0	N	0	0	1.43	1.07	1.79	Y	Low		Overide: Selectivity: Can swim out through mesh (A. Hobday), Encounterability: most inshore or demersal (A. Hobday)
904	Festucalex cinctus	Girdled Pipefish	0	N	0	0	1.43	1.07	1.79	Y	Low		Overide: Selectivity: Can swim out through mesh (A. Hobday), Encounterability: most inshore or demersal (A. Hobday)

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914	Filicampus tigris	Tiger Pipefish	0	N	0	0	1.43	1.07	1.79	Y	Low		Overide: Selectivity: Can swim out through mesh (A. Hobday), Encounterability: most inshore or demersal (A. Hobday)
1591	Halicampus boothae	[a pipefish]	0	N	0	0	1.43	1.07	1.79	Y	Low		Overide: Selectivity: Can swim out through mesh (A. Hobday), Encounterability: most inshore or demersal (A. Hobday)
942	Heraldia nocturna	Upside-down Pipefish	0	N	0	0	1.43	1.07	1.79	Y	Low		Overide: Selectivity: Can swim out through mesh (A. Hobday), Encounterability: most inshore or demersal (A. Hobday)
1548	Heraldia sp. 1 [in Kuiter, 2000]	Western upsidedown pipefish	0	N	0	0	1.43	1.07	1.79	Y	Low		Overide: Selectivity: Can swim out through mesh (A. Hobday), Encounterability: most inshore or demersal (A. Hobday)

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944	Hippichthys heptagonus	Madura Pipefish	0	N	0	0	1.43	1.07	1.79	Y	Low		Overide: Selectivity: Can swim out through mesh (A. Hobday), Encounterability: most inshore or demersal (A. Hobday)
945	Hippichthys penicillus	Beady Pipefish, Steep-nosed Pipefish	0	N	0	0	1.43	1.07	1.79	Y	Low		Overide: Selectivity: Can swim out through mesh (A. Hobday), Encounterability: most inshore or demersal (A. Hobday)
1664	Hippocampus abdominalis	Big-bellied / southern potbellied seahorse	0	N	0	0	1.43	1.07	1.79	Y	Low		Overide: Selectivity: Can swim out through mesh (A. Hobday), Encounterability: most inshore or demersal (A. Hobday)
946	Hippocampus bleekeri	Pot bellied seahorse	0	N	0	0	1.43	1.07	1.79	Y	Low		Overide: Selectivity: Can swim out through mesh (A. Hobday), Encounterability: most inshore or demersal (A. Hobday)

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947	Hippocampus breviceps	Short-head Seahorse, Short-snouted Seaho	0	N	0	0	1.43	1.07	1.79	Y	Low		Overide: Selectivity: Can swim out through mesh (A. Hobday), Encounterability: most inshore or demersal (A. Hobday)
950	Hippocampus minotaur	Bullneck Seahorse	0	N	0	0	1.43	1.07	1.79	Y	Low		Overide: Selectivity: Can swim out through mesh (A. Hobday), Encounterability: most inshore or demersal (A. Hobday)
548	Hippocampus subelongatus	West Australian Seahorse	0	N	0	0	1.43	1.07	1.79	Y	Low		Overide: Selectivity: Can swim out through mesh (A. Hobday), Encounterability: most inshore or demersal (A. Hobday)
1602	Hippocampus tristis	[a pipefish]	0	N	0	0	1.43	1.07	1.79	Y	Low		Overide: Selectivity: Can swim out through mesh (A. Hobday), Encounterability: most inshore or demersal (A. Hobday)

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952	Hippocampus whitei	white's seahorse	0	N	0	0	1.43	1.07	1.79	Y	Low		Overide: Selectivity: Can swim out through mesh (A. Hobday), Encounterability: most inshore or demersal (A. Hobday)
953	Histiogamphelus briggsii	Briggs' Crested Pipefish, Briggs' Pipefish	0	N	0	0	1.43	1.07	1.79	Y	Low		Overide: Selectivity: Can swim out through mesh (A. Hobday), Encounterability: most inshore or demersal (A. Hobday)
954	Histiogamphelus cristatus	Rhino Pipefish, Macleay's Crested Pipefish	0	N	0	0	1.43	1.07	1.79	Y	Low		Overide: Selectivity: Can swim out through mesh (A. Hobday), Encounterability: most inshore or demersal (A. Hobday)
960	Hypselognathus horridus	Shaggy Pipefish, Prickly Pipefish	0	N	0	0	1.43	1.07	1.79	Y	Low		Overide: Selectivity: Can swim out through mesh (A. Hobday), Encounterability: most inshore or demersal (A. Hobday)

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961	Hypselognathus rostratus	Knife-snouted Pipefish	0	N	0	0	1.43	1.07	1.79	Y	Low		Overide: Selectivity: Can swim out through mesh (A. Hobday), Encounterability: most inshore or demersal (A. Hobday)
1699	Idiotropiscis australe	Southern Pygmy Pipehorse	0	N	0	0	1.43	1.07	1.79	Y	Low		Overide: Selectivity: Can swim out through mesh (A. Hobday), Encounterability: most inshore or demersal (A. Hobday)
966	Kaupus costatus	Deep-bodied Pipefish	0	N	0	0	1.43	1.07	1.79	Y	Low		Overide: Selectivity: Can swim out through mesh (A. Hobday), Encounterability: most inshore or demersal (A. Hobday)
967	Kimblaeus bassensis	Trawl Pipefish, Kimbla Pipefish	0	N	0	0	1.43	1.07	1.79	Y	Low		Overide: Selectivity: Can swim out through mesh (A. Hobday), Encounterability: most inshore or demersal (A. Hobday)

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978	Leptoichthys fistularius	Brushtail Pipefish	0	N	0	0	1.43	1.07	1.79	Y	Low		Overide: Selectivity: Can swim out through mesh (A. Hobday), Encounterability: most inshore or demersal (A. Hobday)
979	Lissocampus caudalis	Australian Smooth Pipefish, Smooth Pipefish	0	N	0	0	1.43	1.07	1.79	Y	Low		Overide: Selectivity: Can swim out through mesh (A. Hobday), Encounterability: most inshore or demersal (A. Hobday)
390	Lissocampus fatiloquus	Prophet's Pipefish	0	N	0	0	1.43	1.07	1.79	Y	Low		Overide: Selectivity: Can swim out through mesh (A. Hobday), Encounterability: most inshore or demersal (A. Hobday)
980	Lissocampus runa	Javelin Pipefish	0	N	0	0	1.43	1.07	1.79	Y	Low		Overide: Selectivity: Can swim out through mesh (A. Hobday), Encounterability: most inshore or demersal (A. Hobday)

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1243	Mitotichthys meraculus	Western Crested Pipefish	0	N	0	0	1.43	1.07	1.79	Y	Low		Overide: Selectivity: Can swim out through mesh (A. Hobday), Encounterability: most inshore or demersal (A. Hobday)
994	Mitotichthys mollisoni	Mollison's Pipefish	0	N	0	0	1.43	1.07	1.79	Y	Low		Overide: Selectivity: Can swim out through mesh (A. Hobday), Encounterability: most inshore or demersal (A. Hobday)
995	Mitotichthys semistriatus	Half-banded Pipefish	0	N	0	0	1.43	1.07	1.79	Y	Low		Overide: Selectivity: Can swim out through mesh (A. Hobday), Encounterability: most inshore or demersal (A. Hobday)
996	Mitotichthys tuckeri	Tucker's Pipefish	0	N	0	0	1.43	1.07	1.79	Y	Low		Overide: Selectivity: Can swim out through mesh (A. Hobday), Encounterability: most inshore or demersal (A. Hobday)

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1242	Nannocampus subosseus	Bony-headed Pipefish	0	N	0	0	1.43	1.07	1.79	Y	Low		Overide: Selectivity: Can swim out through mesh (A. Hobday), Encounterability: most inshore or demersal (A. Hobday)
1001	Notiocampus ruber	Red Pipefish	0	N	0	0	1.43	1.07	1.79	Y	Low		Overide: Selectivity: Can swim out through mesh (A. Hobday), Encounterability: most inshore or demersal (A. Hobday)
1061	Pugnaso curtirostris	Pug-nosed Pipefish	0	N	0	0	1.43	1.07	1.79	Y	Low		Overide: Selectivity: Can swim out through mesh (A. Hobday), Encounterability: most inshore or demersal (A. Hobday)
1070	Solegnathus dunckeri	Duncker's Pipehorse	0	N	0	0	1.43	1.07	1.79	Y	Low		Overide: Selectivity: Can swim out through mesh (A. Hobday), Encounterability: most inshore or demersal (A. Hobday)

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?	PSA risk category	High/Med risk category (Refer 2.4.8)	Comments
320	Solegnathus guentheri	Indonesian Pipefish, Gunther's Pipehorse	0	N	0	0	1.43	1.07	1.79	Y	Low		Overide: Selectivity: Can swim out through mesh (A. Hobday), Encounterability: most inshore or demersal (A. Hobday)
1072	Solegnathus robustus	Robust Spiny Pipehorse, Robust Pipehorse	0	N	0	0	1.43	1.07	1.79	Y	Low		Overide: Selectivity: Can swim out through mesh (A. Hobday), Encounterability: most inshore or demersal (A. Hobday)
1073	Solegnathus spinosissimus	spiny pipehorse	0	N	0	0	1.43	1.07	1.79	Y	Low		Overide: Selectivity: Can swim out through mesh (A. Hobday), Encounterability: most inshore or demersal (A. Hobday)
1026	Stigmatopora argus	Spotted Pipefish	0	N	0	0	1.43	1.07	1.79	Y	Low		Overide: Selectivity: Can swim out through mesh (A. Hobday), Encounterability: most inshore or demersal (A. Hobday)

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?	PSA risk category	High/Med risk category (Refer 2.4.8)	Comments
1027	Stigmatopora nigra	Wide-bodied Pipefish, Black Pipefish	0	N	0	0	1.43	1.07	1.79	Y	Low		Overide: Selectivity: Can swim out through mesh (A. Hobday), Encounterability: most inshore or demersal (A. Hobday)
1028	Stipecampus cristatus	Ring-backed Pipefish	0	N	0	0	1.43	1.07	1.79	Y	Low		Overide: Selectivity: Can swim out through mesh (A. Hobday), Encounterability: most inshore or demersal (A. Hobday)
1029	Syngnathoides biaculeatus	Double-ended Pipehorse, Alligator Pipefish	0	N	0	0	1.43	1.07	1.79	Y	Low		Overide: Selectivity: Can swim out through mesh (A. Hobday), Encounterability: most inshore or demersal (A. Hobday)
1089	Trachyrhamphus bicoarctatus	Bend Stick Pipefish, Short-tailed Pipefish	0	N	0	0	1.43	1.07	1.79	Y	Low		Overide: Selectivity: Can swim out through mesh (A. Hobday), Encounterability: most inshore or demersal (A. Hobday)

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?	PSA risk category	High/Med risk category (Refer 2.4.8)	Comments
1092	Urocampus carinirostris	Hairy Pipefish	0	N	0	0	1.43	1.07	1.79	Y	Low		Overide: Selectivity: Can swim out through mesh (A. Hobday), Encounterability: most inshore or demersal (A. Hobday)
1093	Vanacampus margaritifer	Mother-of-pearl Pipefish	0	N	0	0	1.43	1.07	1.79	Y	Low		Overide: Selectivity: Can swim out through mesh (A. Hobday), Encounterability: most inshore or demersal (A. Hobday)
1095	Vanacampus poecilolaemus	Australian Long-snout Pipefish, Long-snouted Pipefish	0	N	0	0	1.43	1.07	1.79	Y	Low		Overide: Selectivity: Can swim out through mesh (A. Hobday), Encounterability: most inshore or demersal (A. Hobday)
1096	Vanacampus vercoi	Verco's Pipefish	0	N	0	0	1.43	1.07	1.79	Y	Low		Overide: Selectivity: Can swim out through mesh (A. Hobday), Encounterability: most inshore or demersal (A. Hobday)

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?	PSA risk category	High/Med risk category (Refer 2.4.8)	Comments
1094	Vanacampus phillipi	Port Phillip Pipefish	0	N	0	0	1.29	1.07	1.68	Y	Low		Overide: Selectivity: Can swim out through mesh (A. Hobday), Encounterability: most inshore or demersal (A. Hobday)

Summary of Habitat PSA results

This component was eliminated at Level 1, and hence not evaluated at Level 2.

Summary of Community PSA results

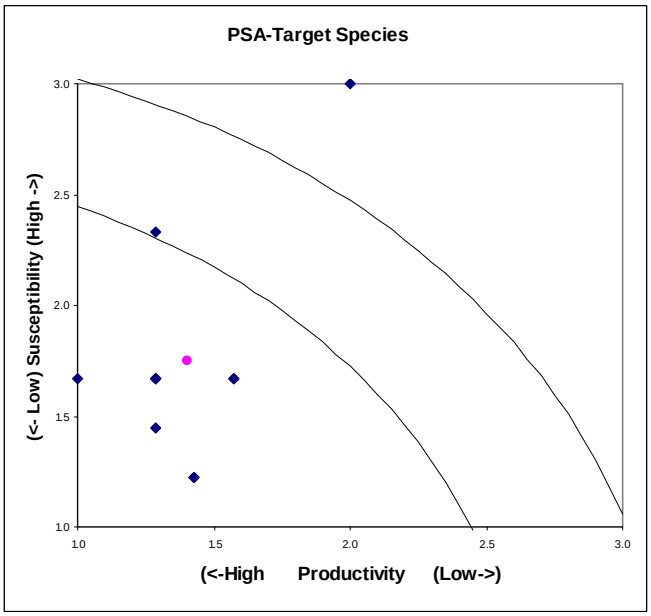
The component was not evaluated in this version of the ERAEF, but should be in future when the methods are further developed, as the community component was not eliminated at Level 1.

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

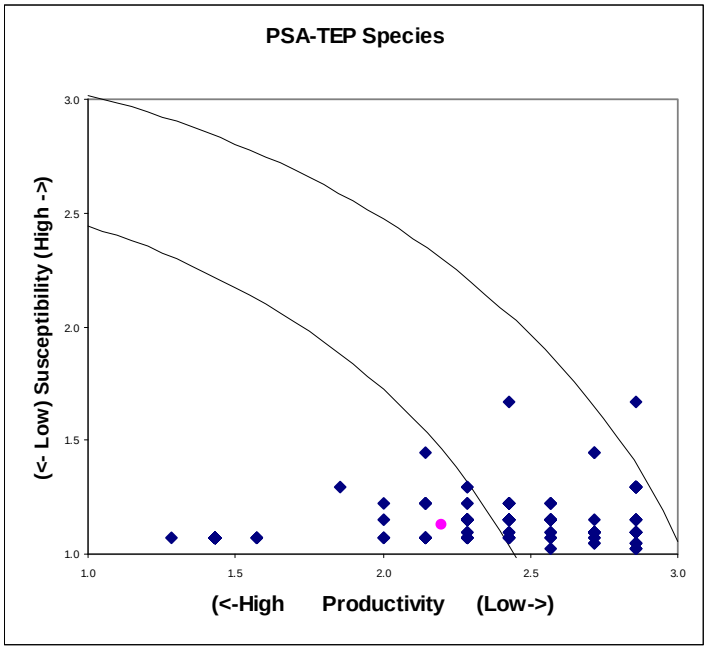
The average productivity and susceptibility scores for each unit of analysis (e.g. for each species) are then used to place the individual units of analysis on 2D plots (as below). The relative position of the units on the plot will determine relative risk at the unit level as per PSA plot below. The 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 in the SBT purse seine fishery (this plot includes the target bait species used in the fishery, all of which were low risk). The magenta dot in the center of the blue diamonds is the average risk for this component.



PSA plot for TEP species in the SBT purse seine fishery. Note the species are generally low productivity and low susceptibility. The magenta dot in the center of the blue diamonds is the average risk for this component.



The overall risk value for each unit is calculated as 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)**.

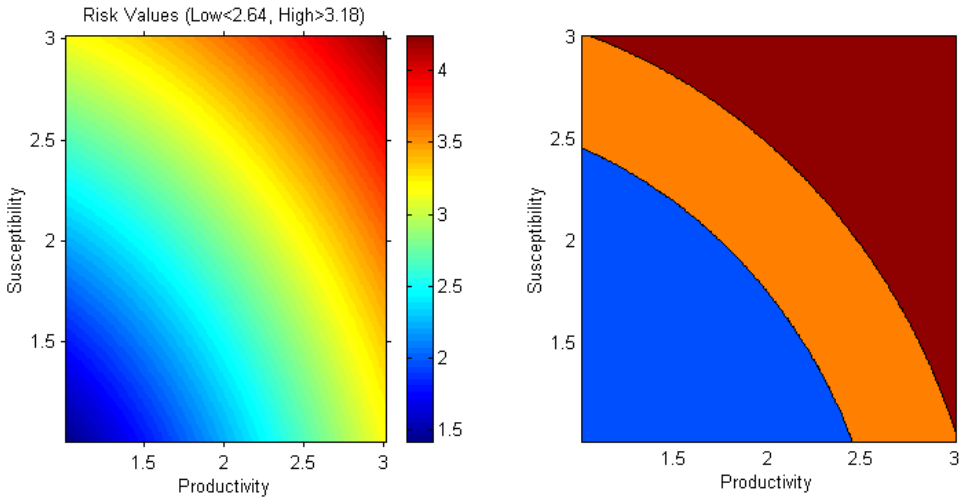


Figure 17. Overall risk values in the PSA plot. Left panel. Colour map of the distribution of the euclidean overall risk values. Right panel. The PSA plot contoured to show the low risk (blue), medium risk (orange) and high risk (red) values.

The PSA output allows identification and prioritization (via ranking the overall risk scores) of the units (e.g. species, habitat types, communities) at greatest risk to fishing activities. This prioritization means units with the lowest inherent productivity or highest susceptibility, which can only sustain the lowest level of impact, can be

examined in detail. The overall risk of an individual unit will depend on the level of impact as well its productivity and susceptibility.

2.4.5 Uncertainty analysis ranking of overall risk (Step 5)

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

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

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

<u>Availability of information</u>
The ability to score each species based on information on each attribute did not vary between the attributes (as per summary below). With regard to the productivity attributes, “trophic level” was missing in 42% of species (mostly the seabirds), and so the most conservative score was used, while information on reproductive strategy could be found or calculated for 100% of species.

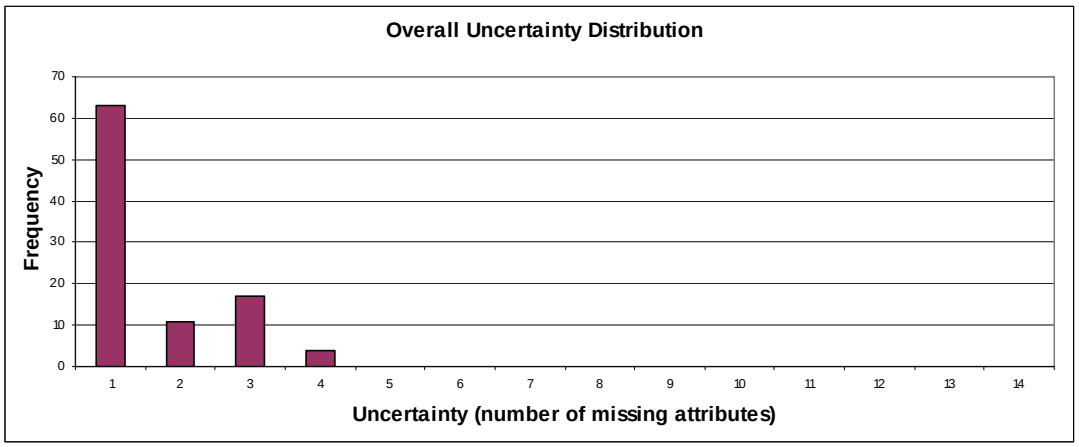
The current method of scoring the susceptibility attributes provides a value for each attribute for each species – some of these are based on good information, whereas others are merely sensible default values.

Summary of the success of obtaining information on the set of productivity and susceptibility attributes for the target and TEP 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	193	193	193	193	193	193	193
n species scores with attribute unknown, (conservative score used)	19	30	8	1	1	0	86
% unknown information	9	14	4	0	0	0	42
Susceptibility Attributes	Availability	Encounterability		Selectivity	PCM		
		Bathymetry overlap	Habitat				
Total species scores for attribute	193	193	193	193	193		
n species scores with attribute unknown, (conservative score used)	0	0	0	0	0		
% unknown information	0	0	0	0	0		

Each species considered in the analysis had information for an average of 6.3 productivity attributes (out of seven) and could be estimated for all susceptibility attributes. This meant that, on average, conservative scores were used for less than 1 of the attributes for a single species. Individual species had missing information for between 1 and 4 of the combined 12 productivity and susceptibility attributes.

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



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. The 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. This was not an issue for this fishery, as the effect of missing data did not lead to high risk scores.

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 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 target and TEP species productivity attributes. The correlation (r) is based on the scores within each attribute pair. Results from PSA workbook ranking worksheet.

	Age at maturity	Max age	Fecundity	Max size	Min size at maturity	Reproductive strategy	Trophic level
Age at maturity	X						
Max age	0.63	X					
Fecundity	0.54	0.68	X				
Max size	0.30	0.48	0.39	X			
Min size at maturity	0.41	0.62	0.60	0.86	X		
Reproductive strategy	0.49	0.66	0.93	0.41	0.62	X	
Trophic level	0.51	0.78	0.78	0.39	0.60	0.81	X

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

	Availability	Encounterability	Selectivity	Post-capture mortality
Availability	X			
Encounterability	0.03	X		
Selectivity	0.03	0.60	X	
Post-capture mortality	-0.27	-0.26	-0.33	X

Productivity and susceptibility values for target and TEP species

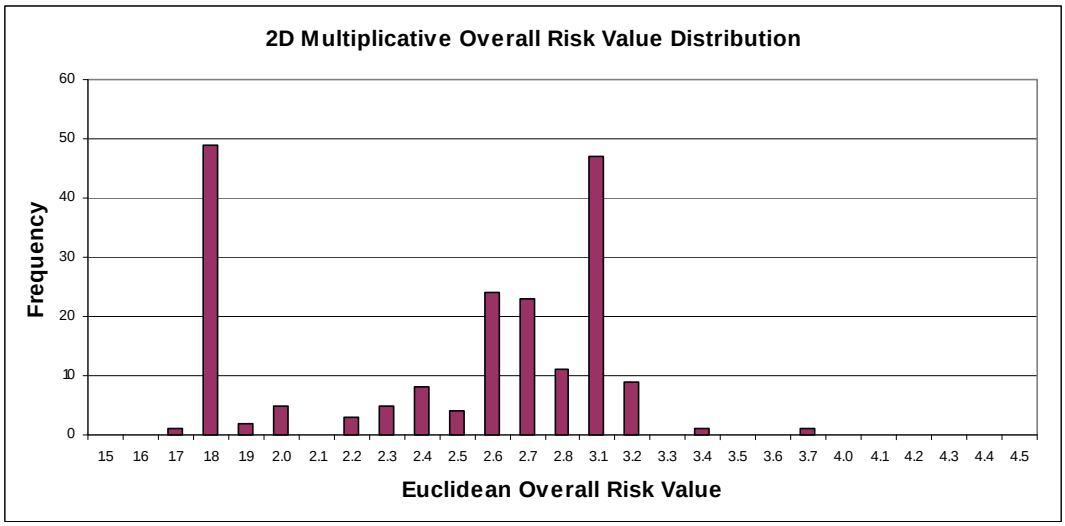
The average productivity score for all target and TEP species was 2.14± 0.11 (mean ± SD of scores calculated using n-1 attributes) and the mean susceptibility score was 1.17 (as per summary of average productivity and susceptibility scores as below). Individual scores are shown in Section 2.4.2 and 2.4.3: Summary of PSA results. The small variation in the average of the boot-strapped productivity values (using n-1 attributes), indicates the productivity scores are robust to elimination of a single attribute. Information for a single attribute does not have a disproportionately large effect on the productivity scores. Uncertainty cannot be calculated in the same way for susceptibility, as this is a multiplicative approach, and so dropping one variable to estimate uncertainty is less straight-forward.

Overall Risk Values for Species

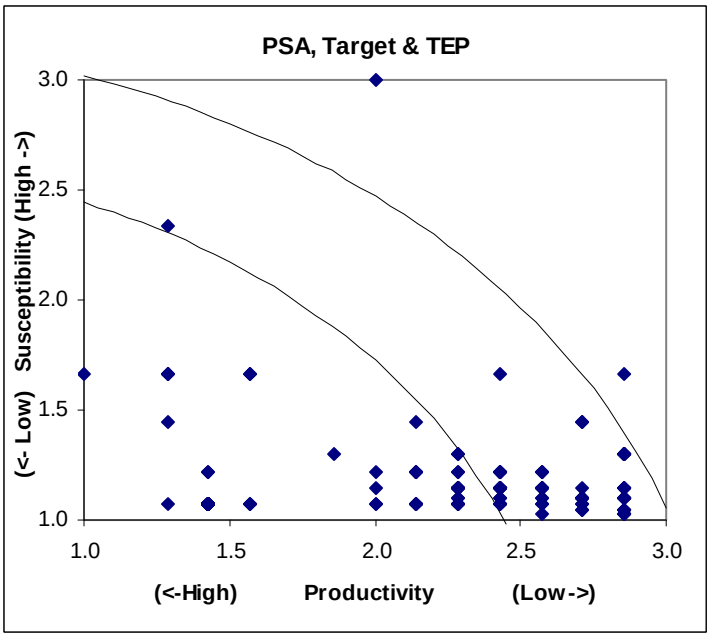
The overall risk values (Euclidean distance on the PSA plot) could fall between 1 and 4.24 (scores of 1&1 and 3&3 for both productivity and susceptibility respectively). The

mean observed overall risk score was 2.47, with a range of 1.7– 3.7. The actual values for each species are shown in *Summary of PSA results*. A total of 2 species, (1%) were classed as high risk, 87 (48%) were in the medium risk category, and 94 (51%) as low risk**.**

Frequency distribution of the overall risk values generated for the 193 Target and TEP species in the SBT PSA.



The distribution of the overall risk values of all species is shown on the PSA plot below. The species are distributed in the lower and lower-right parts of the plot, indicating that the majority of species are of low susceptibility. The highest susceptibility species is the southern bluefin tuna.



PSA plot for all target and TEP species in the SBT purse seine fishery. Species in the upper right of the plot are at highest risk; those in the lower left are at low risk.

2.4.6 Evaluation of the PSA results (Step 6)

Species Components

Overall

A total of 193 species were considered in two components, Target and TEP species. For most species there was little missing data. The average number of missing attributes was 1.14 out of a possible 12. Of the 193 species assessed, expert overrides were used on 180 species. Of the 2 species assessed to be at high risk, none had more than 3 missing attributes; these high risk species were southern bluefin tuna (Target) and white shark (TEP). Approximately half of the remaining species were medium risk, and the rest were low.

Results:

Summary of average productivity, susceptibility and overall risk scores.

Component	Measure	
All species	Number of species	193
	Average of productivity total	2.15
	Average of susceptibility total	1.17
	Average of overall risk value	2.47
	Average number of missing attributes	0.73
Target species	Number of species (SBT and 10 bait)	11
	Average of productivity total	1.4
	Average of susceptibility total	1.75
	Average of overall risk value	2.25
	Average number of missing attributes	0.09
TEP species	Number of species	182
	Average of productivity total	2.20
	Average of susceptibility total	1.13
	Average of overall risk value	2.48
	Average number of missing attributes	0.83

PSA 2D risk categories for each species component (Target and Target bait species are shown separately)**.**

Risk Category	High	Medium	Low	Total
TA	1	0	0	1
Target (Bait species)	0	1	9	10
TEP	1	87	94	182
Total	2	87	94	193

PSA 2D risk categories for each taxa in the two species components evaluated.

Risk Category	High	Medium	Low	Total
Chondrichthyan	1	2	0	3
Marine bird	0	34	39	73
Marine mammal	0	43	4	47
Marine reptile	0	3	0	3
Teleost	1	4	70	75
Total	2	87	94	193

These risk values are generally low because of the location (offshore) and specificity of the fishing method. Schools of fish are spotted from the air, and the vessels directed to the area. The gear is active, and tuna are captured alive, such that any other taxa within the net can also potentially escape or be released.

Discussion

Target species

There is only one "true" target species in the SBT target species component and it was classified as high risk. This is the southern bluefin tuna, a species that is known from stock assessment information to be at historically low levels of abundance.

The species that are targeted for bait were classed as low risk in nine cases, and moderate in one. Even the moderate case must be viewed with some caution, as the availability has likely been overestimated. The bait for the fishery are collected from a smaller area than used to estimate the availability. Data for the area of the bait fishery was not available from AFMA for this assessment. There was very little missing data for the bait species.

Thus, these results are consistent with more detailed assessments of the target species (Southern Bluefin Tuna), and the over-fished classification from BRS.

TEP species

Only 1 TEP species was classified as high risk; 87 were medium risk and 94 as low risk. Risks for TEP species were lowered considerably by expert overrides based on lack of reported interactions and the experience of the assessment team.

Most seabirds were assigned a low selectivity, as observer data shows that although many birds are observed, only a small percentage of these come into contact with the gear or vessels, and of these very few die. Of the 75 marine birds in the analysis, 56 were classified as medium risk and 19 as low risk. Some birds are known to land on vessels and some of these die.

Of the 47 marine mammals that may occur in the area of the fishery, none were classified as high risk, 43 as medium risk, and 4 as low risk. Dolphins were assigned a low encounterability, as observers report that although dolphins are seen occasionally bow riding; they do not interact with the tuna in this region. Whales were also assigned a low encounterability, as they are not reported as seen by observers. Risk scores were reduced for the larger whale species, due to their being assigned a low selectivity because of their large size.

One of the three TEP shark species was classified as high risk, the white shark. This species has been reported to interact with the fishing gear, and to enter the tow cages (Environment Australia 2000). Removal of the sharks is dangerous, and release is not always possible. The other two species, grey nurse and whale shark are rare in the area, and the availability and the selectivity/post capture mortality was low.

For the three species of marine reptiles, all were classified as medium risk. Turtles were scored a low encounterability and low post-capture mortality, as if captured, they can continue to surface for air, and would be captured and released.

The large number of Syngnathids (teleosts) emerged from the PSA at low risk; they had little or no overlap with the operational area of the fishery. They entered the assessment because fishery zone extends to the coast.

2.4.7 Decision rules to move from Level 2 to Level 3 (Step 7)

For the PSA overall risk values, units that fall in the upper third (risk value > 3.18) and middle third (2.64 < risk value < 3.18) of the PSA plots are deemed to be at high and medium risk respectively. These need to be the focus of further work, either through implementing a management response to address the risk to the vulnerable species or by further examination for risk within the particular ecological component at Level 3. Units at low risk, in the lower third (risk value <2.64), will be deemed not at risk from the sub-fishery and the assessment is concluded for these units.

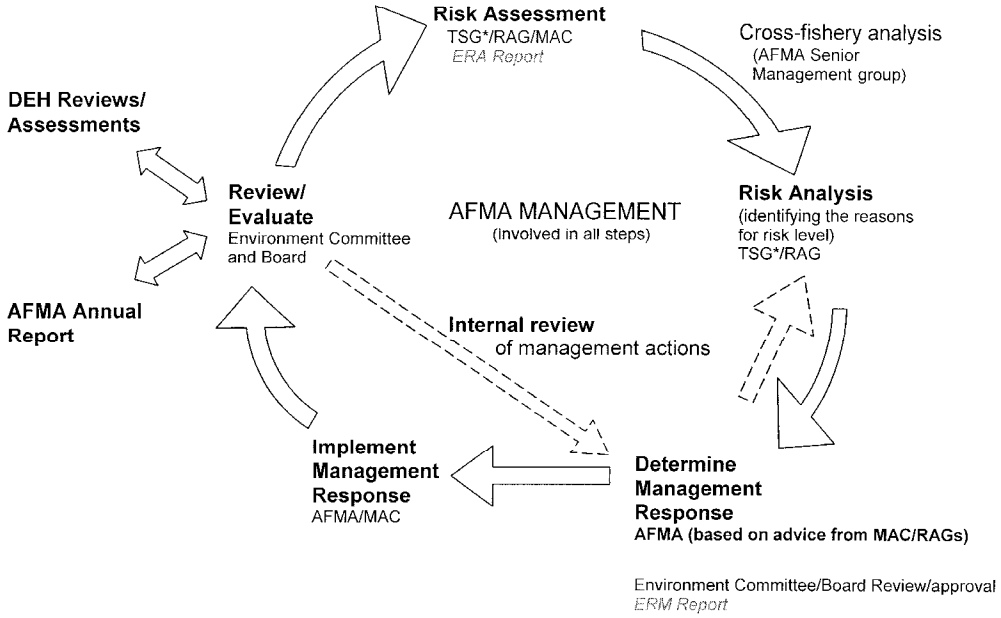
For example, if in a Level 2 analysis of habitat types, two of seven habitat types were determined to have risk from the sub-fishery, only those two habitat types would be considered at Level 3.

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

- The risk of a unit of analysis within a component (e.g. single species or habitat type) is not high, the rationale is documented, and the impact of the fishing activity on this unit need not be assessed at a higher level unless management or the fishery changes.
- The risk of a unit is high but management strategies are introduced rapidly that will reduce this risk, this unit need not be assessed further unless the management or the fishery changes.
- The risk of a unit is high but there is additional information that can be used to determine if Level 3, or even a new management action is required. This information should be sought before action is taken
- The risk of a unit is high and there are no planned management interventions that would remove this risk, therefore the reasons are documented and the assessment moves to Level 3.

At the conclusion of the Level 2 analysis, a fishery can decide to further investigate the risk of fishing to the species via a Level 3 assessment or implement a management response to mitigate the risk. To ensure all fisheries follow a consistent process in responding to the results of the risk assessment, AFMA has developed an ecological risk management framework. The framework (see Figure x below) makes use of the existing AFMA management structures to enable the ERAs to become a part of normal fisheries management, including the involvement of fisheries consultative committees. A separate document, the ERM report, will be developed that outlines the reasons why species are at high risk and what actions the fishery will implement to respond to the risks.

Figure x: Ecological Risk Management Framework



*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.

In the SBT fishery of the 3 species classified as high risk, 2 had low overlap inside the fishery (Category 2B), and one had spatial uncertainty. There were no Other high risk species.

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

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

Elements of Level 3 assessment have already occurred for the high risk target species. In fact, southern bluefin tuna, is one of the most studied fishery species in Australia. Annual stock assessments are carried out, as well as ongoing monitoring. The results of these assessments confirm the result obtained in the ERAEF approach, this species is at high risk.

With regard to the second high risk species, white shark, there is not Level 3 assessment work under way at present. Studies of movement and site fidelity from tagging studies show that the sharks are present throughout the fishery area (Barry Bruce, CSIRO), and also where the cages are anchored at Port Lincoln (Hobday pers. comm.). Attempts to minimise interaction with the fishery should be considered, and this may reduce the susceptibility scores, and hence the risk. The alternative is to assess the maximum possible impact of the fishery on the white shark, and determine if that level of impact poses a risk to the species maintaining a healthy population in southern Australia. Anecdotal evidence suggests that white sharks are now more common that in previous years; this could be increased awareness and reporting, or a real increase in the population. If the population is growing, and the impact of the fishery has remained constant (or even increased), then the risk to white shark from the SBT purse seine fishery may be recognized as low.

3. General discussion and research implications

This fishery, which targets a single species, southern bluefin tuna, with a live purse seine fishery was assessed with the ERAEF methodology.

3.1 Level 1

The results of the Level 1 analysis for the SBT fishery were discussed in Section 2.3.12. A total of 25 of the 32 possible activity scenarios identified as leading to some form of impact in the SBT purse-seine sub-fishery (i.e., the activities occurred in the SBT fishery). Only nine SBT scenarios were identified as having an impact of moderate or above, across three components; target species (one scenario), TEP species (five), and communities (two). The four unique (because an activity could impact more than one area) impact-causing activities involved in these nine scenarios were

- Fishing (direct and indirect impacts on 3 components, Target, TEP and communities)
- Translocation of species (impact on TEP species and communities)
- Discarding catch (impact on TEP species)
- Navigation and steaming (impact on communities)

The significant external hazards to the species, habitats and communities relevant to the SBT fishery were external fishing, and aquaculture, and tourism. International fisheries also place significant pressure on the target species; aquaculture operations (including grow-out cages at Port Lincoln) remove large amounts of tuna prey species, while tourism operators may also be changing the behaviour of white sharks.

3.2 Level 2

The two species components that Level 1 analyses suggested were at risk from fishing were target species and TEP species. This assessment then considered 193 species in the Level 2 analyses, and only 2 were found to be at high risk

3.2.1 Species at risk

The authors consider that the 2 high risk species need further evaluation or management response. This expert 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*
Teleost		
• Southern bluefin tuna	Spatial uncertainty	Target
Chondrichthyan		
• White shark	Low overlap	TEP

The two high risk species resulting from the Level 2 analysis are southern bluefin tuna (target species) and white shark (TEP species). In the case of the single target species,

this was obviously identified in the Level 1 as the species most likely to be impacted. In the TEP Level 1 analysis, white shark was the species thought to be at highest risk from fishing, and this was confirmed in the Level 2 analysis. Seabirds were also thought to be at risk in the Level 1 analysis, although not as a direct impact of fishing. The Level 2 analysis did not show any seabirds to be at high risk from fishing, however, this analysis is not designed to detect other issues, such as the risk of bait introducing disease and so reducing the availability of prey species. In addition, management actions have occurred over the process of this ERA to minimize the likelihood of disease introduction, including testing of imported bait.

The large number of marine mammals considered were all found to be at low or medium risk with regard to the impacts of fishing. The size of these animals means they can be avoided when in an area with fish, and if captured, are able to be released from the gear alive after the fish are transferred to the tow cages. Animals such as seals and sea lions are either rare in the offshore area (such as the true seals), while sea lions can escape the nets before or after closure.

The bycatch and byproduct component was eliminated at Level 1, as the risk to species such as mako and blue shark was considered minor.

A large number of syngnathid species was assessed at Level 2, but none were at high risk due to the way in which the gear is fished, avoiding bottom contact where sygnathids are found.

Overall, the conclusion from this risk assessment is that the risks identified here match the known concerns about this fishery; stock status of southern bluefin tuna, and the interactions with white sharks. There is additional Level 3 information on the status of SBT, including a stock assessment, and the CCSBT is considering the sustainable level of harvest that will allow recovery of the species. In the case of the white shark, the fishery should continue to collect observer-based records of interactions with this shark and the other species, in order to determine if the risk is detrimental to the species.

Residual risk

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

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

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

3.2.2 Habitats at risk

This component was eliminated at Level 1.

3.2.3 Communities at risk

Communities not evaluated as methods not complete.

3.3. Key Uncertainties / Recommendations for Research and Monitoring

In assessing risk to TEP species, like the white shark, it is not possible to further refine 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 (white shark) identified in this analysis.

Specific recommendations arising from this assessment include:

- Implement a monitoring program that will measure the interaction rate and outcome of white sharks with the tuna catching and towing operations.
- Efforts to reduce the interactions with white sharks, through feeding or discarding practices on the tow boats.
- Demonstrate that any take of white sharks will not negatively impact the species.

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Glossary of Terms

Assemblage	A subset of the species in the community that can be 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
October 2006	Consolidated comments received from AFMA	Mention in Executive Summary: ERA encompasses fish capture to the point of transfer to farm cages (in State waters). It should also be clearly stated what the ERA applies to (ie the Commonwealth jurisdiction and not the farm cages themselves which are not considered part of the commerical fishery). Industry response that some of the medium risk species would only possibly interact at the growout cages.	Updated Fishery Report so that context of assessment is clear in executive summary and body of report (Section 2, Results, 2nd paragraph)
October 2006		Scoping figures and inserted tables – improve resolution, illegible	Check scoping document, tables deleted where not required. Suggest electronic version would solve this issue. AFMA requested all data tables come within the Scoping table, which does limit the size of tables.
October 2006		Include stakeholder comments on operational strategies to minimize risk of interaction with Great White Shark.	Update stakeholder feedback table in appendix. Appendix B, and in the text.
October 2006		Executive summary – flags 2 components eliminated at Level 1 – does not state which ones.	Updated executive summary for Level 1
October 2006	Consolidated comments received from AFMA	Productivity scores for the three protected sharks are different to ETBF – productivity should be consistent across all fisheries. Green turtle and leathery turtle also.	Error in ETBF formula for one of the attributes (reproductive strategy). Corrected and scores the same as for SBT fishery. Green and Leatherback turtle scores also ok.
October 2006	Consolidated comments received from AFMA	While in terms of showing comprehensiveness sygnathids should be considered, expert opinion should eliminate the need to do a Level 2 for this group in the SBT Purse Seine Fishery. It is surprising the susceptibility is >1 given the reality of how the gear works and where they fish.	The comprehensive list of sygnathids species were considered at Level 2 (as methods dictate) and none were found to be at risk in this fishery. Susceptibility can be greater than 1, as Availability, Encounterability, Selectivity and Post-capture mortality are all scored independently, as explained in method. This was also a misunderstanding by AFMA (generic comment 25 supplied by AFMA, 29/9/2006)
October 2006	Consolidated comments received from AFMA	"The species that are targeted for bait were classed as low risk in nine cases, and moderate in one. Even the moderate case must be viewed with some caution, as the availability has likely been overestimated." This needs to be explained and justified further, how it is over-estimated etc. "Thus, these results are generally consistent with more detailed assessments of the target species, and the over-fished classification from BRS for SBT". Is this just for SBT or the bait species also? Not a lot of explanation of the results – seems to be more in the executive summary than in the body of report. "Some birds are known to land on vessels and some of these die". Seems misleading –some of these die. Needs context as to why landing on the boat means they die.	Update wording on the discussion section. Clarified that data on the distribution of bait fishing activities was not available, so a conservative estimate was applied, and the species in question was still not high risk. Clarified to refer to SBT only.

Appendix B: PSA results summary of stakeholder discussions

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

The following species were discussed at the SBT meeting on June 13, 2006 in Port Lincoln. Selected high risk species were discussed, as noted below.

Taxa name	Scientific name	Common name	Role in fishery	PSA risk ranking (H/M/L)	Comments from meeting, and follow-up	Action	Outcome	Possible management response
		White shark	TEP	H	Including more information in the ERA explaining how various operational strategies employed by industry – such as feeding/discarding practices on the tow boats – are effective in minimizing the risk of interactions occurring, and that in any case those interactions that do occur result in minimal or zero white shark mortality. Reassessing the status of white sharks taking into account new information based on the research findings from a major white shark research program in South Australia and on likely interaction rates and/or post-release mortality rates using the results from observer reports." Also the Great White Shark work by SA needs to be incorporated into the report in the Level 3 outline.	Statements added to the Executive summary. Add these findings to the action developed by AFMA in response to this Fishery Report	Revisit in next ERA iteration	Record absence of interaction

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	**3. Genetic structure** Change in frequency of genotypes, effective population size or number of spawning units up to 10%.	**3. Genetic structure** Change in frequency of genotypes, effective population size or number of spawning units up to 25%.	**3. Genetic structure** Change in frequency of genotypes, effective population size or number of spawning units, change up to 50%.	**3. Genetic structure** Change in frequency of genotypes, effective population size or number of spawning units > 50%.

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

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

Sub-component	Score/level					
	1 Negligible	2 Minor	3 Moderate	4 Major	5 Severe	6 Intolerable
Population size	**1. Population size** Insignificant change to population size/growth rate (r). Unlikely to be detectable against background variability for this population.	**1. Population size** Possible detectable change in size/growth rate (r) but minimal impact on population size and none on dynamics.	**1. Population size** No information is available on the relative area or susceptibility to capture/ impact or on the vulnerability of life history traits of this type of species Susceptibility to capture is suspected to be less than 50% and species do not have vulnerable life history traits. For species with vulnerable life history traits to stay in this category susceptibility to capture must be less than 25%.	**1. Population size** Relative state of capture/susceptibility suspected/known to be greater than 50% and species should be examined explicitly.	**1. Population size** Likely to cause local extinctions if continued in longer term	**1. Population size** Local extinctions are imminent/immediate
Geographic range	**2. Geographic range** No detectable change in geographic range. Unlikely to be detectable against background variability for this	**2. Geographic range** Possible detectable change in geographic range but minimal impact on population range and none on dynamics, change in	**2. Geographic range** Change in geographic range up to 10 % of original.	**2. Geographic range** Change in geographic range up to 25 % of original.	**2. Geographic range** Change in geographic range up to 50 % of original.	**2. Geographic range** Change in geographic range > 50 % of original.

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

Sub-component	Score/level					
	1 Negligible	2 Minor	3 Moderate	4 Major	5 Severe	6 Intolerable
			recruitment dynamics not adversely damaged.	impact.	generations free from impact.	
Behaviour/movement	**6. Behaviour/ movement** No detectable change in behaviour/ movement. Unlikely to be detectable against background variability for this population. Time taken to recover to pre-disturbed state on the scale of hours.	**6. Behaviour/ movement** Possible detectable change in behaviour/ movement but minimal impact on population dynamics. Time to return to original behaviour/ movement on the scale of days to weeks.	**6. Behaviour/ movement** Detectable change in behaviour/ movement with the potential for some impact on population dynamics. Time to return to original behaviour/ movement on the scale of weeks to months.	**6. Behaviour/ movement** Change in behaviour/ movement with impacts on population dynamics. Time to return to original behaviour/ movement on the scale of months to years	**6. Behaviour/ movement** Change in behaviour/ movement with impacts on population dynamics. Time to return to original behaviour/ movement on the scale of years to decades.	**6. Behaviour/ movement** Change to behaviour/ movement. Population does not return to original behaviour/ movement.

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

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

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

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

Table 5D. Habitats. Description of consequences for each component and each sub-component. Use table as a guide for scoring the level of consequence for habitats. Note that for sub-components Habitat types and Habitat structure and function, time to recover from impact scales differ from substrate, water and air. Rationale: structural elements operate on greater timeframes to return to pre-disturbance states (Modified from Fletcher et al. 2002)

Sub-component	Score/level					
	1 Negligible	2 Minor	3 Moderate	4 Major	5 Severe	6 Intolerable
Substrate quality	**1. Substrate quality** Reduction in the productivity (similar to the intrinsic rate of increase for species) on the substrate from the activity is unlikely to be detectable. Time taken to recover to pre-disturbed state on the scale of hours.	**1. Substrate quality** Detectable impact on substrate quality. At small spatial scale time taken to recover to pre-disturbed state on the scale of days to weeks, at larger spatial scales recovery time of hours to days.	**1. Substrate quality** More widespread effects on the dynamics of substrate quality but the state are still considered acceptable given the percent area affected, the types of impact occurring and the recovery capacity of the substrate. For impacts on non-fragile substrates this may be for up to 50% of habitat affected, but for more fragile habitats, e.g. reef substrate, to stay in this category the % area affected needs to be smaller up to 25%.	**1. Substrate quality** The level of reduction of internal dynamics of habitats may be larger than is sensible to ensure that the habitat will not be able to recover adequately, or it will cause strong downstream effects from loss of function. Time to recover from local impact on the scale of months to years, at larger spatial scales recovery time of weeks to months.	**1. Substrate quality** Severe impact on substrate quality with 50 - 90% of the habitat affected or removed by the activity which may seriously endanger its long-term survival and result in changes to ecosystem function. Recovery period measured in years to decades.	**1. Substrate quality** The dynamics of the entire habitat is in danger of being changed in a major way, or > 90% of habitat destroyed.
Water quality	**2. Water quality** No direct impact on water quality. Impact unlikely to be detectable. Time taken to recover to pre-disturbed state on	**2. Water quality** Detectable impact on water quality. Time to recover from local impact on the scale of days to weeks, at larger spatial scales	**2. Water quality** Moderate impact on water quality. Time to recover from local impact on the scale of weeks to months, at larger spatial scales	**2. Water quality** Time to recover from local impact on the scale of months to years, at larger spatial scales recovery time of weeks to months.	**2. Water quality** Impact on water quality with 50 - 90% of the habitat affected or removed by the activity which may seriously endanger its	**2. Water quality** The dynamics of the entire habitat is in danger of being changed in a major way, or > 90% of habitat destroyed.

Sub-component	Score/level					
	1 Negligible	2 Minor	3 Moderate	4 Major	5 Severe	6 Intolerable
	the scale of hours.	recovery time of hours to days.	recovery time of days to weeks.		long-term survival and result in changes to ecosystem function. Recovery period measured in years to decades.	
Air quality	**3. Air quality** No direct impact on air quality. Impact unlikely to be detectable. Time taken to recover to pre-disturbed state on the scale of hours.	**3. Air quality** Detectable impact on air quality. Time to recover from local impact on the scale of days to weeks, at larger spatial scales recovery time of hours to days.	**3. Air quality** Detectable impact on air quality. Time to recover from local impact on the scale of weeks to months, at larger spatial scales recovery time of days to weeks.	**3. Air quality** Time to recover from local impact on the scale of months to years, at larger spatial scales recovery time of weeks to months.	**3. Air quality** Impact on air quality with 50 - 90% of the habitat affected or removed by the activity .which may seriously endanger its long-term survival and result in changes to ecosystem function. Recovery period measured in years to decades.	**3. Air quality** The dynamics of the entire habitat is in danger of being changed in a major way, or > 90% of habitat destroyed.
Habitat types	**4. Habitat types** No direct impact on habitat types. Impact unlikely to be detectable. Time taken to recover to pre-disturbed state on the scale of hours to days.	**4. Habitat types** Detectable impact on distribution of habitat types. Time to recover from local impact on the scale of days to weeks, at larger spatial scales recovery time of days to months.	**4. Habitat types** Impact reduces distribution of habitat types. Time to recover from local impact on the scale of weeks to months, at larger spatial scales recovery time of months to < one year.	**4. Habitat types** The reduction of habitat type areal extent may threaten ability to recover adequately, or cause strong downstream effects in habitat distribution and extent. Time to recover from impact on the scale of > one year to < decadal timeframes.	**4. Habitat types** Impact on relative abundance of habitat types resulting in severe changes to ecosystem function. Recovery period likely to be > decadal	**4. Habitat types** The dynamics of the entire habitat is in danger of being changed in a catastrophic way. The distribution of habitat types has been shifted away from original spatial pattern. If reversible, will require a long-term recovery period, on the scale of decades

Sub-component	Score/level					
	1 Negligible	2 Minor	3 Moderate	4 Major	5 Severe	6 Intolerable
						to centuries.
Habitat structure and function	**5. Habitat structure and function** No detectable change to the internal dynamics of habitat or populations of species making up the habitat. Time taken to recover to pre-disturbed state on the scale of hours to days.	**5. Habitat structure and function** Detectable impact on habitat structure and function. Time to recover from impact on the scale of days to months, regardless of spatial scale	**5. Habitat structure and function** Impact reduces habitat structure and function. For impacts on non-fragile habitat structure this may be for up to 50% of habitat affected, but for more fragile habitats, to stay in this category the % area affected needs to be smaller up to 20%. Time to recover from local impact on the scale of months to < one year, at larger spatial scales recovery time of months to < one year.	**5. Habitat structure and function** The level of reduction of internal dynamics of habitat may threaten ability to recover adequately, or it will cause strong downstream effects from loss of function. For impacts on non-fragile habitats this may be for up to 50% of habitat affected, but for more fragile habitats, to stay in this category the % area affected up to 25%. Time to recover from impact on the scale of > one year to < decadal timeframes.	**5. Habitat structure and function** Impact on habitat function resulting from severe changes to internal dynamics of habitats. Time to recover from impact likely to be > decadal.	**5. Habitat structure and function** The dynamics of the entire habitat is in danger of being changed in a catastrophic way which may not be reversible. Habitat losses occur. Some elements may remain but will require a long-term recovery period, on the scale of decades to centuries.

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

Sub-component	Score/level					
	1 Negligible	2 Minor	3 Moderate	4 Major	5 Severe	6 Intolerable
Species composition	1. Species composition Interactions may be occurring which affect the internal dynamics of communities leading to change in species composition not detectable against natural variation.	1. Species composition Impacted species do not play a keystone role – only minor changes in relative abundance of other constituents. Changes of species composition up to 5%.	1. Species composition Detectable changes to the community species composition without a major change in function (no loss of function). Changes to species composition up to 10%.	1. Species composition Major changes to the community species composition (~25%) (involving keystone species) with major change in function. Ecosystem function altered measurably and some function or components are locally missing/declining/increasing outside of historical range and/or allowed/facilitated new species to appear. Recovery period measured in years.	1. Species composition Change to ecosystem structure and function. Ecosystem dynamics currently shifting as different species appear in fishery. Recovery period measured in years to decades.	1. Species composition Total collapse of ecosystem processes. Long-term recovery period required, on the scale of decades to centuries
Functional group composition	2. Functional group composition Interactions which affect the internal dynamics of communities leading to change in functional group composition not detectable against natural variation.	2. Functional group composition Minor changes in relative abundance of community constituents up to 5%.	2. Functional group composition Changes in relative abundance of community constituents, up to 10% chance of flipping to an alternate state/ trophic cascade.	2. Functional group composition Ecosystem function altered measurably and some functional groups are locally missing/declining/increasing outside of historical range and/or allowed/facilitated new species to appear. Recovery period measured in months to years.	2. Functional group composition Ecosystem dynamics currently shifting, some functional groups are missing and new species/groups are now appearing in the fishery. Recovery period measured in years to decades.	2. Functional group composition Ecosystem function catastrophically altered with total collapse of ecosystem processes. Recovery period measured in decades to centuries.
Distribution of the community	3. Distribution of the community	3. Distribution of the community	3. Distribution of the community	3. Distribution of the community	3. Distribution of the community	3. Distribution of the community

Sub-component	Score/level					
	1 Negligible	2 Minor	3 Moderate	4 Major	5 Severe	6 Intolerable
	Interactions which affect the distribution of communities unlikely to be detectable against natural variation.	Possible detectable change in geographic range of communities but minimal impact on community dynamics change in geographic range up to 5 % of original.	Detectable change in geographic range of communities with some impact on community dynamics Change in geographic range up to 10 % of original.	Geographic range of communities, ecosystem function altered measurably and some functional groups are locally missing/declining/increasing outside of historical range. Change in geographic range for up to 25 % of the species. Recovery period measured in months to years.	Change in geographic range of communities, ecosystem function altered and some functional groups are currently missing and new groups are present. Change in geographic range for up to 50 % of species including keystone species. Recovery period measured in years to decades.	Change in geographic range of communities, ecosystem function collapsed. Change in geographic range for >90% of species including keystone species. Recovery period measured in decades to centuries.
Trophic/size structure	4. Trophic/size structure Interactions which affect the internal dynamics unlikely to be detectable against natural variation.	4. Trophic/size structure Change in mean trophic level, biomass/ number in each size class up to 5%.	4. Trophic/size structure Changes in mean trophic level, biomass/ number in each size class up to 10%.	4. Trophic/size structure Changes in mean trophic level. Ecosystem function altered measurably and some function or components are locally missing/declining/increasing outside of historical range and/or allowed/facilitated new species to appear. Recovery period measured in years to decades.	4. Trophic/size structure Changes in mean trophic level. Ecosystem function severely altered and some function or components are missing and new groups present. Recovery period measured in years to decades.	4. Trophic/size structure Ecosystem function catastrophically altered as a result of changes in mean trophic level, total collapse of ecosystem processes. Recovery period measured in decades to centuries.
Bio-geochemical cycles	5. Bio- and geochemical cycles Interactions which affect bio- &	5. Bio- and geochemical cycles Only minor changes in relative	5. Bio- and geochemical cycles Changes in relative abundance of other	5. Bio- and geochemical cycles Changes in relative abundance of constituents	5. Bio- and geochemical cycles Changes in relative abundance of	5. Bio- and geochemical cycles Ecosystem function catastrophically

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