R04/1072 I 29/06/2007

Australian Government
Australian Fisheries Management Authority

Ecological Risk Assessment for Effects of Fishing

REPORT FOR THE WESTERN TUNA AND BILLFISH SUB-FISHERY

Authors
Helen Webb
Cathy Bulman
Miriana Sporcic
Jo Dowdney
Mike Fuller
Tony Smith
Alistair Hobday

CSIRO

Natural Heritage Trust
Helping Communities Helping Australia
An Australian Government Initiative

www.afma.gov.au
Protecting our fishing future
Box 7051, Canberra Business Centre, ACT 2610 Tel (02) 6272 5029 Fax (02) 6272 5175
AFMA Direct 1300 723 621

This fishery ERA report should be cited as

Webb, H. C. Bulman, M. Sporcic, J. Dowdney, M. Fuller, T. Smith. A. Hobday (2007) Ecological Risk Assessment for the Effects of Fishing: report for Western Tuna and Billfish sub-Fishery. Report for the Australian Fisheries Management Authority.

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 Western Tuna and Billfish Fishery 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; byproduct and bycatch species; threatened, endangered and protected (TEP) species; habitats; and (ecological) communities.

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

ERAEF provides an explicit approach to uncertainty in assessment of ecological risks from fishing. First, the approach results in progressive reductions in uncertainty at each successive level in the hierarchy, as more data and more quantitative approaches are used. Second, there is a precautionary approach to uncertainty adopted within each level in the hierarchy. For example, a "plausible worst case" approach is used in the expert judgement based Level 1 analyses. At Level 2, all risk attributes are initially assumed to be high, and are successively reduced as data and information are brought to bear. This means that ecological components will be judged to be at high risk where relevant data are missing, resulting in possible false positives (risk assessed to be high when it is low), but generally few false negatives (risk assessed to be low when it is actually high). Level 3 analyses provide explicit quantitative approaches to measurement of uncertainty and risk.

This assessment of the Western Tuna and Billfish Fishery includes the following:

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

Fishery Description

Gear:	Pelagic longline
Area:	Extends westward from Cape York Peninsula (142°30'E) off Queensland to 34°S off the west coast of Western Australia. It also extends eastward from 34°S off the west coast of WA, across the Great Australian Bight to 141°E at the South Australian / Victorian border. The main area fished is offshore from the west coast of WA, with some fishing also occurring in the GAB.
Depth range:	30 to 200 m (of the gear)
Fleet size:	125 permits, but fewer boats (5-10 in 2005)
Effort:	Average (1986-2003) 3,989 sets and 4,355,385 hooks
Landings:	Average (based on 2000-04) per year yellowfin 348t, Bigeye tuna 333t, Broadbill swordfish 1,325t, Albacore tuna 49t, Striped marlin 15t.
Discard rate:	Not known
Main target species:	Broadbill swordfish, Bigeye tuna, Yellowfin tuna, Albacore tuna
Management:	Input control management regime, based on limited entry – ITQs for key species to be implemented under new management plan.
Observer program:	Currently there is no observer program. A pilot scientific monitoring program ran from April 2003 to August 2004

Ecological Units Assessed

Target species:	6 (and 7 target bait species)
Byproduct and bycatch species:	23 and 48 respectively
TEP species:	264
Habitats:	162 (benthic and pelagic)
Communities:	50 (benthic and pelagic)

Level 1 Results

The habitat component was eliminated at Level 1. For all other components, there was at least one risk score of 3 – moderate – or above.

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

- Fishing (direct impact on 4 ecological components)
- Translocation of species (impact on communities)

Significant external hazards included other fisheries in the region, coastal development, and other extractive activities.

Risks rated as major (risk score 4) for the WTBF were related to direct impacts from primary fishing operations on target and byproduct/bycatch species. No severe impacts (risk score 5) were recorded. Impacts from fishing on all species components were assessed in more detail at Level 2.

Level 2 Results

Species

A total of 348 species were assessed at Level 2 using the PSA analysis. Of these, 32 were assessed to be at high risk, 2 byproduct species, 3 bycatch species, and 27 TEP species. By taxa, the high risk species comprised 6 chondrichthyans (sharks and rays), 21 marine birds, and 5 marine mammal.

The uncertainty is due lack of biological data for some of the birds and sea snakes, to the poor observer coverage on the fishery so far, and the lack of detailed taxonomic resolution in the observer reports. A number of shark and ray species, and several groups of marine birds are most likely to be at high risk from this fishery.

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

Communities

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

Summary

There remains considerable uncertainty about many high risk species for this fishery. Those that should be the focus of initial management response include several chondrichthyan species (including byproduct, bycatch and TEP), and several groups of marine birds (including albatross, petrels and shearwaters).

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.

TABLE OF CONTENTS

Executive Summary ..... **i**
1. Overview **1**
Ecological Risk Assessment for the Effects of Fishing (ERAEF) Framework **1**
The Hierarchical Approach 1
Conceptual Model 1
ERAEF stakeholder engagement process 3
Scoping 3
Level 1. SICA (Scale, Intensity, Consequence Analysis) 4
Level 2. PSA (Productivity Susceptibility Analysis) 4
Level 3 5
Conclusion and final risk assessment report 5
Subsequent risk assessment iterations for a fishery 5
2. Results **6**
2.1 Stakeholder Engagement **6**
2.2 Scoping **8**
2.2.1 General Fishery Characteristics (Step 1). 8
2.2.2 Unit of Analysis Lists (Step 2) 38
2.2.3 Identification of Objectives for Components and Sub-components (Step 3) 66
2.2.4 Hazard Identification (Step 4) 73
2.2.5 Bibliography (Step 5) 80
2.2.6 Decision rules to move to Level 1(Step 6) 80
2.3 Level 1 Scale, Intensity and Consequence Analysis (SICA) **81**
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) 82
2.3.2 Score spatial scale of activity (Step 2) 82
2.3.3 Score temporal scale of activity (Step 3) 82
2.3.4 Choose the sub-component most likely to be affected by activity (Step 4) .. 83
2.3.5 Choose the unit of analysis most likely to be affected by activity and to have highest consequence score (Step 5) 83
2.3.6 Select the most appropriate operational objective (Step 6) 83
2.3.7 Score the intensity of the activity for the component (Step 7) 83
2.3.8 Score the consequence of intensity for that component (Step 8) 84
2.3.9 Record confidence/uncertainty for the consequence scores (Step 9) 84
2.3.10 Document rationale for each of the above steps (Step 10) 85
2.3.11 Summary of SICA results 134
2.3.12 Evaluation/discussion of Level 1 137
2.3.13 Components to be examined at Level 2 138
2.4 Level 2 Productivity and Susceptibility Analysis (PSA) **139**
2.4.1 Units excluded from analysis and document the reason for exclusion (Step 1) 143
2.4.2 and 2.4.3 Level 2 PSA (steps 2 and 3) 145
2.4.4 PSA Plot for individual units of analysis (Step 4) 188
2.4.5 Uncertainty analysis ranking of overall risk (Step 5) 191
2.4.6 Evaluation of the PSA results (Step 6) 195
2.4.7 Decision rules to move from Level 2 to Level 3 (Step 7) 201
2.4.8 High/Medium risk categorisation (Step 8) 202

2.5 Level 3 204
3. General discussion and research implications 205
3.1 Level 1 205
3.2 Level 2 205
3.2.1 Species at risk 205
3.2.2 Habitats at risk 208
3.2.3 Communities at risk 208
3.3 Key Uncertainties / Recommendations for Research and Monitoring 208
References 209
Glossary of Terms 215
Appendix A: General summary of stakeholder feedback 217
Appendix B: PSA results summary of stakeholder discussions 218
Appendix C: SICA descriptions of consequences for each component 219

Fishery ERA report documents to be completed

List of Summary documents

2.1 Summary Document SD1. Summary of stakeholder involvement for fishery 6

List of Scoping documents

Scoping Document S1 General Fishery Characteristics 8
Scoping Document S2A Species 38
Scoping Document S2B1. Benthic Habitats 54
Scoping Document S2B2. Pelagic Habitats 61
Scoping Document S2C1. Demersal Communities 63
Scoping Document S2C2. Pelagic Communities 64
Scoping Document S3 Components and Sub-components Identification of Objectives 67
Scoping Document S4. Hazard Identification Scoring Sheet 74

List of Level 1 (SICA) documents

2.3.1 Level 1 (SICA) Document L1.1 - Target Species Component; 86
2.3.1 Level 1 (SICA) Document L1.2 - Byproduct and Bycatch Component 97
2.3.1 Level 1 (SICA) Document L1.3 - TEP Species 107
2.3.1 Level 1 (SICA) Document L1.4 - Habitat Component 116
2.3.1 Level 1 (SICA) Document L1. 5 - Community Component 123
Level 1 (SICA) Document L1.6. Summary table of consequence scores for all activity/component combinations. 134

List of Level 2 (PSA) documents

Level 2 (PSA) Document L2.1. Summary table of stakeholder discussion regarding PSA results.. 217

List of Figures

Figure 1. Overview of ERAEF showing focus of analysis for each level at the left in italics. 1
Figure 2. Generic conceptual model used in ERAEF. 2
Figure 13. The axes on which risk to the ecological units is plotted. 142
Figure 17. Overall risk values in the PSA plot.. 190

List of Tables

Table 4. Examples of fishing activities. 77
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. 219
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. 222
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. 225
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. 228
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. 231

1. Overview

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

The Hierarchical Approach

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

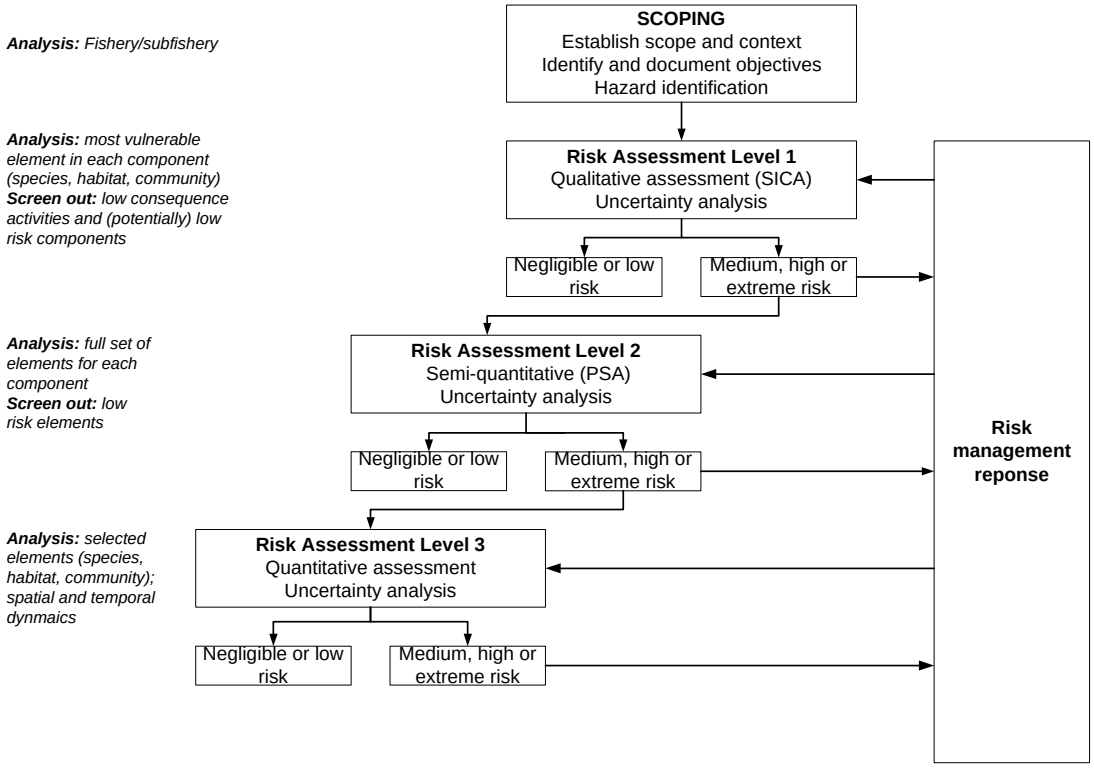


Figure 1. Overview of ERAEF showing focus of analysis for each level at the left in italics.

Conceptual Model

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

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

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

This conceptual model (**Figure 2**) progresses from *fishery characteristics* of the fishery or sub-fishery, → *fishing activities* associated with fishing and *external activities*, which may impact the five ecological components (target, byproduct and bycatch species, TEP species, habitats, and communities); → *effects of fishing and external activities* which are the direct impacts of fishing and external activities; → *natural processes and resources* that are affected by the impacts of fishing and external activities; → *sub-components* which are affected by impacts to natural processes and resources; → *components*, which are affected by impacts to the sub-components. Impacts to the sub-components and components in turn affect achievement of management objectives.

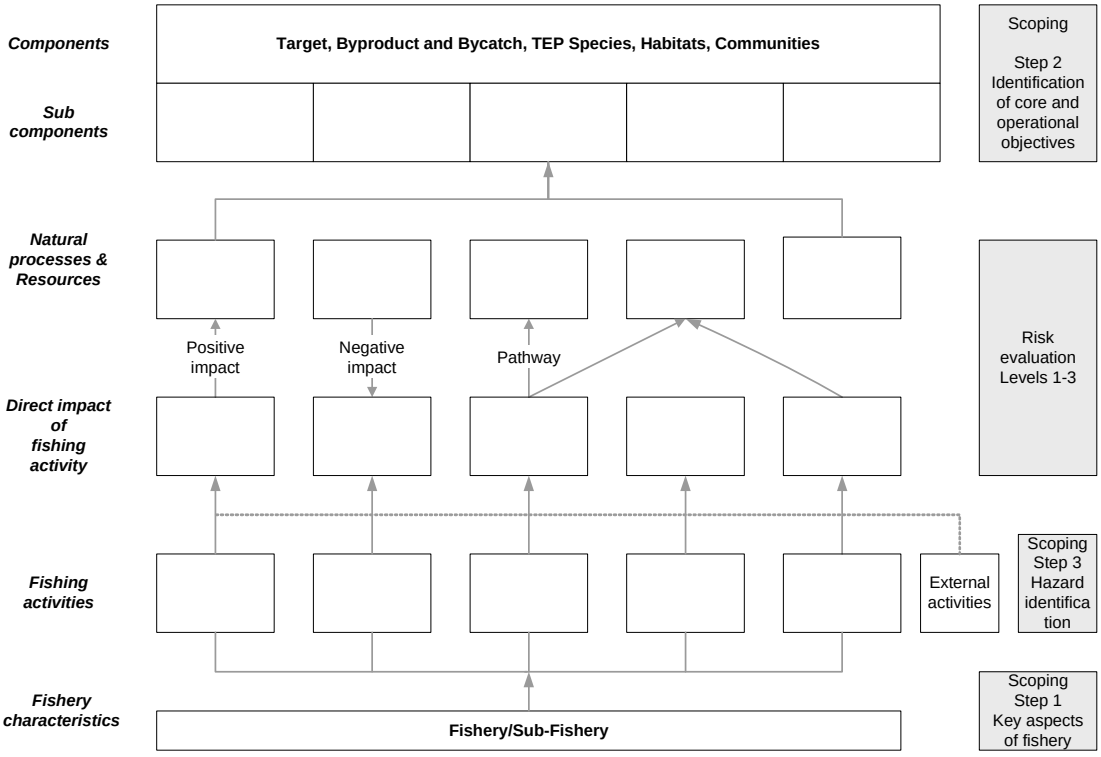


Figure 2. Generic conceptual model used in ERAEF.

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

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

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

ERAEF stakeholder engagement process

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

Scoping

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

1. Identification of units of analysis (species, habitats and communities) potentially impacted by fishery activities (section S1.1).
2. Selection of objectives (section S1.2) 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 S1.3) that occur in the sub-fishery is made using a checklist of potential activities provided. The checklist was developed following extensive review, and allows repeatability between fisheries. Additional activities raised by the stakeholders can be included in this checklist (and would feed back into the original checklist). The background information and consultation with the stakeholders is used to finalize the set of activities. Many activities will be self-evident (e.g. fishing, which obviously occurs), but for others, expert or anecdotal evidence may be required.

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

The SICA analysis evaluates the risk to ecological components resulting from the stakeholder-agreed set of activities. Evaluation of the temporal and spatial scale, intensity, sub-component, unit of analysis, and credible scenario (consequence for a sub-component) can be undertaken in a workshop situation, or prepared ahead by the draft fishery ERA report author and debated at the stakeholder meeting. Because of the number of activities (up to 24) in each of five components (resulting in up to 120 SICA elements), preparation before involving the full set of stakeholders may allow time and attention to be focused on the uncertain or controversial or high risk elements. The rationale for each SICA element must be documented and this may represent a challenge in the workshop situation. Documenting the rationale ahead of time for the straw-man scenarios is crucial to allow the workshop debate to focus on the right portions of the logical progression that resulted in the consequence score.

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

Level 2. PSA (Productivity Susceptibility Analysis)

The semi-quantitative nature of this analysis tier should reduce but not eliminate the need for stakeholder involvement. In particular, transparency about the assessment will lead to greater confidence in the results. The components that were identified to be at moderate or greater risk (SICA score > 2) at Level 1 are examined at Level 2. The units of analysis at Level 2 are the agreed set of species, habitat types or communities in each component identified during the scoping stage. A comprehensive set of attributes that are proxies for productivity and susceptibility have been identified during the ERAEF project. Where information is missing, the default assumption is that risk will be set high. Details of the PSA method are described in the accompanying ERAEF Methods Document. Stakeholders can provide input and suggestions on appropriate attributes, including novel ones, for evaluating risk in the specific fishery. The attribute values for many of the units (e.g. age at maturity, depth range, mean trophic level) can be obtained from published literature and other resources (e.g. scientific experts) without full stakeholder involvement. This is a consultation of the published scientific literature. Further stakeholder input is required when the preliminary gathering of attribute values is completed. In particular, where information is missing, expert opinion can be used to derive the most reasonable conservative estimate. For example, if the species attribute values for annual fecundity have been categorized as low, medium and high on the set [<5, 5-500, >500], estimates for species with no data can still be made. Estimated fecundity of a species such as a broadcast-spawning fish with unknown fecundity, is still likely greater than the cutoff for the high fecundity categorization (>500). Susceptibility attribute estimates, such as “fraction alive when landed”, can also be made based on input from experts such as scientific observers. The final PSA is completed by scientists because access to computing resources, databases, and programming skills is required. Feedback to stakeholders regarding comments received during the preliminary PSA consultations is considered crucial. The final results are

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

Level 3

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

Conclusion and final risk assessment report

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

Subsequent risk assessment iterations for a fishery

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

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

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

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

2. Results

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

The results presented below are for the longline sub-fishery of the WTBF.

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

2.1 Stakeholder Engagement

2.1 Summary Document SD1. Summary of stakeholder involvement for fishery

Western Tuna and Billfish Fishery

Fishery ERA report stage	Type of stakeholder interaction	Date of stakeholder interaction	Composition of stakeholder group (names or roles)	Summary of outcome
Scoping	Phone calls and email regarding the hazard identification.	September, 2003	Anthony de Fries, Executive Officer for the WTBF.	Feedback incorporated in the document and discussed at next meeting
	Workshop. Review by stakeholders at SAG meeting	Fremantle, September 11 & 12, 2003	See report from this meeting *(managers, fishers, science, environment)*	Feedback on species lists was provided. Hazards agreed on.
	Email and phone calls	April 2004	Anthony de Fries, Executive Officer for the WTBF	Additional detail on wire traces, and finning for scoping stage.
Level 1 (SICA)	Workshop. Review by stakeholders at SAG meeting	Fremantle, September 11 & 12, 2003	See report from this meeting *(managers, fishers, science, environment)*	Debated the credible SICA scenarios, and ERA team agreed to modify out of session, and move to Level 2.
	Out-of-session review	Nov 17, 2003	James Brooks, Conservation Member	Provided feedback on Level 1, also suggested way to revise Table 8 for clarity. Comments addressed and included in draft where appropriate
Level 2 (PSA)	Workshop	Fremantle, March 8, 2004	WTBF SAG 7 and Alistair Hobday	Provided feedback on revised Level 1, presented Draft Level 2

Fishery ERA report stage	Type of stakeholder interaction	Date of stakeholder interaction	Composition of stakeholder group (names or roles)	Summary of outcome
	Email	April 2004	Anthony de Fries, Executive Officer for the WTBF.	Supplied summary of recent catch data from logbooks for the fishery. Data used to update the species list and attributes used at Level 2.
Draft ERAEF Report	Draft distributed to stakeholder group	Sent May 20th, distributed June 4th 2004.	See Anthony de Fries, Executive Officer for the WTBF	Comments received and coordinated by Anthony de Fries, Executive Officer for the WTBF.
Draft final report	Sent to AFMA	31/7/04		Stage 1 of ERAEF concluded Comments received from Western Australia Department of Fisheries, Lananton and Gaughan, July 2004. Clarification or changes made to document.
Level 2 PSA		SAG meeting Freemantle 9-10/8/05	Alistair Hobday and Helen Webb	Review Level 1 and present updated Level 2 (as at Aug 05). Identify high risks and why. Discuss possible management options to mitigate high risks

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).

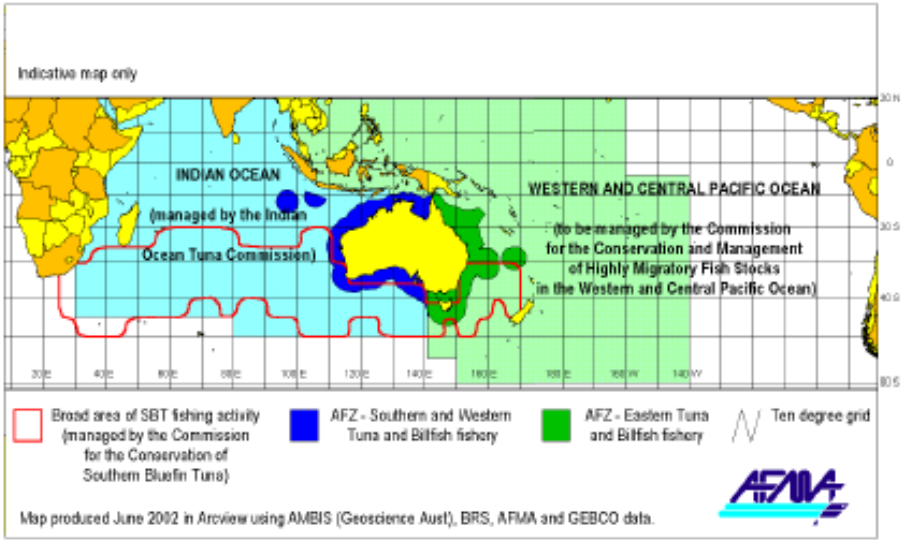
The information used to complete this step may come from a range of documents such as the Fishery's Management Plan, Assessment Reports, Bycatch Action Plans, and any other relevant background documents. The level and range of information available will vary. Some fisheries/sub-fisheries will have a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

Scoping Document S1 General Fishery Characteristics

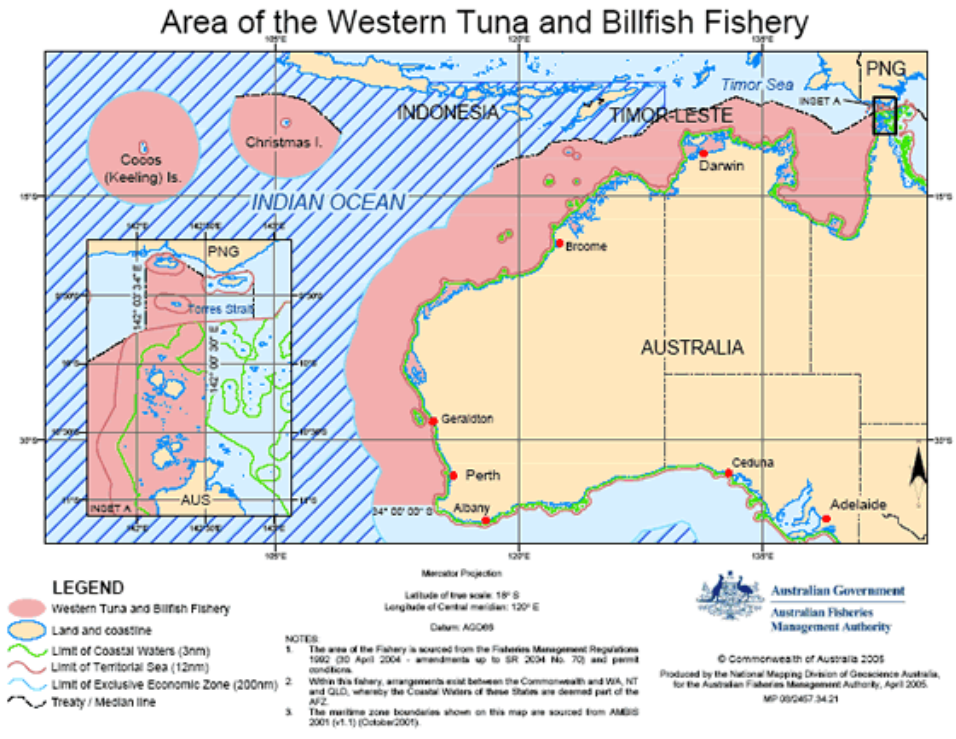
Fishery Name: Western Tuna and Billfish Fishery
Date of assessment: 27 August 2003, updated 22 July 2004, updated 28 May 2006
Assessor: Helen Webb

General Fishery Characteristics	
Fishery Name	Western Tuna and Billfish Fishery (WTBF)
Sub-fisheries	*Identify sub-fisheries on the basis of fishing method/area* The WTBF subfisheries include • Longlining • Purse seining • Pole and line • Trolling
Sub-fisheries assessed	*The sub-fisheries to be assessed on the basis of fishing method/area in this report.* The risk assessment part of this report will consider only the Pelagic longlining as it currently the dominant commercial fishing method in the WTBF. The fishery for bait by the longliners will also be included in this assessment.
Start date/history	*Provide an indication of the length of time the fishery has been operating.* 1920s Recreational Anglers 1952-1997 Japanese longliners 1986 Domestic pelagic longliners first operate in waters of the WTBF Since the declaration of the Australian Fishing Zone in 1979 there has been substantial change in the management and jurisdictional arrangements that have applied to fishing for

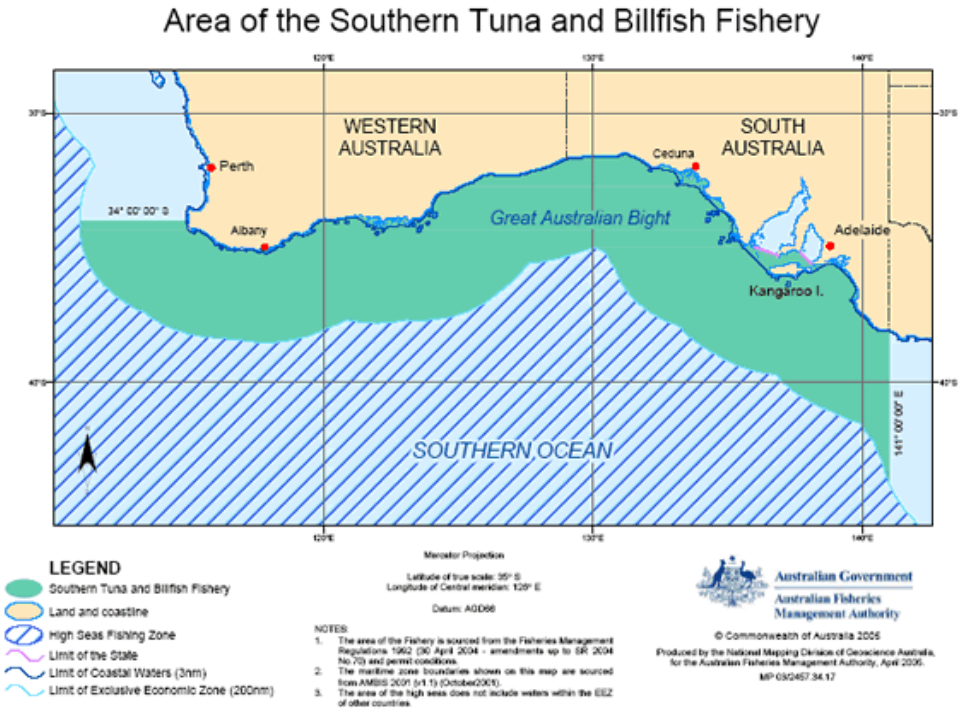
	tuna and tuna-like species in the current waters of the fishery. Since the exclusion of Japanese longliners in 1997, there has been a marked increase in domestic investment in the fishery with a number of larger vessels being refitted for dedicated longlining (Caton, 2002). Abbreviated Recent History • Early 1990s Domestic longliners only fish sporadically in the waters of the WTBF. Until 1996 most of the domestic catch (by weight) in the fishery was skipjack tuna taken by purse seine vessels. • 1992 AFMA requires holders of Commonwealth fishing boat licenses for tuna fishing to nominate the area of waters of their fishing operations. This reduced the number of fishing entitlement holders for the WTBF to 278. • 1994 AFMA closes the Southern and Western Tuna and Billfish Fishery to new entrants. • Mar 1996 The Indian Ocean Tuna Commission (IOTC) came into effect in March 1996. The IOTC is an inter-governmental organisation established under Article XIV of the FAO constitution. It is mandated to manage tuna and tuna-like species in the Indian Ocean and adjacent seas. • Dec 1996 The STBF and the WTBF were described separately in the Fisheries Management Regulations. • Dec 1996 AFMA moves the boundary between the ETBF and the STBF from 146ºE to 141ºE (South Australian/Victorian borders). Operators were advised of this boundary change and were given details of permit surrender provisions. • 1997 Following the boundary change and restructure of the permit system the number of permit holders in the WTBF was reduced from 278 to the current 124 permit holders. • Jul 1998 The AFMA Board approved the removal of all internal boundaries in the WTBF and the STBF with the exception of the line at 34º S. The decision was taken in the context of AFMA's legislative objectives. As most species taken in the fishery are highly migratory, the boundaries were removed to allow for a more rationalised management approach. AFMA Draft Assessment for WTBF July 2003
Geographic extent of fishery	*The geographic extent of the managed area of the fishery. Maps of the managed area and distribution of fishing effort should be included in the detailed description below, or appended to the end of this table.* The WTBF area of waters encompasses a large and complex range of eco-regions in both temperate and tropic waters. Commercial fishing in the WTBF is largely confined to waters outside the continental shelf break and at present mainly takes place between Esperance and Broome in Western Australia. Pelagic longlining is the dominant method in the WTBF and is currently undertaken in waters beyond the continental shelf break (~ 200m isobath). This was not the case during the mid- late-1990s when much fishing took place on the outer shelf. Recent discussions between AFMA, the WTBF representatives and the Department of Fisheries have indicated that shelf break continues to be an area that the fleet would target effort. The Great Australian Bight, the North West Shelf and large areas off the Northern Territory are too shallow for pelagic longlining due to the extent of the continental shelf in these regions. Technically the WTBF includes waters in the AFZ off the Northern Territory, Western Australia, South Australia, part of Queensland and around Christmas Island and the Cocos (Keeling) Islands (12nm-200nm); and high seas waters within the Indian Ocean Tuna Commission's (IOTC) area of competence. The Draft Plan's area of jurisdiction is not directly related to the distribution of the key target species in the Australian EEZ; however, the boundary between the WTBF and the Eastern Tuna and Billfish Fishery (ETBF) is believed to be a reliable demarcation between the Indian Ocean and Pacific Ocean stocks of yellowfin tuna, bigeye tuna and broadbill swordfish. These species are common to both oceans. AFMA Draft Assessment for WTBF July 2003



Western sector



AFMA Web page



AFMA web page

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

Schedule 1 from WTBF Management Plan 2005

1 Area within the AFZ

The area bounded by a notional line:

- commencing at the intersection of the northern coastline of Australia with the meridian of longitude 142° 09′ E
- then running north along that meridian to the intersection with the parallel of latitude 10° 28′ S
- then running west along that parallel to the intersection with the meridian of longitude 141° 20′ E
- then running north along that meridian to the intersection with the outer limit of the AFZ
- then running generally westerly, southerly and easterly along the outer limit of the AFZ to the intersection with the meridian of longitude 141° E
- then running north along that meridian to its first intersection with the southern coastline of Australia
- then running generally westerly, northerly and easterly along that coastline to the point where the line began.

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

2 Areas adjacent to Christmas and Cocos (Keeling) Islands

Those parts of the AFZ that:

(a) surround Christmas Island and the Cocos (Keeling) Islands; and

(b) extend toward the outer limit of the AFZ from a line every point of which is 12 nautical miles from the Australian territorial sea baseline.

3 High seas area

Those parts of the high seas that are within the area of competence of the IOTC and west of 141° E.

Note See the Agreement for the Establishment of the Indian Ocean Tuna Commission for details about the area mentioned in this clause.

Fishing season

What time of year does fishing in each sub-fishery occur?
Fishing activities occur year round, with seasonal spatial and temporal variation.

Tuna and billfish are characterised by extensive seasonal movements that are reflected in variation in catch rates. Larcombe et al (1997) considered that much of the seasonal and interannual variability was attributable to variability in the oceanographic environment. As a result fishing effort is rarely concentrated in the same area for long periods.
AFMA Draft Assessment for WTBF July 2003

Target species and stock status

Species targeted and where known stock status.

Species targeted Broadbill swordfish, Bigeye tuna , Yellowfin tuna , Albacore tuna, Striped marlin

Part 1 Primary species WTBF Management Plan 2005

Item	Common name	Scientific name
1	Albacore tuna	*Thunnus alalunga*
2	Bigeye tuna	*Thunnus obesus*
3	Billfish	Families Istiophoridae and Xiphiidae
4	Longtail tuna	*Thunnus tonggol*
5	Northern bluefin tuna	*Thunnus thynnus*
6	Rays bream (or pomfret)	Family Bramidae
7	Skipjack tuna	*Katsuwonus pelamis*
8	Yellowfin tuna	*Thunnus albacares*

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.

Baitfishing
Under the OCS agreements WTBF operators are permitted to catch bait for their own use in fishing for scheduled species. Australia's pelagic longliners use squid and small pelagic fish species to fish for tuna and billfish. Broadbill swordfish and bigeye tuna are targeted using squid. Other target species are caught using pilchard, blue mackerel, yellowtail scad and other species. Operators fishing off south-eastern NSW often use yellowtail scad and blue mackerel as live bait. It is quite likely that more WTBF operators will follow this practice in the future. According to logbooks, less than 2% per cent (approximately 14 tonnes per year) of the 700 tonnes of bait used by longliners in the WTBF is self-caught. Catches of bait species will be monitored and management actions taken if there are any sustainability concerns. The *Draft Western Tuna and Billfish Fishery Management Plan 2004* will apply to bait species. Bait species fall into the category of secondary species within Schedule 2 of the

<table>
<tr><td></td><td>management plan. The impact of baitfishing on prey species is addressed at Guideline 2.3.2.

If the level of baitfishing expands significantly from the current low levels AFMA and the states may need to develop more specific arrangements to manage the combined impact of state managed baitfish fisheries and bait gathering by WTBF operators. The states and Northern Territory are currently examining potential management issues in relation to baitfish.
AFMA Draft Assessment for WTBF July 2003

Species blue mackerel, yellow tail scad, southern ocean arrow squid, tommy rough, jack mackerel, pilchard, scaly mackerel. AFMA Logbook data

These species will be assessed together with the target species in the Level 1, and Level 2 if it is required.</td></tr>
<tr><td>Current entitlements</td><td>The number of current entitlements in the fishery. Note latent entitlements.
Licences/permits/boats and number active.
125 (2005/06 less than 5 active vessels)
Table 8: Total number of active vessels by sector in the WTBF from 1998 to 2003.

<table>
<tr><th></th><th>Southern</th><th>Western</th><th>Total across WTBF</th></tr>
<tr><td>1998</td><td>7</td><td>18</td><td>23</td></tr>
<tr><td>1999</td><td>25</td><td>35</td><td>42</td></tr>
<tr><td>2000</td><td>32</td><td>41</td><td>51</td></tr>
<tr><td>2001</td><td>31</td><td>38</td><td>43</td></tr>
<tr><td>2002</td><td>33</td><td>37</td><td>45</td></tr>
<tr><td>2003</td><td>20</td><td>29</td><td>30</td></tr>
</table>

AFMA WTBF Data Summary 2003
The total number of permits (potential operators) in the WTBF is 124. A permit may contain one or more fishing methods. These are distinct numbers and should not be summed, as operators' fishing permits often allow for more than one access area per method and more than one method. Holding more than one method on a permit does not entitle the holder to nominate more than one boat against that permit at the same time. Despite the number of methods listed on a permit, the permit represents one access entitlement. In the same context, permits that provide access to both the Southern and Western areas (on the one permit) only constitute a single access entitlement. In this sense both area and method define permits.

Under the Draft Plan the allocation of transferable quota statutory fishing rights will be based on allocation formulas detailed in the Plan. AFMA convened an independent Allocation Advisory Panel to prepare a report and recommendations on an allocation process for the fishery. Under the Draft Plan the number of the vessels in the fishery will be managed using Boat SFRs. Currently most longline vessels that access the fishery carry a master and up to seven crew.
AFMA Draft Assessment for WTBF July 2003</td></tr>
<tr><td>Current and recent TACs, quota trends by method</td><td>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

Western tuna and billfish fishery management plan 2005

AFMA to determine TACC (Act s 17 (6))</td></tr>
</table>

(1) AFMA must, before the start of each fishing season, determine the TACC for each quota species for the season, and during the course of the season, must determine:

(a) the determined weight or the determined percentage (or both) for the purposes of section 18; and

(b) the determined percentage for the purposes of section 19.

(2) Before determining any of the matters referred to in subsection (1), AFMA must consider:

(a) information given by the advisory committee, other interested Australian and international bodies and other interested persons; and

(b) the total estimated catch by the commercial, recreational, indigenous and any other users of the fishery; and

(c) information about the sustainability of marine species in the area of the fishery; and

(d) the reference points set for the stocks of quota species; and

(e) the precautionary principle; and

(f) any decision made by the Minister or an intergovernmental Ministerial Council about resource sharing in the fishery; and

(g) any decision rule used for setting the TACC; and

(h) the likely effect, for the fishing season, of any overcatch permitted under section 18.

(3) A determination of a TACC must specify the TACC, expressed as:

(a) whole weight; or

(b) another weight, as specified in the determination.

(4) If a determination of a TACC for a quota species and a fishing season is revoked or disallowed, the TACC for that species for the immediately preceding fishing season is taken to be the TACC for that species for the fishing season.

Note 1 AFMA may determine the fishing capacity permitted for the fishery — see paragraph 17 (6) (aa) of the Act.

Note 2 Subsection 17 (6B) of the Act provides that a determination under this section is a disallowable instrument for the purposes of section 46A of the *Acts Interpretation Act 1901*. Although section 46A of the *Acts Interpretation Act 1901* has been repealed, section 6 of the *Legislative Instruments Act 2003* provides that such an instrument is a disallowable instrument.

12 Quantity of fish that may be taken

The quota for an SFR for a quota species for a fishing season is:

$$\frac{T}{S}$$

where:

T is the TACC for the species for the fishing season.

S is the total number of SFRs in force for the species at the start of

the fishing season.

13 AFMA to notify TACC and quota

Before the start of each fishing season, AFMA must send a notice to each owner of a quota SFR setting out, for the relevant quota species:

(a) the TACC for the fishery and that species for the season; and

(b) the number of quota SFRs for that species held by the owner; and

(c) the quota that applies to an SFR for that species for the season; and

(d) the owner's quota for the season.

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

Effort decreased significantly in 2003, overall there was a 34% decrease in the number of hooks set. Both the southern and western sectors recorded a decrease in effort of around 1 million hooks. This represented a 77% decrease in the southern sector and a 20% decrease the western sector compared to last year (table 6).

Table 6: Total number of longline hooks deployed in the WTBF by sector from 1998 to 2003.

	Southern	Western	Total
1998	76,165	965,469	**1,041,634**
1999	626,200	2,902,453	**3,528,653**
2000	1,700,774	3,873,741	**5,574,515**
2001	1,724,683	4,448,981	**6,173,664**
2002	1,411,289	4,500,905	**5,912,194**
2003	318,129	3,583,520	**3,901,649**

The number of sets in 2003 decreased by 39% (table 7). Since 1998 the average number of hooks per set has increased by 23% from 973 per set in 1998 to 1,269 per set in 2003.

Table 7: Total number of longline sets deployed by sector in the WTBF from 1998 to 2003.

	Southern	Western	Total
1998	61	1,009	**1,070**
1999	626	3,166	**3,792**
2000	1,512	3,916	**5,428**
2001	1,524	3,968	**5,492**
2002	1,225	3,855	**5,080**
2003	242	2,833	**3,075**

Vessel activity for fishing years 1998 to 2003 is displayed below (table 8). There was a considerable decrease in the number of vessels that fished in the 2003 fishing year.

AFMA WWTBF Data summary 2003

Current and recent fishery catch trends by

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

method

From AFMA WTBF Data Summary 2003

Southern Sector

Total catch in the southern sector of the pelagic longline fishery decreased by 600 tonnes (84%) in 2003 when compared with 2002 (table 3).

Table 3: Total catch (tonnes) for southern sector of the pelagic longline fishery by species from 1998 to 2003.

1998		1999	2000	2001	2002	2003
Swordfish	4	146	364	683	499	60
Bigeye	16	126	135	140	161	36
Yellowfin	0	2	5	5	8	0
Albacore	9	1	6	44	11	4
Other	1	5	25	36	32	12
Total	31	280	535	908	712	112

Western Sector

Total catch in the western sector of the pelagic longline fishery decreased by 652 tonnes (29%) in 2003 when compared with 2002 (table 4). Catches of most species except albacoretuna were down.

Table 4: Total catch (tonnes) for western sector of the pelagic longline fishery by species from 1998 to 2003.

1998		1999	2000	2001	2002	2003
Swordfish	234	867	1015	1453	1499	1,124
Bigeye	145	286	279	246	258	170
Yellowfin	231	405	346	552	346	191
Albacore	15	19	22	50	61	62
Other	82	106	89	114	115	81
Total	707	1683	1751	2415	2280	1,628

Current and recent value of fishery ($)

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

There has been a considerable expansion in domestic investment in the fishery since the cessation of bilateral access for Japan in 1997. This is reflected in the growth in participation rates (number of vessels active in the fishery) over the last few years. From 1997/98 to 2000/01 the value of the fishery increased from $4.3 million to $34.5 million

AFAM draft assessment for WTBF 2003

2001: 4253 tonnes, 2001/02 $33.7m (includes 898 tonnes of Skipjack)

2002: 3992 tonnes, 2002/03 $20.0m (includes 1144 tonnes of Skipjack)

2003/04: 1232 tonnes, $8.2m

AFMA at a glance updated 25 July 2005

Relationship with other fisheries

Commercial and recreational, state, national and international fisheries List other fisheries operating in the same region any interactions

State Fisheries

Many state fisheries operate within the waters of the WTBF, however direct interactions with the WTBF are limited given that the key pelagic species caught in the WTBF do not inhabit near shore waters and only a few species of inshore fish are susceptible to capture on pelagic longlines.

Interaction can be expected with the WA managed shark fisheries, and in particular, the

dusky and sandbar shark stocks (DOFWA, July 2004).

Table 7: Characteristics of Australian fisheries in the region of the SWTBF

Fishery/Managing Agency	Target species	Interactions with SWTBF	Gear
Southern Bluefin Tuna Fishery (AFMA)	Southern bluefin tuna	Southern bluefin tuna bycatch on pelagic longlines in the SWTBF. Very small catches of bigeye and albacore in purse seining and poling operations	Purse seine Pole and line
Southern Shark Fishery (AFMA)	School shark Gummy shark	Some species of sharks species caught as bycatch in both fisheries: Bronze whalers, shortfin makos, thresher species	Gillnet Demersal longline
Western Deepwater Trawl Fishery (AFMA)	Finfish	Demersal species are occasionally caught on pelagic longlines - boarfish, dogfish species	Trawl
Western Australian Southern Demersal Gillnet and Longline Fishery Commonwealth - Western Australian Government Joint Authority	Dusky whalers Gummy sharks Whiskery shark	Dusky whaler sharks are a regular bycatch on pelagic longlines. This species is considered overfished and there is concern about additional mortality in the SWTBF. Other species taken in this fishery that are also caught in the SWTBF are sandbar sharks and hammerhead species.	Gillnet Demersal longline
Western Australian Shark Fishery (Fisheries WA)	Spot-tail sharks Blacktip sharks	Shark species common to this fishery and the SWTBF are sandbar sharks and hammerhead species.	Gillnet Dropline
Western Australian Pilchard Fishery (Fisheries WA)	Pilchard Scaly mackerel	The SWTBF permits operators to catch bait for their own use. Currently very few operators catch their own bait. Quotas in several of the zones in the Fishery have been set very low (some at zero) in response to 1998/99 mortality event.	Purse seine
South Australian Pilchard Fishery (PIRSA)	Pilchard	The pilchard fishery consists of 14 marine scale fishers. The fleet is based mainly around the Port Lincoln area. The TACC for 2001/2002 has been set at 17,750 tonnes.	Purse seine

Commonwealth fisheries that currently operate in the same region as the WTBF include

- Southern Bluefin Tuna Fishery
- Southern Shark Fishery (will become part of GHAT Fishery)
- Western Deepwater and North West Slope Trawl Fisheries.

The skipjack fishery when managed separately will also overlap with the WTBF.

Christmas and Cocos (Keeling) Islands inshore and offshore tuna and billfish fisheries
Overlap with the Christmas and Cocos (Keeling) Islands inshore and offshore tuna and billfish fisheries is also likely.

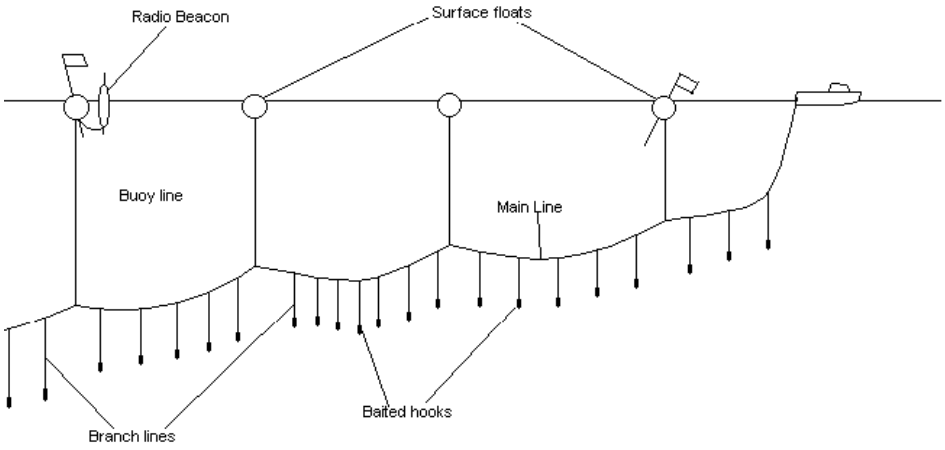
The WTBF abuts the Christmas and Cocos (Keeling) Islands inshore fishery (within 12nm). Operators in the inshore fishery may take small amounts of tuna and billfish. The inshore fishery is managed by the Department of Transport and Regional Services (DOTARS). DOTARs has in place a Service Delivery Arrangements with the Western Australian Department of Fisheries to deliver procedural and technical advice in relation to the management of fish resources within 12 nautical miles (A. de Fries, June 2004).

Both the Inshore and Offshore tuna and billfish fisheries target tuna and billfish resources that are thought to form part of broader Indian stocks being exploited by other countries Access to the Christmas Island Inshore Fishery is limited to five operators, all of whom have an entitlement to use pelagic longline and minor line (pole, rod and reel, and troll) gear to target various tuna and reef species, excluding billfish and southern bluefin tuna. Fishing Permits provide access to waters inside 12 nautical miles and limit the annual landing to three tonnes, in aggregate, of specific species. Fishing Permits are granted for a five year period and are fully transferable. A maximum of 250 hooks may be set by pelagic longline at any one time and tori pole apparatus must be used at all times.

The Offshore Tuna Fishing Program provides access for up to six operators - four off Christmas Island and two off the Cocos (Keeling) Islands. The three year Fishing Program, now entering its second year, is aimed at controlling the rate of access to the region while

	information is collected on the interactions between commercial fishing operations and non-target species, primarily two seabirds endemic to Christmas Island that are listed in the EPBC Act. Fishing Permits provide access to Australian Fishing Zone waters adjacent to either Island, outside 12 nautical miles. A series of gear and area restrictions apply and an Observer Program has been implemented requiring a minimum of 30 percent coverage. Fishing Permits are non-transferable and no indication of ongoing access, beyond the three-year period, has been provided. After the third year of the Program has been completed, AFMA will undertake a broad assessment of the Fishery focusing on, among other things, the sustainability of non-target species, to determine the viability of ongoing fishing activity in the region. The WTBF MAC provides the principal forum in which matters relating to the management of the Christmas and Cocos (Keeling) Islands Inshore and Offshore tuna and billfish fisheries are considered. Management arrangements are developed in close consultation with Parks North Australia and Environment Australia, through the Christmas and Cocos Island Marine Consultative Committees, given the unique conservation values of the region (Source: Bycatch action plan) International fisheries Species covered under the Draft Plan and many of the bycatch species encountered in the WTBF are migratory and range widely throughout the Indian Ocean and to a lesser extent into the temperate waters of the Southern Ocean. Artisanal fisheries account for a large proportion of the total Indian Ocean catch (40-50%). The remainders are either large-scale industrial fleets based mainly throughout the high seas or EEZ based export fisheries. Longline and purse-seine fisheries are the two major industrial fisheries of the Indian Ocean. Australia as a signatory to the United Nations Fish Stocks Agreement (UNFSA) supports the cooperative management of shared resources and is a member of the Indian Ocean Tuna Commission (IOTC). The IOTC is responsible for developing management arrangements for tuna and billfish in the exclusive economic zones of member countries and adjacent high seas. Indeed, the IOTC has jurisdiction for 16 tuna species, billfish and tuna-like species (see list of species at www.iotc.org) Larcombe *et al* (1997) note that, although stock structure and movement patterns of tuna and billfish are unclear in the Indian Ocean, it is reasonable to assume that nearby tuna fisheries are likely to have the greatest potential effect on availability of fish to the WTBF in the short term. These include the large Indonesian longline fishery and the distant-water fishing fleets of Japan, Taiwan and Korea, which operate just west of the AFZ. Tuna catches in the Indian Ocean have increased rapidly and attained 1.2 million tonnes in 1999 and the total billfish catches reached 80,000 tonnes in the same year. In 1999 the total Indian Ocean catch of yellowfin tuna was 329,000 t, bigeye tuna 147,000 t and skipjack 404,000 t (updated catches from IOTC databases for tropical tunas WPTT-02-01). In 1999 the total Indian Ocean catch for broadbill swordfish was 36,000 (rounded figure from Campbell et al “Review of information pertinent to setting of a TAC in WTBF, June 2002). The WTBF catch of all species in 2001 was less than 3,500 tonnes. France and Spain maintain large purse seine fleets that operate mainly in the Western Indian Ocean and north of Seychelles where they catch large quantities of yellowfin and skipjack tuna and smaller quantities of bigeye tuna. Purse seiners tend to shoot their nets around logs or Fish Aggregating Devices (FADs) that attract and hold schools of tuna and other pelagic fish. This increases the efficiency of purse seine operations however as a result significant numbers of juvenile bigeye are also caught (bigeye tuna are caught in small quantities in free sets11). Scientists have raised concerns in the IOTC that this level of juvenile mortality has been a major contributing factor to bigeye tuna potentially being over fished. Indonesia, Japan, Korea and Taiwan maintain longline fleets that fish the entire Indian Ocean and target mainly bigeye, yellowfin, albacore and southern bluefin tuna. Indonesia maintains

	by far the largest of these longline fleets. Many of the coastal states in the Indian Ocean and many of the major distant water fishing nations, except Taiwan, are members of the IOTC. The IOTC is an FAO organisation and therefore cannot extend membership to Taiwan. The Commission is however working closely with Taiwan and the People's Republic of China so that it can engage to the greatest extent possible with Taiwanese scientists, industry and administrators. Indonesia and the Maldives are not currently members of the IOTC and both take very large catches of tuna and tuna like species. The Indonesian longline fleet has grown rapidly since the early 1990s and is based along the western coasts of Sumatra, Java, Bali and Nus Tenggara. The Indonesian fleet targets mainly yellowfin tuna and bigeye tuna. The Maldives is home to a large artisanal tuna fishery in which approximately 90,000 tonnes of skipjack and 10,000 tonnes of yellowfin tuna are caught by pole and line annually. **Recreational fisheries** Game fishing in Western Australia began, on a regulated basis, by members of the Big Game & Rod Fishers Association circa 1919. This body represented Western Australian game fishers at the inaugural meeting of the Game Fishing Association of Australia in 1938. During the 1920s there were purpose built recreational fishing boats used for fishing for 'tunny' tuna species. Recreational fishing in offshore waters slowed during the Second World War as the RAN commandeered the larger boats and little fuel was available. In 1949 the Game Fishing Association of Western Australia was formed and later changed its name to the Perth Game Fishing Club. Members targeted various species of tuna around Rottnest Island off Fremantle and in the waters beyond. It was some years later that "white" (likely striped) marlin were reported as being sighted and ultimately caught. Other recreational fishers were also targeting game species in other areas that are now part of the WTBF's area of waters. An example is Roughley's Fisheries of Australia (1953) that reported angling for big tuna being established off Albany. The Australian recreational sector has grown considerably, particularly with the advent of trailer boats capable of fishing safely some distance offshore. Many anglers who fish for tunas and billfish, sharks and other gamefish belong to fishing clubs. There are now 14 game fishing clubs in Western Australia, and five each in South Australia and the Northern Territory that are affiliated with the Game Fishing Association of Australia (GFAA). Game fishers target the following species, which are also caught by the commercial sector: • Tunas: yellowfin, southern bluefin, albacore, mackerel, skipjack and to a lesser extent bigeye. • Billfish: black marlin, blue marlin, striped marlin, sailfish and to a lesser extent broadbills wordfish. • Sharks: shortfin mako, blue whaler and dusky whaler sharks • Others: dolphinfish, wahoo and bonito Most fish caught are tagged and released. NSW Fisheries coordinates the game fish tagging program across Australia. Game fishing clubs in Perth and Busselton have, with the assistance of sponsors, organized the placement of several FADs. Currently there are six FADs extending from 31º50'S to 33º36'S in waters ranging from 140 to 220m deep. These aggregate pelagic fish and assist recreational anglers to focus a search for fish. There are no consolidated records of recreational catches and therefore no accurate estimate of the commercial catch. The day-to-day management of recreational fishing is the responsibility of the states and territories. Attachment 5 has a list of the legal length and bag/boat limit restrictions in place for species that are frequently caught in the WTBF. AFMA Draft Assessment for WTBF July 2003
Gear	
Fishing gear and methods	*Description of the methods and gear in the fishery, average number days at sea per trip.*

	Pelagic longlining is the dominant method in the WTBF and is mostly undertaken in waters beyond the continental shelf break (~ 200m isobath). Currently most domestic longliners in the WTBF use dead bait (99% of longline sets). Squid is the dominant bait used (>90%) with blue mackerel (3%) and pilchards (2%) constituting most of the remainder. Some domestic fishers attach chemical light sticks to selected branchlines when targeting broadbill swordfish. Live bait was reported used on 1% of shots, with blue mackerel and yellowtail scad being the species used. Pelagic longlines are set near the surface of the water. Longlines can be many kilometres long and carry thousands of hooks. Baited hooks are attached to the longline by short lines called snoods that hang off the mainline. Pelagic longlines are not anchored and are set to drift near the surface of the ocean with a radio beacon attached so that the vessel can track them to haul in the catch. Pelagic longlines are usually used to catch large tuna and billfish species. Pelagic longline fishing involves use of a mainline to which are attached branch lines, each fitted with one or more, baited hooks pr artificial lures. The longline is set in the sea in such a manner that the mainline, branch lines, and hooks are suspended above the sea bed by floats at the sea surface. Longlines are deployed from the vessels and radio beacons are used to locate the gear after a period of time.  Trips are generally at least three to seven days, although since the late 1990s, trips of seven to 20 days have become common for longliners targeting bigeye and swordfish in offshore grounds with the advent of larger capacity vessels.
Fishing gear restrictions	*Any restrictions on gear* Since 1995 pelagic longline vessels required to deploy tori pole and line (bird scaring line) when setting ;onglines south of 30^{O} Regulations implemented Feb 2001 under Fisheries management act 1991 to meet requirements of TAP.Regulations require all longliners to: • Carry tori pole when fishing waters south of latitude 30^{O} to attach the line where baits enter the water • Ensure no offal is discharged when longlines being set and where possible when longlines being hauled • Operating in waters south of 30^{O} to set lines at night • To use only thawed bait • Use of wire traces is banned The requirement on fishers is to not discard lightsticks (BRS 2004)
Selectivity of gear and fishing	*Description of the selectivity of the sub-fishery methods* In comparison to many other fishing methods, pelagic longlining is considered relatively selective. A lower diversity of species that are susceptible to longline gear are found in the

methods	water column in comparison to the range of species that may be impacted on by other methods of fishing such as demersal trawling. The species and size selectivity of the longline gear is dependent on a number of factors such as: • horizontal and vertical distribution of the gear • bait used • hook and other gear design However, BRS (2004) Scientific Monitoring of longline fishing of WA report bycatch species outnumbered commercial target species.
Spatial gear zone set	*Description where gear set i.e. continental shelf, shelf break, continental slope (range nautical miles from shore)* Pelagic longlining is the dominant method in the WTBF and is mostly undertaken in waters beyond the continental shelf break (~ 200m isobath). AFMA Draft assessment report for WTBF 2003
Depth range gear set	*Depth range gear set at in metres* 30-200 m from the surface, the bottom may be much deeper
How gear set	*Description how set, pelagic in water column, benthic set (weighted) on seabed* Pelagic longlines are set near the surface of the water. Longlines can be many kilometres long and carry thousands of hooks. Baited hooks are attached to the longline by short lines called snoods that hang off the mainline. Pelagic longlines are not anchored and are set to drift near the surface of the ocean with a radio beacon attached so that the vessel can track them to haul in the catch.
Area of gear impact per set or shot	*Description of area impacted by gear per set (square metres)* Pelagic set, so whilst in the water area covered is large, but once retrieved from water column no impact remains
Capacity of gear	*Description number hooks per set, net size weight per trawl shot* Most Australian pelagic longline vessels are between 15 and 40 m long and set between 200 and 1200 hooks per fishing operation. Some longliners now routinely set more that 1200 hooks per day. Some longliners fish around seamounts while others range up to 500 nautical miles from port in search of target species. Australian longliners store their catch on ice, in ice slurry, brine or use brine spray systems, which limits the time at sea vessels can spend.
Effort per annum all boats	*Description effort per annum of all boats in fishery by shots or sets and hooks, d for all boats* See **Current and recent fishery effort trends by method** above
Lost gear and ghost fishing	*Description of how gear is lost, whether lost gear is retrieved, and what happens to gear that is not retrieve, and impacts of ghost fishing* Radio beacons are used to locate the gear for hauling. However, some gear or parts of line may break free. If gear lost then it may drift for a while before balling up, baits usually fall off.
Issues	
Target species issues	*List any issues, including biological information such as spawning season and spawning location, major uncertainties about biology* BRS (2004) raised some issues on the status of some species, bigeye tuna is not classified as overfished but over-fishing is likely occurring, particularly in western Indian ocean. Yellow fin tuna 2004 this species is probably only moderatley fished in and adjacent to the WTBF, but the status is uncertain in western Indian Ocean. Broadbill swordfish; this species is fully fished in Indian Ocean and the WTBF, and that it should be monitored closely in the WTBF for localised depletion associated with intensive fishing. Information from modified version 22 July 2004 The WTBF is a multi-species and multi-method fishery. Fishing targets tuna and tuna-like species. The primary species taken in the fishery are listed at Schedule 2 of the Draft Plan.

Operators are permitted to target tuna and tuna like species, billfish of the families Istiophoridae and Xiphiidae and members of the family Bramidae. Pelagic longliners currently target broadbill swordfish, bigeye tuna and yellowfin tuna. Three other tuna species (excluding southern bluefin tuna) have been targeted by other domestic gear sectors in the area of waters of the WTBF:

- albacore *Thunnus alalunga* (trolling and pole and line in the GAB)
- longtail tuna *Thunnus tonggol* (minor line Western Australia and Northern Territory)
- skipjack tuna *Katsuwonus pelamis* (purse seine in the GAB)

Summary of issues

Based on logbook data and Japanese longline fishery and observer data, there is a partial understanding of the distribution and spatial structure of target and byproduct stocks, however, future work on stock structure is required. Assessments undertaken by the IOTC have provided estimates of the potential productivity of the fished stocks of bigeye tuna and yellowfin tuna, however, these will require further refinement to ensure that they provide sound estimates of the productivity of these stocks.

Current management arrangements for the fishery do not include defined reference points for any species. Under the Draft, precautionary reference points will be defined for the fishery. A precautionary level of removals for each target species will be identified and management measures put in place to ensure that catch levels are within these levels.

The IOTC WPTT meeting expressed concern about increasing pressure on juvenile yellowfin by purse-seine fishing on FADs. Large purse-seine catches of juvenile bigeye tuna around fish aggregating devices in the western Indian Ocean are a concern. The broadbill fishery is growing rapidly; as a result it may be difficult to detect overfishing in time to take management action.

The level of mixing of yellowfin and bigeye tuna and broadbill swordfish between the Eastern and Western fisheries remains unknown. However, information on habitat preferences (ie. preferred water temperatures, etc) and the distribution of catches would indicate that the level of mixing of yellowfin and bigeye tuna across southern Australia is likely to be quite small if not negligible. Broadbill swordfish on the other hand, are caught right across southern Australia and the level of mixing for this species may be higher. Genetic studies failed to find significant differences between eastern and western populations of broadbill swordfish.

Bigeye tuna: The origin of bigeye recruits to the western AFZ is unknown, nor is there a specific bigeye assessment for the WTBF. It is unlikely that WTBF bigeye represents a separate stock but there could be some level of isolation from the broader Indian Ocean resource (Extract from the BRS 2000/01 Status Report (Caton, 2002))

Yellowfin tuna

Assessment of yellowfin tuna: There is little data on Indian Ocean yellowfin tuna stock structure and the level of mixing between WTBF and the broader region.

Broadbill swordfish

There is no formal stock assessment of the Indian Ocean broadbill swordfish. The BRS Status Report 2000/01 (2002) states: *In the WTBF, the status of swordfish resource is uncertain. The impact of domestic catch increases will depend on stock structure and the mixing rates between the wider Indian Ocean fishery and the WTBF. If, for example, the swordfish harvested in the WTBF are predominantly local stock, catch rates might decline as the accumulated biomass is fished. However, a similar trend could be anticipated were the stock a common one and broader Indian Ocean catches unsustainable. An additional complication is that in either case a decline in availability may be difficult to identify from catch rates alone because of increasing fishing efficiency as larger vessels join the fleet and as fishers gain experience and develop skills in targeting western AFZ swordfish. Changes in*

	the size composition of the catch may provide an alternative indicator of stock status. Age and growth of broadbill swordfish (*Xiphias gladius*) from Australian waters (FRDC Project No. 2000/005) is currently under way to investigate age validation from five age classes of broadbill swordfish and estimates of mean size-at-age for male and female fish. The results from this study will assist in stock assessments for the WTBF broadbill swordfish. An operational model for the broadbill swordfish fishery off eastern Australia has been developed to evaluate indicators and reference points for the fishery (Punt et al., 2001) and a similar tool may be useful for evaluation of the WTBF swordfish fishery. <u>Albacore tuna</u> There has been no stock assessment of albacore tuna for the WTBF. The BRS Fishery Status Report 2000/01 (Caton, 2002) documents that the status of albacore tuna is uncertain in the Southern and Western AFZ, and is moderately fished in the Indian Ocean. <u>Striped marlin</u> There has been no formal stock assessment of striped marlin in the WTBF or Indian Ocean.
Byproduct and bycatch issues and interactions	*List any issues, as for the target species above* The Dusky shark is considered at risk by McAuley and Thomas (2005). As Ward and Curren BRS (Nov 2004) explain this species is also caught by State WA fishery and there is concern over additional pressure, they suggest that more monitoring is required to obtain accurate estimates of shark catches in coastal waters further south. Fish base highly migratory species, resilience very low, minimum population doubling time more than 14 years, Red list lower risk near threatened. The Blue shark is considered at risk because of the high numbers caught. The WTBF Data summaries for 2002 and 2003 report high bycatch numbers. For 2002 1,613 retained and 32,210 not retained; 2003 1,859 were retained and 21,517not retained. Ward and Curren (Nov 2004) results from the scientific monitoring of longline fishing off W. A report blue shark as the largest catch of all species exceeding those of commercially targeted species. For those not retained 5% were dead, 25% alive and sluggish, 70% alive and vigorous, however survival after release will vary with the animals condition. Fishbase distribution circumglobal, resilience very low, minimum population doubling time more than 14 years, sexually mature at 250cm and 4-5 years, gives birth up to 80 young, gestation lasts almost a year, Red list lower risk near threatened. The Crocodile shark is considered at risk because of high numbers caught. The WTBF Data summaries for 2002 and 2003 report high bycatches. For 2002 426 retained and 2,855 not retained; 2003 none were retained and 10,036 not retained. Ward and Curren (Nov 2004) results from the scientific monitoring of longline fishing off WA report crocodile sharks as the third largest catch of all species caught, with none retained. For those retained about 50% were released alive and vigourous, 25% alive and sluggish, and the other 25% dead. These species have low productivity and are believed to be extremely slow growing. Whilst this species is found worldwide, they recommend that more information is needed from the Australian fishery and the broader Indican Ocean to determine whether they are vulnerable to current levels of fishing. Fishbase distribution: tropical and subtropical water of all oceans, resilience very low, minimum population doubling time more than 14 years, 4 young in a litter, Red list lower risk near threatened. Information from modified version 22 July 2004 Any species of fish, other than primary species, that may lawfully be taken in the area of the fishery and retained. Other species (secondary species) may also be lawfully taken in the fishery when fishing for primary species. Most non-target species taken in the WTBF are caught as a result of pelagic longlining

activity. Lynch (2002) reports that 78% of the total catch in the fishery in 2002 was taken by the longlining method. In Australian tuna fisheries using minor line, purse seine and pole and line gear are highly selective methods and industry and scientists have reported that levels of bycatch with these methods are very low. The *Australian Tuna and Billfish Fisheries Bycatch Action Plan 2001* has therefore concentrated on addressing bycatch issues associated with pelagic longlining.

There are two significant sources of data on longline bycatch for the WTBF:

1. Logbook data for both:
    - licensed Japanese operations (1979 to 1997); and
    - the domestic fleet.
2. Observer data for 5.5% of the Japanese longlining operations.

Logbook data from Japanese vessels for most years has limited information on byproduct (non-target species were lumped together as 'Other'). Domestic logbooks provide more detail and the current version, the AL05, has extensive fields for recording of bycatch, discards and interactions with protected species. It is important to note that Japanese fishing activity does not necessarily reflect current activity in the WTBF, however, data collected from Japanese fishing activity can be used to identify potential bycatch species and areas in which bycatch may be caught in the WTBF.

Byproduct species

Byproduct refers to any part of the catch which is kept or sold by the fisher but which is not the target species. Many of the species taken in the WTBF are utilised as byproduct; however, some of the species taken are either unsuitable as commercial species or are taken in numbers too small to warrant the development of markets. Some of the management arrangements in place in the current domestic fishery influence fisher's discarding practices. Since October 2000 six species have contributed to 94% of the byproduct landed by domestic vessels in the WTBF. In 2001 approximately 173 tonnes of byproduct species were reported landed.

Management of those byproduct species under state or territory jurisdiction, as a result of the Offshore Constitutional Settlements (OCS), uses a mix of species specific or 'pooled species' trip limits. These limits are designed to reduce the incentive for vessels to target these species which in some cases are target species for state managed fisheries and/or by recreational fishers.

The Draft Plan includes management measures for those byproduct species that are under Commonwealth jurisdiction (tuna and tuna like species, billfish and Bramidae) exclusively. The Draft Plan lists primary species in Part 1 of Schedule 2 and includes secondary species in Part 2. When commercial interest in any of these secondary species becomes evident and catches begin to increase significantly they will be moved into the quota management system. More routine stock assessment (refer to Guideline 2.1.3) will be undertaken for species under the quota system. Estimated retained whole weight by percentage for the byproduct species in the WTBF from the domestic fleet (AL05 logbook data) are:

- Rudderfish 86 tonnes 38%
- Blue whaler shark 45 tonnes 19%
- Escolar 39 tonnes 17%
- Dolphinfish 20 tonnes 9%
- Shortfin mako 10 tonnes 4%
- Oilfish 8 tonnes 3%
- Moonfish 5 tonnes 2%
- Wahoo 4 tonnes 2%
- Other 15 tonnes 6%

Bycatch species

There is information available on the composition and abundance of bycatch species taken in

	the fishery however the level of verified data for the fishery is limited. An indicator group of bycatch species has not been identified for the fishery, nor have ecosystem indicators been identified. The observer data is validated data and is the best indication of the bycatch likely to occur in the WTBF. Observers recorded 46 species of fish in the Japanese longline catch from 1991 to 1997 (refer to Table 2). This measure of diversity is conservative because not all observers were trained to identify some species of whaler sharks to species level. Consequently the relative abundance of bronze, dusky, sandbar and silky sharks in the Japanese catch is unclear. Observed catch composition (based on numbers of individuals observed caught) from Japanese longlining in the WTBF (1992-1997): • Tuna and tuna-like species 50% • Sharks 32% • Fish 11% • Billfish 5% • Seabirds 2% Oceanic species of sharks are a common bycatch taken mainly during longline and minor line fishing operations in Australia's tuna and billfish fisheries. A number of species of sharks are taken, however logbook data indicates that blue whaler (83%), oceanic whitetip (4%) crocodile (3%), mako (3%) and dusky sharks (1.5%) are the major species caught by longline fishers in the WTBF. Department of Fisheries Western Australia (DoFWA) has indicated that dusky shark stocks in Western Australia are overfished and that additional mortality of adults as a result of pelagic longlining is a concern. Catches of inshore whaler shark species are not a large part of the bycatch in the WTBF however some of these species have long life cycles, delayed sexual maturity, low fecundity and long gestation periods which make them vulnerable to fishing pressure. In particular, DoFWA, have stated that (Draft Case Study Comments, July 2004); • Many coastal sharks were caught in the WTBF in the mid- to late 1990s. • Records of these catches are not reliable. • The fate of released/escaped sharks remains unknown, but some level of post-release mortality is likely. • Dusky shark stocks in Western Australia are currently considered to be over-exploited, a status that has arisen due to increases in mortality of breeding age animals from a variety of sources, including the WTBF. • Recent discussions between AFMA, the WTBF representatives and the Department of Fisheries have indicated that shelf break continues to be an area that the fleet would target effort. The distribution of adult dusky sharks is known to extend beyond the shelf break; as such, ongoing bycatch of dusky sharks will occur in the WTBF. DoFWA is also concerned because considerable effort in WTBF during the mid- late-1990s occurred near the shelf edge and on the shelf there is likely to have been regular bycatch of inshore whalers. The absence of any independent recording of retained bycatch of dusky sharks during this period does not mean it did not occur. Better recording of shark bycatch has occurred in recent years (separation of bronze whalers and dusky sharks). Nonetheless, breaches of the shark regulations within the WTBF highlight the fact that reporting of shark bycatch may be highly inaccurate. Therefore, it is not entirely correct to state that catches of inshore whalers are low. Catches are suspected to have been relatively high in terms of what levels of exploitation could be withstood by the dusky stock, and this concern was sufficient for a pilot observer program to be instigated. While this program looks at all types of bycatch, the importance of shark as an issue can be seen by the fact that the responsibility for organizing the at-sea observes was undertaken through the Department's shark research team. Given that significant numbers of adult dusky shark and other inshore whaler sharks have already been killed by the WTBF, even small levels of mortality should be avoided by the WTBF. DoFWA is sufficiently concerned about the poor status of dusky shark stocks to

	be moving towards stopping the take of ALL adult dusky sharks in state-managed fisheries by imposing an upper size limit and introducing further gear restrictions (DoFWA, July 2004). It will be mandatory (either as a condition on SFRs or Direction) that fishers wishing to retain sharks must land carcasses with fins intact (finning at sea is banned). In October 2000 the Federal Minister for Agriculture, Fisheries and Forestry announced a new Commonwealth government policy to ban the practice of shark finning at sea in all Commonwealth tuna fisheries. AFMA placed conditions on fishing permits preventing all Commonwealth tuna and billfish fishery operators from removing the fins from a shark at sea prior to it being landed in port (Anthony de Fries, May 17, 2004). In addition there is currently a generic 20-shark bycatch trip limit for the fishery and wire traces are banned from use on longlines. AFMA amended longline permits as of 19 September 2001 to prohibit the use of wire traces.
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.* Before discussing the TEP species, it is important to review briefly the observer data that are available for the fishery, and their adequacy in assessing risk to bycatch and particularly TEP species. The main period of observer coverage for the fishery was from April 2003 to June 2004, when BRS ran a pilot observer program that covered about 4% of the effort during that period. Observations were primarily in the western part of the fishery (solely off WA). Observers reported on 46 species of target, byproduct and bycatch species caught, as well as on interactions with marine wildlife. Since that pilot observer study finished, there have been only a handful of trips with observers aboard, and data from these trips are not yet available. The annual Data Summaries produced for the fishery contain summarized information on wildlife interactions, but the taxonomic resolution is broad (often just undifferentiated marine birds or mammals), and there has been no (reported) detailed analysis of observer data. Seabirds: In the data summaries for the period 1998-2002, marine birds captured included undifferentiated albatross (5 alive, 4 dead, 1 unknown), mutton birds (4 alive, 1 dead) and other seabirds (6 alive, 3 dead, 1 unknown). Ward and Curren (2004) reported that seabirds such as shearwaters, petrels and albatross often followed the vessels as they retrieved longlines. Shearwaters were occasionally snagged in branch lines during hauling. However, reports indicated that most escaped or were released unharmed. No seabirds were reported killed during the period of that study. Marine mammals: Small whales and dolphins could probably get caught. As a group, for the period 1998-2002, 1 undifferentiated whale was caught alive, and 4 undifferentiated seals were caught alive. Whales in the Balaenidae and Balaenopteridae families are plankton feeders so are not likely to be attracted to the bait. Discussions at a MAC meeting on 9th August 2005 suggested that some whales are likely to scavenge bait off hooks, but there have been no reports of entanglements, and most species caught would be likely to break the line. Dolphins were reported as rarely caught. Tutrtles as a group, for the period 1998-2002 (Data Summary 2002), 37 undifferentiated turtles were caught alive, and 3 dead; 66 leatherback turtles were caught alive, 1 dead, 1 unknown; 5 loggerhead turtles were caught alive. Ward and Curren (2004) report 5 turtles (2 leatherback, 2 loggerhead and 1 Olive Ridley) caught and all were released alive. There is insufficient information currently available to determine the species composition of turtle bycatch and verify catch levels in the WTBF. Caton (2002) states that expansion of shallow line sets targeting swordfish has increased the potential for interactions with turtles. The survival of turtles released alive is unknown although anecdotal information suggests that if handled correctly they may have high levels of post-capture survival. *The Australian Tuna*

	Fisheries Bycatch Action Plan 2001 includes action specifically aimed at improving identification, care and release of hooked turtles (page 104).Research: Robins et al (2002) completed the project "*Bycatch of sea turtles in longline fisheries"* for which AFMA and industry provided data. Information from modified version 22 July 2004 Under the Draft Plan AFMA must develop and implement a bycatch action plan for the fishery taking into account the protection given to whales and other cetaceans under the Division 3 of Part 13 of the EPBC Act and; • Requirements under the EPBC Act for the protection of: • Threatened species listed for section 178 of the EPBC Act • Migratory species listed at section 209 of the EPBC Act • Marine species listed for section 248 of the EPBC Act In addition the Draft Plan sets obligations on SFR and permit holders to take all reasonable steps to avoid interactions with species listed at sections 248, 209, 181 and 178 of the EPBC Act. This includes: • Cetaceans • Listed marine species • Listed migratory species • Listed threatened ecological communities • Listed threatened species. There is limited verified data available on the fishery's interactions with TEP species. The pilot observer program will address the need for verified data collection on interactions with these species. The observer program will provide independently verified data about endangered, threatened and protected species in the WTBF. If interactions occur, the fisher is required to record details of the interaction in a logbook, inform and assist observers (if present) with data collection and sampling, assist where necessary an injured member of the species or community that resulted from the interaction, and report, in accordance with regulations, any deaths of members of the species or community that resulted from the interaction. To date the main focus of the impacts of longline fishing on non-target species has been on protected species which may be caught on longlines–seabirds and turtles; and some shark species, whose life history make their populations vulnerable to overfishing. <u>Turtles</u> Data collected on turtles through the Logbook Program indicates that there are some interactions between longliners and turtles in the area of the WTBF. Similarly, data collected by observers on Japanese vessels operating in the AFZ indicates a low level of interaction. There may be an ongoing risk to the risk to the status of some species. In particular, the status of loggerhead turtles and leatherback turtles is such that very low levels of take and subsequent mortality may pose a risk to these populations. There is insufficient information currently available to determine the species composition of turtle bycatch and verify catch levels in the WTBF. However, BRS (Caton, 2002) states that the expansion of shallow line sets targeting swordfish has increased the potential for interaction with sea turtles. The likelihood of survival of released turtles is also unknown although anecdotal information suggests that turtles, handled correctly, may have high levels of post-release survival. Available information on sea turtle bycatch recorded in tuna longline fishery logbooks has recently been assessed by AFMA. Although available information suggests that bycatch of sea turtles is at a low level, it may pose an ongoing risk and further monitoring is required. There is insufficient information currently available to determine the species composition of

	turtle catch and to verify catch levels. The Bureau of Rural Sciences (BRS), the University of Wollongong and AFMA have completed a report entitled *Bycatch of Sea Turtles in Pelagic Longline Fisheries – Australia* (Robins *et al*, 2002). AFMA will consider the recommendations of the project and the implementation of any suggested measures. <u>Seabirds</u> Data from observed Japanese longlining operations and domestic logbooks indicate that seabird bycatch is an issue in the waters south of latitude 30ºS in the WTBF (an estimated 2% of the catch recorded by Japanese Observers was seabirds). Because of the difficulties involved with identifying seabirds drowned on longlines observers were instructed to retain dead birds for identification by the Tasmanian Parks and Wildlife Service. The incidental catch of seabirds during oceanic longline fishing operations is listed as a key threatening process under the EPBC Act. Data from observed Japanese longlining operations and domestic logbooks indicate that seabird bycatch is an issue in the waters south of latitude 30o in the WTBF. AFMA has implemented a range of mitigation measures in line with actions under of the *Longline Fishing Threat Abatement Plan.* These measures and other seabird mitigation strategies are described in more detail against Guideline 2.2.4. The current level of catch is currently not known. While there has been very limited observations on domestic longliners in the WTBF (two trips with one seabird observed recovered from a hook; Brothers et al 1999), experiences in other longline fisheries and the rapid expansion of fishing effort in the west since 1999 indicates a need for increased observing effort under the Threat Abatement Plan (TAP). <u>Marine mammals</u> All marine mammals are protected under the EPBC Act. Observer data from Japanese longlining operations and domestic logbooks indicate that the level of marine mammal entanglement in tuna fishing gear is very low. The primary source of interactions with longline fishing activities appears be cetaceans eating fish caught on longlines. Observers on Japanese boats fishing off north-western Western Australia reported that on some shots most of the target species caught on the longlines had been bitten off cleanly behind the head by marine mammals (shark damage by comparison leaves a ragged edge). Marine mammals are considered to be at a low risk of entanglement with fishing gear and the actions in the *Australian Tuna and Billfish Fisheries Bycatch Action Plan 2001* therefore focus on identifying the level of interaction in Australia's tuna and billfish fisheries. The *Australian Tuna and Billfish Fisheries Bycatch Action Plan 2001* identifies actions to minimise the likelihood of interactions. Research is being undertaken to to find ways of reducing losses to cetaceans as well as the likelihood of hookups or entanglements. The industry (WTBF, ETBF and AFMA) contributed funds to a study on losses of catch off longlines to cetaceans. R02/0923 Acoustic source tracking system, Alternative mammal tracking systems, Coral Sea toothed whale signals, Diet and feeding behaviour of toothed whale species http://www.afma.gov.au/services/research/reports/r02_0923/default.php FRDC is now funding the second phase of this project which is looking at ways to reduce these impacts: FRDC 2003/016 Reduction of toothed whale interactions with fishing gear: development and assessment of predation mitigation devices around longlines. Principal Investigator Geoff McPherson, Department of Primary Industries Queensland. <u>Sharks</u> Whale sharks, great white sharks and grey nurse sharks are protected species. Logbook and anecdotal information collected to date indicates only a single interaction with these species in the WTBF; a great white shark caught and released by a longliner. Should the data collection program provide significant evidence to indicate that the fishery does interact with

these sharks, AFMA will develop mitigation measures as appropriate.

Table 15: Interactions with no-take species (numbers) in the western sector from 1998 to 2002.

		1998	1999	2000	2001	2002
Black Marlin	Retained	0	0	0	0	0
	Discarded	0	0	2	35	72
Blue Marlin	Retained	0	0	0	0	0
	Discarded	0	0	6	113	65
Striped Marlin	Retained	254	670	39	4	24
	Discarded	19	91	248	301	352
Great White Shark	Retained	0	0	0	0	0
	Discarded	0	0	1	0	0
Grey Nurse Shark	Retained	0	0	0	0	0
	Discarded	0	1	0	0	0
ANNUAL TOTAL		**273**	**762**	**296**	**453**	**513**

Table 16: Interactions with no-take species (numbers) in the southern sector from 1998 to 2002.

		1998	1999	2000	2001	2002
Black Marlin	Retained	0	0	0	0	0
	Discarded	0	0	0	0	4
Blue Marlin	Retained	0	0	0	0	0
	Discarded	0	0	0	1	2
Striped Marlin	Retained	0	1	0	0	0
	Discarded	0	4	16	2	0
Great White Shark	Retained	0	0	0	0	0
	Discarded	0	0	0	0	0
Grey Nurse Shark	Retained	0	0	0	0	0
	Discarded	0	0	0	0	0
ANNUAL TOTAL		**0**	**5**	**16**	**3**	**6**

Data Summary 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*

There are no known habitat issues for this fishery.

Community issues and interactions

*List any issues for any of the community units identified in **Scoping Document S1.2**.*

No major issues. However, sustainability of fishing level on apex predators important to lower trophic levels.

AFMA considers that the impact of the fishery is largely confined to the pelagic ecosystems inhabited by tuna and billfish species as well as seabirds, marine mammals and sea turtles. The impacts take the form of direct and indirect mortality on species caught on the fishing gear, trophic impacts and impacts on ecologically related species.

Discarding

Summary of discarding practices by sub-fishery, including bycatch, juveniles of target species, high-grading, processing at sea.

Discarding species due to high grading and damage by sharks or marine mammals, and discarding byproduct species of low value or lack of markets, occurs. Species of concern are dusky shark, Blue shark, and crocodile shark see **Byproduct and bycatch issues and interactions** above.

AFMA WTBF Data summary 2002: Discards refer to fish that have been released alive, or

are not kept regardless of there life status because they have no commercial value or cannot be landed due to management restrictions on their take or sale. This may include target species that have been damaged by sharks or whales and are subsequently discarded. The discard rate for the main target species appears to be relatively stable (figure 7). Bigeye have the highest discard rate of the target species with about one fifth of bigeye caught being discarded, while over four fifths of non-target catch is discarded

Table 8: Total discard rate in the pelagic longline sector of the WTBF between 1998 to 2002.

	1998	1999	2000	2001	2002	
Swordfish	4.3	4.6	4.6	6.2	7.2	
Bigeye	8.0	10.7	15.3	20.2	17.4	
Yellowfin	8.5	3.6	12.2	9.7	11.5	
Albacore	10.7	18.0	39.0	15.0	20.0	
Skipjack	11.1	30.9	71.2	62.5	37.5	
Other	19.9	53.0	68.5	80.5	84.5	

Note: Discard rate is the number of fish not kept as a percentage of fish that were retained eg. if 100 fish were retained and 10 were discarded the discard rate would be 10%.

Management: planned and those implemented

Management Objectives

The management objectives from the most recent management plan

5 Objectives (Act s 17 (5)) WTBF management plan 2005

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

(a) to manage the fishery efficiently and cost-effectively for the Commonwealth;

(b)to ensure that the exploitation of the resources of the fishery and the carrying on of any related activities are conducted in a manner consistent with the principles of ecologically sustainable development and the exercise of the precautionary principle, and in particular, the need to have regard to the impact of fishing activities on bycatch species and the long-term sustainability of the marine environment;

(c) to maximise economic efficiency in the exploitation of the resources of the fishery;

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

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

(f) to ensure that conservation and management measures taken in relation to the fishery implement Australia's obligations under relevant international agreements.

Fishery management plan

Is there a fisheries management plan is it in the planning stage or implemented what are the key features

6 Measures by which the objectives are to be attained (Act s 17 (5))

The measures by which the objectives of this Management Plan are to be attained include the following:

(a) providing the services needed to manage the fishery, including:

(i) data collection, research and consultation; and

(ii) services to ensure compliance with the Plan;

(b) annually evaluating and, if necessary, revising the range, extent and cost of the services mentioned in paragraph (a);

(c) in the first year of the Management Plan, developing and implementing a data plan to collect, verify, analyse and manage data that is related to the management of the fishery, including data about:

(i) the catch and the effort required to achieve the catch; and

(ii) the biological and ecological state of the fishery; and

(iii) the technical and economic issues related to fishing in the fishery;

(d) publishing and biennially reviewing the data plan mentioned in paragraph (c);

(e) if relevant information about the fishery is received — reviewing ecological risk assessments of marine communities, primary species and secondary species to determine the risk to the maintenance of an ecologically sustainable fishery;

(f) developing, in cooperation with stakeholders, a plan to strategically address any high risks identified during an ecological risk assessment;

(g) setting catch limits, or designing other measures, for species of fish that are managed under State or Territory law;

6 Measures by which the objectives are to be attained (Act s 17 (5))

The measures by which the objectives of this Management Plan are to be attained include the following:

(a) providing the services needed to manage the fishery, including:

(i) data collection, research and consultation; and

(ii) services to ensure compliance with the Plan;

(b) annually evaluating and, if necessary, revising the range, extent and cost of the services mentioned in paragraph (a);

(c) in the first year of the Management Plan, developing and implementing a data plan to collect, verify, analyse and manage data that is related to the management of the fishery, including data about:

(i) the catch and the effort required to achieve the catch; and

(ii) the biological and ecological state of the fishery; and

(iii) the technical and economic issues related to fishing in the fishery;

(d) publishing and biennially reviewing the data plan mentioned in paragraph (c);

(e) if relevant information about the fishery is received — reviewing ecological risk assessments of marine communities, primary species and secondary species to determine the risk to the maintenance of an ecologically sustainable fishery;

(f) developing, in cooperation with stakeholders, a plan to strategically address any high risks identified during an ecological risk assessment;

(g) setting catch limits, or designing other measures, for species of fish that are managed under State or Territory law;

(p) within the first 18 months of the Management Plan, developing and implementing a communication plan for the fishery, providing for the publication of regular

reports about the status of stocks and the management of the fishery;

(q) in accordance with the government's cost recovery policy, preparing annual budgets and recommending levies to recover the costs of management that are attributable to the fishing industry;

(r) managing the fishery in a way that is compatible with Australia's international obligations;

(s) at least every 5 years, reviewing the Management Plan and, if necessary, amending the Plan to improve management of the fishery.

7 Performance criteria against which measures taken may be assessed (Act s 17 (5))

(1) The performance criteria against which the measures taken may be assessed are the following:

(a) that the range and cost of AFMA's services in the fishery are reviewed annually and:

(i) the review is published; and

(ii) the management of the fishery has been carried out cost-effectively;

(b) that the method used to collect data is published in accordance with the data plan;

(c) that data is collected, analysed and used in accordance with the data plan;

(d) that the data plan is reviewed, and, if necessary, improved;

(e) that the necessary stock assessments or risk assessments, or both, are carried out for primary species, secondary species, bycatch species and ecologically-related species affected by fishing;

(f) that the following are published, reviewed, evaluated and, if necessary, improved:

(i) decision rules for setting the TACC and any other related management decisions;

(ii) the bycatch action plan and any other action plan;

(g) that reference points are established for quota species, and monitored, reviewed and, if appropriate, improved;

(h) that the status of stocks is assessed in relation to the reference points for those stocks, and, if a risk to the sustainability of a species is discovered, steps are taken to manage those risks;

(i) that, each fishing season, the TACC is set for each quota species;

(j) that SFRs for each quota species are granted to eligible persons;

(k) that the research program mentioned in paragraph 6 (l) is operating, and information about the program is published;

(l) that the compliance program and catch monitoring program mentioned in paragraph 6 (m) are implemented, reviewed periodically and, if necessary, improved;

(m) that, subject to the provisions relating to overcatch and undercatch, the TACCs for each species are not exceeded;

(n) that the fishery is managed in a way that is compatible with relevant decisions of the IOTC and other relevant international agreements;

(o) that the economic efficiency of the fishery is assessed periodically using relevant information;

	(p) that any changes to the management of the fishery are assessed in relation to their likely effect on the economic efficiency of the fishery; (q) that the public and the fishing industry are, in accordance with the communication plan mentioned in paragraph 6 (p), given information about the management of the fishery; (r) that the costs of the management of the fishery that are attributable to the fishing industry are recovered. (2) AFMA must, at least once every 5 years after the commencement day, assess the effectiveness of this Management Plan, including the measures taken to achieve the objectives of this Management Plan, by: (a) reference to the performance criteria mentioned in subsection (1); and (b) taking into account the advice of the advisory committee.
Input controls	*Summary of any input controls in the fishery, e.g. limited entry, area restrictions (zoning), vessel size restrictions and gear restrictions. Primarily focused on target species as other species are addressed below.* Limited entry, gear and area restrictions, and bycatch restrictions. The use of limited entry to control fishing effort is now considered to be inadequate for effective management.
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.* By individual transferable quotas in the form statutory fishing rights expected to be granted late 2006. In the new management plan ITQs will be the principal management tool. The quotas will be set initially for swordfish, yellowfin, bigeye and striped marlin. Other species both target and nontarget will be monitored to determine any futre need for quota management. Although ITQs preferred method, the limited amount of data available from the fishery and the regional extent of the key stocks presents problems for estimating appropriate TACs. Stock structure of the main target species poorly known. The fishing entitlements of some operators restricted them to waters either soutor north of 34oS with the introduction ITQs will remove the management distinction between the zones, relaxing controls on fishing effort.
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.* Wire traces have been banned in the fishery to reduce shark bycatch
Regulations	Pollution of the marine environment by ships of all types, including fishing vessels, is strictly controlled by the International Convention for the Prevention of Pollution from Ships, commonly known as MARPOL 73/78. In Australian waters discharges from all ships including fishing vessels are regulated by the *Protection of the Sea (Prevention of Pollution from Ships) Act 1983.* This Act implements the Australian MARPOL regulations, which apply to Australian fishing vessels wherever they are operating and can also be applied against foreign fishing vessels operating anywhere within Australia's EEZ Potential sources of plastic pollution associated with tuna fishing are described in Table 9. Table 9: Potential sources of plastic waste on tuna fishing vessels. **Source** | **Buoyancy** | **Characteristic** Nylon mainline and branchline material | Sinks | Broken section of leaders, offcuts etc sometimes lost or washed overboard in rough weather Buoys | Buoyant | Rarely lost – beach drift Bait straps | Buoyant | Dangerous to marine life if lost overboard as intact loops. Plastic bait bags | Buoyant | Potentially dangerous to marine turtles and mammals (if ingested) Chemical lightsticks | Buoyant | Lost due to shark damage or poor handling by crew – large numbers have been reported washed up some on east coast beaches. Packaging associated with ship's stores | Buoyant | Common to most seagoing vessels

AFMA only has limited information on compliance with MARPOL in the WTBF. Observers on Japanese longliners between 1995 and 1997 reported a positive attitude to MARPOL requirements for rubbish disposal. Observers on two vessels noted four blue whaler sharks with bait straps deeply embedded around their necks. Several domestic fishers have reported similar entanglements and provided photos to AFMA of sharks and broadbill swordfish with bait straps caught on their necks. These operators have indicated that they and fellow tuna fishers handle their plastic wastes carefully. AFMA has forwarded these reports to the Australian Maritime Safety Authority. The use of bait packed in boxes secured with plastic straps is widespread amongst foreign longline fishing fleets. Limited observer data on domestic longline vessels indicated these crews are diligent in regard to waste handling.

Initiatives and strategies

BAPs; TEDs; industry codes of conduct, MPAs, Reserves

The Long line and minor line Bycatch Action Plan was finalised in late 2004. Australia's Tuna and Billfish Longline and Minor Line Fisheries Bycatch Action Plan (AFMA 2004) outlines AFMA's intended monitoring strategies and management responses to address at risk species.

The National Representative System of Marine Protected Areas is designed to include representative samples of Australia's marine ecosystems. There are four Commonwealth MPAs in the area of the WTBF.

Table 8. Commonwealth MPAs in the SWTBF area of waters

Name	Location	Is there significant fishing effort adjacent to the park/reserve?	Issues
Mermaid Reef Marine National Nature Reserve	Rowley shoals 300km north-west of Broome	Low to moderate amount of domestic effort adjacent to the Rowley Shoals	Shelf edge reef
Ashmore Reef National Nature Reserve	Timor Sea 610km north of Broome	Little domestic effort to date adjacent to Ashmore Reef. Japanese fished here consistently during access years.	Shelf edge reef Important turtle breeding ground for sea turtles Traditional Indonesian fishers are permitted access to nearby waters
Ningaloo Marine Park	Off Exmouth	Important adjacent fishing area for commercial and recreational fishers	Green turtle nesting rookeries Whale shark aggregations
Great Australian Bight Marine Park	Head of the Bight	Very little impact on SWTBF operators	Tuna fishing permitted within benthic protection zone

On 26 September 2001, the Minister for the Environment and Heritage announced eleven new marine areas to be assessed for conservation values. Seven of these fall within the area of waters of the WTBF.

- Heywood Shoals (north WA – 250-300m to near surface)
- Pea Shoals (north WA - 250-300m to near surface)
- Sea Angel Bank (north WA- about 300km long and 15km wide at 10-20m depth)
- Wallaby Plateau (WA – 2500 to 5000m)
- Naturaliste Plateau (south WA - 2500 to 5000m)
- Swan Canyon (south WA – off Rottnest Island)
- Eucla Canyon (western/south Australia – 200km offshore in 1000-3500m depth)

Enabling processes

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

See above amangment plan

Other initiatives or

State, national or international conventions or agreements that impact on the management of the fishery/sub-fishery being evaluated.

agreements	Regional marine plans are currently being prepared for Australian marine ecosystems as part of Australia's National Oceans Policy. Regional marine plans will provide for ecosystem–based allocation of resource access and use across and within sectors based on an understanding of the economic, environmental, social and cultural values of the region. The plans will provide a focus for coordination between existing and developing ocean uses and the range of the agencies with responsibilities for marine systems. The policy will be implemented through the development of regional marine plans for areas based on large marine ecosystems and will include marine protected areas described below. The first regional marine plan is currently being prepared for the south-east region, which includes part of the waters of the WTBF.
Data	
Logbook data	*Verified logbook data; data summaries describe programme* **Data Collection Program** WTBF operator endorsed with pelagic longline and minor line methods, are required to complete the Australian Pelagic Longline Daily Fishing Log' (AL05) on a shot-byshot basis. The AL05 was introduced into the fishery in September 2000, replacing the AL04. WTBF operators endorsed with only a minor line (including pole and line) are required to fill in the Australian Tuna Minor Line Daily Fishing Log' (OT03) on a daily basis. The OT03 was introduced into the fishery in December 1992. It replaced the OT02. Operators fill in catch and effort logbooks while fishing. They are required to send them to AFMA 14 days after the end of each month. The data is entered, and stored, in the AFMA logbook database. Data for the 2003 WTBF fishing season was extracted from the logbook database on 15 March 2004. This data represents 100% return of logsheets. Logbook data is provided to the Indian Ocean Tuna Commission annually for use in stock assessments and AFMA uses the data as a basis for making fishery management decisions. Research organizations such as the CSIRO also use this data when undertaking specific projects relating to the fishery. AFMA Data Summary WTBF 2003
Observer data	*Observer programme describe parameters as below* Currently there is no formal ongoing observer programme. The BRS pilot observer program commenced in April 2003 and aimed to cover around 5% of fishing effort over the following 12 months. AFMA and BRS agreed to extend the pilot program in response to the reduction in effort in the fishery in 2004. AFMA now expects that the pilot observer program will conclude in June 2006. AFMA then intends to develop a routine observer program for the fishery and will take into account BRS's final report on the program – which will include a series of recommendations relevant to the design of a long term observer program. In April 2006 WTBF MAC, recognising the low levels of activity in the fishery, recommended that $15,000 be set aside to maintain an observer presence in the fishery in 2006/07. Observations in the pilot program were primarily made in the western part of the fishery (Australian and high seas waters adjacent to WA). Observers reported on 46 species of target, byproduct and bycatch species caught, as well as on interactions with marine wildlife. Information from the pilot observer program was summarised in an interim report (November 2004) and WTBF SAG and MAC regularly reviewed pilot program updates. A complete analysis will be provided as part of the BRS final report (R01/1293) which is expected to be finalised in July 2006. AFMA produced Data Summaries for the WTBF for 2001, 2002 and 2003. These contain summarised information on wildlife interactions, but the taxonomic resolution is usually broad (often just undifferentiated marine birds or reptiles). Since 2004 WTBF MAC and SAG have relied upon fishery summaries produced by CSIRO (these focus on target and key bycatch species) as well as targeted extracts from AFMA's logbook and observer databases to inform consideration of the fishery' impact on bycatch and protected species. MAC papers, including those containing fishery and protected species interaction summaries, are posted on AFMA's website unless low levels of fishing activity prevent their release under

	AFMA's guidelines for the public release of aggregated catch and effort information (5 boat rule). (information provided by Anthony de Fries)
Other data	*Studies, surveys* Southern tuna and Billfish fishery size monitoring programme 2004-2005 AFMA 2001/014 Age and growth of broadbill swordfish (Xiphias gladius) from Australian waters 2003/414 A manual of best practice handling techniques for longline caught tuna 2002/235 Improving post harvest swordfish quality 2003/013 Sea turtle mitigation for Australian pelagic longline fisheries 2003/016 Reduction of toothed whale interactions with fishing gear: development and assessment of predation mitigation devices around longlines 2003/042 Development of a robust suite of stock status indicators for the Southern and Western and the Eastern Tuna and Billfish fisheries 2003/060 Byproduct: Catch, economics and co-occurrence in Australias longline fisheries 2003/067 Development of a DNA database for compliance and management of Western Australian sharks 2004/063 Determining ecological effects of longline fishing in the Eastern Tuna and Billfish Fishery 2005/002 Adaptive frameworks for Australian fishery observer programs: effort allocation and tools for decision support 2005/004 Determination of effective longline effort in the Eastern Tuna and Billfish Fishery AFMA web Research for WTBF The 2007/08 research priorities for the WTBF are listed under five ranked categories 1. Improving Industry efficiency 2. Development and refinement of AREa of Relevance harvest strategies in the context of IOTC stock assessments for key species 3. Bycatch management better utilization and reduction in impacts 4. Improving the data potential of the recreational, charter and industry sectors 5. Idenfitication of suitable fishery specific indicators for bycatcha dn ecosystem health

Attachment 2

Attachment 2. Research relevant to the WTBF as of April 2006

Reference	Year	Research priority	Project title	Status	Agency
F98/0213	1996	Stock assessment and structure	SWTBF fishery desktop study	completed	BRS
F97/0191	1997	Stock assessment and structure	Preliminary stock assessment of the tuna and billfish resources within the western AFZ	completed	CSIRO
F97/0217	1997	Stock assessment and structure	Synopsis on the billfish stocks within the western AFZ	completed	CSIRO
F97/0607	1997	Industry development	Determine operations regimes and efficiency of Western Australia longlining operations with the intention of further developing a bigeye tuna and broadbill sword fishery off WA	completed	CSIRO
F97/1466	1997	Ecosystem	Albatross longline interaction - Seabird interactions with longline fishing in the AFZ: 1996 seabird mortality estimates and 1988 - 1996 trends	completed	Tasmanian Parks and Wildlife Service
F97/1481	1997	Ecosystem	The effects of longlining on seabird populations	completed	DPIWE (Tasmania)
F99/0415	1999	Stock assessment and structure	Assessment of the tuna and billfish resources in the WTBF and support for development of an operating model for tuna and billfish fisheries within AFZ	completed	CSIRO
F99/1541	1999	Stock assessment and structure	Determining the nature and extent of swordfish movement and migration in the eastern and western AFZ through an industry-based tagging program	Report at final draft stage	CSIRO
R99/0159	1999	Stock assessment and structure	Population structure of Australian swordfish, *Xiphias gladius*	completed	CSIRO
R99/0171	1999	Stock assessment and structure	Archival Hard Part Collection - A basis for routine aging of tuna and billfish	completed	CSIRO
R99/1497	1999	Stock assessment and structure	Archival Hard Part Collection - A basis for routine aging of tuna and billfish	completed	CSIRO
R99/1540	1999	Stock assessment and structure	Assessment of the tuna and billfish resources within the Western AFZ and support for the development of an operating model for the tuna and billfish fisheries within the AFZ	completed	CSIRO
R99/1542	1999	Stock assessment and structure	WTBF size monitoring program for 1999/2000	completed	WW Fisheries
FRDC 2000/100	2000	Stock assessment and structure	Age and growth of bigeye tuna (*Thunnus obesus*) from the eastern and western AFZ.	completed	CSIRO
R00/0327	2000	Stock assessment and structure	SWTBF SAG 2000/2001	completed	BRS
R00/1154	2000	Stock assessment and structure	Striped marlin: Biology and Fisheries	completed	BRS and Pepperell Research
R00/1158	2000	Stock assessment and structure	A basis for routine aging of tuna and billfish	completed	R00/1157

Reference	Year	Research priority	Project title	Status	Agency
R01/014	2001	Stock assessment and structure	Age and growth of broadbill swordfish from Australian waters	completed	Jock Young CSIRO
R01/0254	2001	Ecosystem	A scientific appraisal of the suitability of underwater setting chute technology as a seabird mitigation measure for Australian tuna longline fisheries	completed	Nigel Brothers
R01/0934	2001	Ecosystem	Ecological risk assessment for Commonwealth fisheries, Final Report Stage One - Hazard identification and preliminary risk assessment	completed	CSIRO, BRS, MAFRI
R01/0376	2001	Stock assessment and structure	SWTBF SAG 2001/2002	completed	BRS
R01/1294	2001	Stock assessment and structure	Review and analysis of information required for the determination of TACs and decision rules relevant to the SWTBF	completed	Robert Campbell, CSIRO
R01/1295	2001	Stock assessment and structure	WTBF size monitoring for 2002/03	completed	WW Fisheries
R2001/1158	2001	Stock assessment and structure	Archival hard part collection - a basis for routine ageing of tuna and billfish	completed	CSIRO
2002 FRFF	2002	Ecosystem	Bycatch of sea turtles in pelagic longline fisheries	completed	BRS
FRDC 2002/235	2002	Industry development	Onboard chilled storage of broadbill swordfish: Assessing and improving post harvest quality	awaiting final	Queensland DPI
R01/1293	2002	Stock assessment/ecosystem	Pilot scientific monitoring program for the WTBF	Expected June 2006	Peter Ward: BRS
R02/0068	2002	Stock assessment and structure	SWTBF SAG 2002/2003	completed	BRS
R02/0923	2002	Industry development	Acoustic tracking system for marine mammals around fishing gear and preliminary trials of predation mitigation prototypes for line based fisheries	completed	Geoff McPherson, QDPI
R02/1071	2002	Industry development	A review of byproduct interactions and economics in Australia's longline fisheries	completed	James Findlay, BRS
R02/1097	2002	Stock assessment and structure	Archival hard parts - A basis for routine ageing of tuna and billfish	completed	CSIRO
FRDC 2003/016	2003	Industry development	Reduction of toothed whale interactions with fishing gear: development and assessment of predation mitigation devices around longlines	underway	Geoff McPherson, QDPI
FRDC 2003/042	2003	Stock assessment and structure	Development of a robust suite of stock status indicators for the Southern and Western, and Eastern Tuna and Billfish Fisheries	expected completion late 2006	Marinelle Basson, CSIRO
R02/1108	2003	Stock assessment and structure	WTBF size monitoring program for 2003/04	completed	WW Fisheries
R03/1398	2003	Ecosystem	New deep setting longline technique for bycatch mitigation	completed	SPC/SeaNet
R03/1431	2003	Stock assessment and structure	Archival Hard Part Collection - A basis for routine aging of tuna and billfish	completed	CSIRO

2.2.2 Unit of Analysis Lists (Step 2)

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

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

Ecological Units Assessed

Target species:	6 (and 7 target bait species)
Byproduct and bycatch species:	23 and 48 respectively
TEP species:	264
Habitats:	162 (benthic and pelagic)
Communities:	50 (benthic and 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 and target bait species*: WTBF longline sub-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, TB = target bait.

Species ID	Taxa	Scientific name	CAAB code	Family name	Common name	Role in fishery
884	Teleost	Tetrapturus audax	37444002	Istiophoridae	Striped marlin	TA
62	Teleost	Thunnus obesus	37441011	Scombridae	Bigeye Tuna	TA
64	Teleost	Katsuwonus pelamis	37441003	Scombridae	Skipjack Tuna	TA
212	Teleost	Thunnus albacares	37441002	Scombridae	Yellowfin Tuna	TA
895	Teleost	Thunnus alalunga	37441005	Scombridae	Albacore	TA
213	Teleost	Xiphias gladius	37442001	Xiphiidae	Broad Billed Swordfish	TA
46	Invertebrate	Todarodes filippovae	23636011	Ommastrephidae	Southern Ocean arrow squid	TB

Species ID	Taxa	Scientific name	CAAB code	Family name	Common name	Role in fishery
511	Teleost	Arripis georgianus	37344001	Arripidae	Tommy rough	TB
540	Teleost	Trachurus novaezelandiae	37337003	Carangidae	Yellow tail scad	TB
1088	Teleost	Trachurus declivis	37337002	Carangidae	Jack Mackerel	TB
825	Teleost	Sardinops neopilchardus	37085002	Clupeidae	pilchard	TB
210	Teleost	Scomber australasicus	37441001	Scombridae	Blue Mackerel	TB
872	Teleost	Sardinella lemuru	37085018	Scombridae	Scaly Mackerel	TB

Byproduct species*: WTBF longline sub-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.

Species ID	Taxa name	Scientific name	CAAB code	Family name	Common name	Role in fishery
625	Chondrichthyan	Carcharhinus longimanus	37018032	Carcharhinidae	Oceanic Whitetip Shark	BP
808	Chondrichthyan	Carcharhinus obscurus	37018003	Carcharhinidae	Dusky Shark	BP
1039	Chondrichthyan	Prionace glauca	37018004	Carcharhinidae	Blue Shark	BP
964	Chondrichthyan	Isurus oxyrinchus	37010001	Lamnidae	Shortfinned Mako or Blue Pointer	BP
972	Chondrichthyan	Lamna nasus	37010004	Lamnidae	Porbeagle shark	BP
862	Chondrichthyan	Pseudocarcharias kamoharai	37009003	Pseudocarchariidae	Crocodile Shark	BP
963	Chondrichthyan	Isistius brasiliensis	37020014	Squalidae	cookie-cutter shark (cigar shark)	BP
152	Teleost	Brama brama	37342001	Bramidae	Ray's Bream	BP
882	Teleost	Taractichthys longipinnis	37342003	Bramidae	Long finned Bream (pomfret)	BP
215	Teleost	Centrolophus niger	37445004	Centrolophidae	Rudderfish	BP
958	Teleost	Hyperoglyphe antarctica	37445001	Centrolophidae	Blue Eye Trevalla	BP
814	Teleost	Coryphaena hippurus	37338001	Coryphaenidae	Dolphin Fish (mahi mahi)	BP
204	Teleost	Ruvettus pretiosus	37439003	Gempylidae	Oilfish	BP
845	Teleost	Lepidocybium flavobrunneum	37439008	Gempylidae	Escolar or Black Oil fish	BP
1066	Teleost	Rexea solandri	37439002	Gempylidae	Gemfish	BP
836	Teleost	Istiophorus platypterus	37444005	Istiophoridae	Sailfish	BP
842	Teleost	Lampris guttatus	37268001	Lampridae	Spotted moonfish	BP
255	Teleost	Thunnus maccoyii	37441004	Scombridae	Southern Bluefin Tuna	BP
259	Teleost	Acanthocybium solandri	37441024	Scombridae	Wahoo	BP
830	Teleost	Gasterochisma melampus	37441019	Scombridae	Butterfly Mackerel	BP
835	Teleost	Gymnosarda unicolor	37441029	Scombridae	Dogtooth tuna	BP
897	Teleost	Thunnus orientalis	37441026	Scombridae	Northern Bluefin Tuna	BP
899	Teleost	Thunnus tonggol	37441013	Scombridae	Long-tail tuna	BP

Bycatch species*: WTBF longline sub-fishery*

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

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

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

Species ID	Taxa	Scientific name	CAAB Code	Family name	Common name	Role in fishery
179	Chondrichthyan	Alopias vulpinus	37012001	Alopiidae	Thintail Thresher Shark, thresher shark	DI
462	Chondrichthyan	Alopias superciliosus	37012002	Alopiidae	Bigeye thresher shark	DI
286	Chondrichthyan	Callorhinchus milii	37043001	Callorhinchidae	Elephantfish	DI
469	Chondrichthyan	Carcharhinus leucas	37018021	Carcharhinidae	Bull Shark	DI
535	Chondrichthyan	Carcharhinus brachyurus	37018001	Carcharhinidae	Bronze Whaler	DI
551	Chondrichthyan	Galeocerdo cuvier	37018022	Carcharhinidae	Tiger Shark	DI
619	Chondrichthyan	Carcharhinus dussumieri	37018009	Carcharhinidae	Whitecheek shark	DI
621	Chondrichthyan	Carcharhinus falciformis	37018008	Carcharhinidae	Silky Shark	DI
629	Chondrichthyan	Carcharhinus plumbeus	37018007	Carcharhinidae	Sandbar shark	DI
630	Chondrichthyan	Carcharhinus sorrah	37018013	Carcharhinidae	Sorrah shark	DI
647	Chondrichthyan	Carcharhinus tilstoni	37018014	Carcharhinidae	Australian blacktip	DI
866	Chondrichthyan	Rhizoprionodon acutus	37018006	Carcharhinidae	Milk shark	DI
371	Chondrichthyan	Centrophorus moluccensis (west)	37020001	Centrophoridae	Endeavour Dogfish	DI
604	Chondrichthyan	Deania calcea	37020003	Centrophoridae	Brier Shark	DI
609	Chondrichthyan	Deania quadrispinosa	37020004	Centrophoridae	Platypus Shark	DI
346	Chondrichthyan	Cetorhinus maximus	37011001	Cetorhinidae	basking shark	DI

Species ID	Taxa	Scientific name	CAAB Code	Family name	Common name	Role in fishery
491	Chondrichthyan	Centroscymnus owstoni	37020019	Dalatiidae	owston's dogfish	DI
633	Chondrichthyan	Centroscymnus plunketi	37020013	Dalatiidae	plunket's shark	DI
809	Chondrichthyan	Centroscymnus coelolepis	37020025	Dalatiidae	Portuguese dogfish	DI
875	Chondrichthyan	Scymnodalatias albicauda		Dalatiidae	Sherwoods dogfish	DI
816	Chondrichthyan	Dasyatis violacea	37035010	Dasyatididae	Pelagic Stingray	DI
784	Chondrichthyan	Myliobatis australis	37039001	Myliobatidae	Southern Eagle Ray	DI
853	Chondrichthyan	Manta birostris	37041004	Myliobatidae	Manta Ray	DI
552	Chondrichthyan	Sphyrna zygaena	37019004	Sphyrnidae	smooth hammerhead	DI
880	Chondrichthyan	Sphyrna lewini	37019001	Sphyrnidae	Scalloped Hammerhead	DI
489	Chondrichthyan	Centroscymnus crepidater	37020012	Squalidae	deepwater dogfish	DI
905	Chondrichthyan	Zameus squamulosus	37020042	Squalidae	Velvet dogfish	DI
1077	Chondrichthyan	Squalus acanthias	37020008	Squalidae	white-spotted dogfish	DI
372	Teleost	Alepisaurus brevirostris	37128002	Alepisauridae	Short-nosed Lancet Fish	DI
373	Teleost	Alepisaurus ferox	37128001	Alepisauridae	Long-nosed lancet fish	DI
148	Teleost	Seriola lalandi	37337006	Carangidae	Yellowtail Kingfish	DI
664	Teleost	Caranx sexfasciatus	37337039	Carangidae	Great Trevally	DI
1087	Teleost	Thyrsites atun	37439001	Gempylidae	Barracouta	DI
851	Teleost	Makaira indica	37444006	Istiophoridae	Black Marlin	DI
852	Teleost	Makaira mazara	37444003	Istiophoridae	Blue Marlin	DI
883	Teleost	Tetrapturus angustirostris	37444007	Istiophoridae	Short Bill Spearfish	DI
644	Teleost	Lampris immaculatus	37268002	Lampridae	Southern moonfish	DI
252	Teleost	Mola mola	37470002	Molidae	ocean sunfish	DI
1533	Teleost	Mola ramsayi	37470001	Molidae	[an ocean sunfish]	DI
147	Teleost	Rachycentron canadum	37335001	Rachycentridae	cobia	DI
162	Teleost	Argyrosomus hololepidotus	37354001	Sciaenidae	Jewfish	DI
63	Teleost	Euthynnus affinis	37441010	Scombridae	Eastern Little Tuna/Mackerel tuna	DI
211	Teleost	Sarda australis	37441020	Scombridae	australian bonito	DI
377	Teleost	Allothunnus fallai	37441021	Scombridae	Slender Tuna	DI

Species ID	Taxa	Scientific name	CAAB Code	Family name	Common name	Role in fishery
873	Teleost	Scomber scombrus	37441790	Scombridae	Atlantic mackerel	DI
908	Teleost	Auxis thazard	37441009	Scombridae	Frigate mackerel	DI
879	Teleost	Sphyraena jello	37382004	Sphyraenidae	Slender Barracuda	DI
208	Teleost	Lepidopus caudatus	37440002	Trichiuridae	Southern Frostfish	DI

TEP species*: WTBF longline sub-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.

Species ID	Taxa	Scientific name	CAAB code	Family name	Common name	Role in fishery
315	Chondrichthyan	Carcharodon carcharias	37010003	Lamnidae	white shark	TEP
313	Chondrichthyan	Carcharias taurus	37008001	Odontaspididae	grey nurse shark	TEP
1067	Chondrichthyan	Rhincodon typus	37014001	Rhincodontidae	whale shark	TEP
451	Marine bird	Diomedea exulans	40040006	Diomedeidae	Wandering Albatross	TEP
628	Marine bird	Diomedea antipodensis	40040011	Diomedeidae	Antipodean Albatross	TEP
753	Marine bird	Diomedea epomophora	40040005	Diomedeidae	Southern Royal Albatross	TEP
755	Marine bird	Diomedea gibsoni	40040010	Diomedeidae	Gibson's Albatross	TEP
799	Marine bird	Diomedea sanfordi	40040012	Diomedeidae	Northern Royal Albatross	TEP
889	Marine bird	Thalassarche eremita	40040017	Diomedeidae	Chatham albatross	TEP

Species ID	Taxa	Scientific name	CAAB code	Family name	Common name	Role in fishery
893	Marine bird	Thalassarche platei	40040015	Diomedeidae	Pacific albatross	TEP
894	Marine bird	Thalassarche salvini	40040016	Diomedeidae	Salvin's albatross	TEP
1008	Marine bird	Phoebetria fusca	40040008	Diomedeidae	Sooty Albatross	TEP
1009	Marine bird	Phoebetria palpebrata	40040009	Diomedeidae	Light-mantled Albatross	TEP
1031	Marine bird	Thalassarche carteri	40040014	Diomedeidae	Indian Yellow-nosed Albatross	TEP
1032	Marine bird	Thalassarche bulleri	40040001	Diomedeidae	Buller's Albatross	TEP
1033	Marine bird	Thalassarche cauta	40040002	Diomedeidae	Shy Albatross	TEP
1034	Marine bird	Thalassarche chlororhynchos	40040003	Diomedeidae	Yellow-nosed Albatross, Atlantic Yellow-	TEP
1035	Marine bird	Thalassarche chrysostoma	40040004	Diomedeidae	Grey-headed Albatross	TEP
1084	Marine bird	Thalassarche impavida	40040013	Diomedeidae	Campbell Albatross	TEP
1085	Marine bird	Thalassarche melanophrys	40040007	Diomedeidae	Black-browed Albatross	TEP
1428	Marine bird	Diomedea amsterdamensis	40040018	Diomedeidae	Amsterdam Albatross	TEP
1429	Marine bird	Diomedea dabbenena	40040019	Diomedeidae	Tristan Albatross	TEP
827	Marine bird	Fregata andrewsi	40050001	Fregatidae	Christmas frigatebird	TEP
829	Marine bird	Fregata ariel	40050002	Fregatidae	Lesser frigatebird	TEP
1435	Marine bird	Fregata minor	40050003	Fregatidae	Great Frigatebird, Greater Frigatebird	TEP
555	Marine bird	Garrodia nereis	40042003	Hydrobatidae	Grey-backed storm petrel	TEP
556	Marine bird	Oceanites oceanicus	40042004	Hydrobatidae	Wilson's storm petrel (subantarctic)	TEP
917	Marine bird	Fregetta tropica	40042002	Hydrobatidae	Black-bellied Storm-Petrel	TEP
918	Marine bird	Fregetta grallaria	40042001	Hydrobatidae	White-bellied Storm-Petrel (Tasman Sea),	TEP
1004	Marine bird	Pelagodroma marina	40042007	Hydrobatidae	White-faced Storm-Petrel	TEP
67	Marine bird	Anous tenuirostris	40128003	Laridae	Lesser noddy	TEP
203	Marine bird	Anous stolidus	40128002	Laridae	Common noddy	TEP
325	Marine bird	Catharacta skua	40128005	Laridae	Great Skua	TEP
974	Marine bird	Larus novaehollandiae	40128013	Laridae	Silver Gull	TEP
975	Marine bird	Larus pacificus	40128014	Laridae	Pacific Gull	TEP

Species ID	Taxa	Scientific name	CAAB code	Family name	Common name	Role in fishery
1014	Marine bird	Sterna albifrons	40128022	Laridae	Little tern	TEP
1015	Marine bird	Sterna anaethetus	40128023	Laridae	Bridled Tern	TEP
1016	Marine bird	Sterna bengalensis	40128024	Laridae	Lesser crested tern	TEP
1017	Marine bird	Sterna bergii	40128025	Laridae	Crested Tern	TEP
1018	Marine bird	Sterna caspia	40128026	Laridae	Caspian Tern	TEP
1019	Marine bird	Sterna dougallii	40128027	Laridae	Roseate tern	TEP
1020	Marine bird	Sterna fuscata	40128028	Laridae	Sooty tern	TEP
1021	Marine bird	Sterna hirundo	40128029	Laridae	Common tern	TEP
1023	Marine bird	Sterna paradisaea	40128032	Laridae	Arctic tern	TEP
1025	Marine bird	Sterna sumatrana	40128034	Laridae	Black-naped tern	TEP
1431	Marine bird	Phaethon lepturus	40045001	Laridae	White-tailed Tropicbird	TEP
1438	Marine bird	Anous minutus	40128001	Laridae	Black Noddy	TEP
1432	Marine bird	Phaethon rubricauda	40045002	Phaethontidae	Red-tailed Tropicbird	TEP
912	Marine bird	Phalacrocorax fuscescens	40048003	Phalacrocoracidae	Black faced cormorant	TEP
73	Marine bird	Macronectes giganteus	40041007	Procellariidae	Southern Giant-Petrel	TEP
314	Marine bird	Fulmarus glacialoides	40041004	Procellariidae	Southern fulmar	TEP
494	Marine bird	Procellaria cinerea	40041019	Procellariidae	Grey petrel	TEP
504	Marine bird	Pterodroma lessoni	40041029	Procellariidae	White-headed petrel	TEP
595	Marine bird	Daption capense	40041003	Procellariidae	Cape Petrel	TEP
939	Marine bird	Halobaena caerulea	40041005	Procellariidae	Blue Petrel	TEP
981	Marine bird	Macronectes halli	40041008	Procellariidae	Northern Giant-Petrel	TEP
1003	Marine bird	Pachyptila turtur	40041013	Procellariidae	Fairy Prion	TEP
1041	Marine bird	Procellaria aequinoctialis	40041018	Procellariidae	White-chinned Petrel	TEP
1042	Marine bird	Procellaria parkinsoni	40041020	Procellariidae	Black Petrel; Parkinsons Petrel	TEP
1046	Marine bird	Pterodroma leucoptera	40041030	Procellariidae	Gould's Petrel	TEP
1047	Marine bird	Pterodroma macroptera	40041031	Procellariidae	Great-winged Petrel	TEP
1048	Marine bird	Pterodroma mollis	40041032	Procellariidae	Soft-plumaged Petrel	TEP
1053	Marine bird	Puffinus assimilis	40041036	Procellariidae	Little Shearwater (Tasman Sea)	TEP
1055	Marine bird	Puffinus carneipes	40041038	Procellariidae	Flesh-footed Shearwater	TEP

Species ID	Taxa	Scientific name	CAAB code	Family name	Common name	Role in fishery
1056	Marine bird	Puffinus gavia	40041040	Procellariidae	Fluttering Shearwater	TEP
1057	Marine bird	Puffinus griseus	40041042	Procellariidae	Sooty Shearwater	TEP
1058	Marine bird	Puffinus huttoni	40041043	Procellariidae	Hutton's Shearwater	TEP
1059	Marine bird	Puffinus pacificus	40041045	Procellariidae	Wedge-tailed Shearwater	TEP
1060	Marine bird	Puffinus tenuirostris	40041047	Procellariidae	Short-tailed Shearwater	TEP
1580	Marine bird	Calonectris leucomelas	40041002	Procellariidae	streaked shearwater	TEP
1692	Marine bird	Pterodroma arminjoniana	40041023	Procellariidae	Round Island Petrel	TEP
1693	Marine bird	Pterodroma baraui	40041024	Procellariidae	Barau's Petrel	TEP
898	Marine bird	Eudyptula minor	40001008	Spheniscidae	Little Penguin	TEP
861	Marine bird	Papasula abbotti	40047003	Sulidae	Abbots booby	TEP
881	Marine bird	Sula leucogaster	40047005	Sulidae	Brown boobies	TEP
998	Marine bird	Morus serrator	40047002	Sulidae	Australasian Gannet	TEP
1433	Marine bird	Sula dactylatra	40047004	Sulidae	Masked Booby	TEP
1434	Marine bird	Sula sula	40047006	Sulidae	Red-footed Booby	TEP
1549	Marine bird	Morus capensis	40047001	Sulidae	Cape gannet	TEP
289	Marine mammal	Caperea marginata	41110002	Balaenidae	Pygmy Right Whale	TEP
896	Marine mammal	Eubalaena australis	41110001	Balaenidae	Southern Right Whale	TEP
1439	Marine mammal	Balaenoptera bonaerensis	41112007	Balaenidae	Antarctic Minke Whale	TEP
256	Marine mammal	Balaenoptera acutorostrata	41112001	Balaenopteridae	Minke Whale	TEP
261	Marine mammal	Balaenoptera borealis	41112002	Balaenopteridae	Sei Whale	TEP
262	Marine mammal	Balaenoptera edeni	41112003	Balaenopteridae	Bryde's Whale	TEP
265	Marine mammal	Balaenoptera musculus	41112004	Balaenopteridae	Blue Whale	TEP
268	Marine mammal	Balaenoptera physalus	41112005	Balaenopteridae	Fin Whale	TEP
984	Marine mammal	Megaptera novaeangliae	41112006	Balaenopteridae	Humpback Whale	TEP
61	Marine mammal	Lissodelphis peronii	41116009	Delphinidae	Southern Right Whale Dolphin	TEP
612	Marine mammal	Delphinus delphis	41116001	Delphinidae	Common Dolphin	TEP
860	Marine mammal	Orcaella brevirostris	41116010	Delphinidae	Irrawaddy dolphin	TEP
864	Marine mammal	Delphinus capensis		Delphinidae	Common dolphin, long-beaked	TEP
902	Marine mammal	Feresa attenuata	41116002	Delphinidae	Pygmy Killer Whale	TEP

Species ID	Taxa	Scientific name	CAAB code	Family name	Common name	Role in fishery
934	Marine mammal	Globicephala macrorhynchus	41116003	Delphinidae	Short-finned Pilot Whale	TEP
935	Marine mammal	Globicephala melas	41116004	Delphinidae	Long-finned Pilot Whale	TEP
937	Marine mammal	Grampus griseus	41116005	Delphinidae	Risso's Dolphin	TEP
970	Marine mammal	Lagenodelphis hosei	41116006	Delphinidae	Fraser's Dolphin	TEP
971	Marine mammal	Lagenorhynchus obscurus	41116008	Delphinidae	Dusky Dolphin	TEP
1002	Marine mammal	Orcinus orca	41116011	Delphinidae	Killer Whale	TEP
1007	Marine mammal	Peponocephala electra	41116012	Delphinidae	Melon-headed Whale	TEP
1044	Marine mammal	Pseudorca crassidens	41116013	Delphinidae	False Killer Whale	TEP
1076	Marine mammal	Sousa chinensis	41116014	Delphinidae	Indo-Pacific Humpback Dolphin	TEP
1080	Marine mammal	Stenella attenuata	41116015	Delphinidae	Spotted Dolphin	TEP
1081	Marine mammal	Stenella coeruleoalba	41116016	Delphinidae	Striped Dolphin	TEP
1082	Marine mammal	Stenella longirostris	41116017	Delphinidae	Long-snouted Spinner Dolphin	TEP
1083	Marine mammal	Steno bredanensis	41116018	Delphinidae	Rough-toothed Dolphin	TEP
1091	Marine mammal	Tursiops truncatus	41116019	Delphinidae	Bottlenose Dolphin	TEP
1494	Marine mammal	Tursiops aduncus	41116020	Delphinidae	Indian Ocean bottlenose dolphin	TEP
813	Marine mammal	Dugong dugon	41206001	Dugongidae	Dugong	TEP
216	Marine mammal	Arctocephalus forsteri	41131001	Otariidae	New Zealand Fur-seal	TEP
253	Marine mammal	Arctocephalus pusillus doriferus	41131003	Otariidae	Australian Fur Seal	TEP
263	Marine mammal	Arctocephalus tropicalis	41131004	Otariidae	Subantarctic fur seal	TEP
1000	Marine mammal	Neophoca cinerea	41131005	Otariidae	Australian Sea-lion	TEP
295	Marine mammal	Hydrurga leptonyx	41136001	Phocidae	Leopard seal	TEP
968	Marine mammal	Kogia breviceps	41119001	Physeteridae	Pygmy Sperm Whale	TEP
969	Marine mammal	Kogia simus	41119002	Physeteridae	Dwarf Sperm Whale	TEP
1036	Marine mammal	Physeter catodon	41119003	Physeteridae	Sperm Whale	TEP
269	Marine mammal	Berardius arnuxii	41120001	Ziphiidae	Arnoux's Beaked Whale	TEP
959	Marine mammal	Hyperoodon planifrons	41120002	Ziphiidae	Southern Bottlenose Whale	TEP
985	Marine mammal	Mesoplodon bowdoini	41120004	Ziphiidae	Andrew's Beaked Whale	TEP
986	Marine mammal	Mesoplodon densirostris	41120005	Ziphiidae	Blainville's Beaked Whale	TEP

Species ID	Taxa	Scientific name	CAAB code	Family name	Common name	Role in fishery
987	Marine mammal	Mesoplodon gingkodens	41120006	Ziphiidae	Gingko Beaked Whale	TEP
988	Marine mammal	Mesoplodon grayi	41120007	Ziphiidae	Gray's Beaked Whale	TEP
989	Marine mammal	Mesoplodon hectori	41120008	Ziphiidae	Hector's Beaked Whale	TEP
990	Marine mammal	Mesoplodon layardii	41120009	Ziphiidae	Strap-toothed Beaked Whale	TEP
991	Marine mammal	Mesoplodon mirus	41120010	Ziphiidae	True's Beaked Whale	TEP
1030	Marine mammal	Tasmacetus shepherdi	41120011	Ziphiidae	Tasman Beaked Whale	TEP
1098	Marine mammal	Ziphius cavirostris	41120012	Ziphiidae	Cuvier's Beaked Whale	TEP
1440	Marine mammal	Indopacetus pacificus	41120003	Ziphiidae	Longman's Beaked Whale	TEP
324	Marine reptile	Caretta caretta	39020001	Cheloniidae	Loggerhead	TEP
541	Marine reptile	Chelonia mydas	39020002	Cheloniidae	Green turtle	TEP
822	Marine reptile	Eretmochelys imbricata	39020003	Cheloniidae	Hawksbill turtle	TEP
844	Marine reptile	Lepidochelys olivacea	39020004	Cheloniidae	Olive Ridley turtle	TEP
857	Marine reptile	Natator depressus	39020005	Cheloniidae	Flatback turtle	TEP
613	Marine reptile	Dermochelys coriacea	39021001	Dermochelyidae	Leathery turtle	TEP
957	Marine reptile	Hydrophis elegans	39125021	Hydrophiidae	Elegant seasnake	TEP
1408	Marine reptile	Acalyptophis peronii	39125001	Hydrophiidae	Horned Seasnake	TEP
1409	Marine reptile	Aipysurus apraefrontalis	39125002	Hydrophiidae	Short-nosed Seasnake	TEP
1410	Marine reptile	Aipysurus duboisii	39125003	Hydrophiidae	Dubois' Seasnake	TEP
1411	Marine reptile	Aipysurus eydouxii	39125004	Hydrophiidae	Spine-tailed Seasnake	TEP
1413	Marine reptile	Aipysurus fuscus	39125006	Hydrophiidae	Dusky Seasnake	TEP
1414	Marine reptile	Aipysurus laevis	39125007	Hydrophiidae	Olive Seasnake, Golden Seasnake	TEP
1415	Marine reptile	Aipysurus tenuis	39125008	Hydrophiidae	Brown-lined Seasnake	TEP
1416	Marine reptile	Disteira major	39125011	Hydrophiidae	Olive-headed Seasnake	TEP
1417	Marine reptile	Emydocephalus annulatus	39125012	Hydrophiidae	Turtle-headed Seasnake	TEP
1418	Marine reptile	Enhydrina schistosa	39125013	Hydrophiidae	Beaked Seasnake	TEP
1420	Marine reptile	Hydrelaps darwiniensis	39125015	Hydrophiidae	Black-ringed Seasnake	TEP
1421	Marine reptile	Hydrophis coggeri	39125019	Hydrophiidae	Slender-necked Seasnake	TEP
1422	Marine reptile	Hydrophis mcdowelli	39125025	Hydrophiidae	seasnake	TEP
1423	Marine reptile	Hydrophis ornatus	39125028	Hydrophiidae	seasnake	TEP
1424	Marine reptile	Lapemis hardwickii	39125031	Hydrophiidae	Spine-bellied Seasnake	TEP

Species ID	Taxa	Scientific name	CAAB code	Family name	Common name	Role in fishery
1530	Marine reptile	Disteira kingii	39125010	Hydrophiidae	spectacled seasnake	TEP
1531	Marine reptile	Hydrophis czeblukovi	39125020	Hydrophiidae	fine-spined seasnake	TEP
1681	Marine reptile	Hydrophis atriceps	39125016	Hydrophiidae	Black-headed seasnake	TEP
1686	Marine reptile	Hydrophis melanosoma	39125027	Hydrophiidae	Black-banded robust seasnake	TEP
1687	Marine reptile	Hydrophis pacificus	39125029	Hydrophiidae	Large-headed Seasnake	TEP
1689	Marine reptile	Parahydrophis mertoni	39125032	Hydrophiidae	Northern mangrove seasnake	TEP
308	Teleost	Heteroclinus perspicillatus	37416013	Clinidae	Common weedfish	TEP
1074	Teleost	Solenostomus cyanopterus	37281001	Solenostomidae	Blue-finned Ghost Pipefish, Robust Ghost	TEP
52	Teleost	Corythoichthys intestinalis	37282049	Syngnathidae	Australian Messmate Pipefish, Banded Pipefish	TEP
53	Teleost	Bulbonaricus brauni	37282037	Syngnathidae	Braun's Pughead Pipefish, Pug-headed Pipefish	TEP
54	Teleost	Halicampus brocki	37282065	Syngnathidae	Brock's Pipefish	TEP
55	Teleost	Doryrhamphus janssi	37282059	Syngnathidae	Cleaner Pipefish, Janss' Pipefish	TEP
56	Teleost	Bhanotia fasciolata	37282104	Syngnathidae	Corrugated Pipefish, Barbed Pipefish	TEP
57	Teleost	Halicampus nitidus	37282069	Syngnathidae	Glittering Pipefish	TEP
105	Teleost	Acentronura australe	37282034	Syngnathidae	Southern Pygmy Pipehorse	TEP
114	Teleost	Acentronura breviperula	37282035	Syngnathidae	Hairy Pygmy Pipehorse	TEP
287	Teleost	Campichthys galei	37282039	Syngnathidae	Gale's Pipefish	TEP
288	Teleost	Campichthys tryoni	37282041	Syngnathidae	Tryon's Pipefish	TEP
318	Teleost	Hippocampus spinosissimus		Syngnathidae	Hedgehog Seahorse	TEP
319	Teleost	Acentronura larsonae	37282036	Syngnathidae	Helen's Pygmy Pipehorse	TEP
320	Teleost	Solegnathus guentheri	37282003	Syngnathidae	Indonesian Pipefish, Gunther's Pipehorse	TEP
321	Teleost	Festucalex scalaris	37282063	Syngnathidae	Ladder Pipefish	TEP
322	Teleost	Trachyrhamphus longirostris	37282101	Syngnathidae	Long-nosed Pipefish, Straight Stick Pipefish	TEP
359	Teleost	Halicampus dunckeri	37282066	Syngnathidae	Red-hair Pipefish, Duncker's Pipefish	TEP

Species ID	Taxa	Scientific name	CAAB code	Family name	Common name	Role in fishery
360	Teleost	Haliichthys taeniophorus	37282007	Syngnathidae	Ribboned Seadragon, Ribboned Pipefish	TEP
361	Teleost	Dunckerocampus dactyliophorus	37282057	Syngnathidae	Ringed Pipefish	TEP
362	Teleost	Phoxocampus belcheri	37282109	Syngnathidae	Rock Pipefish	TEP
386	Teleost	Dunckerocampus pessuliferus	37282108	Syngnathidae	Many-banded Pipefish	TEP
387	Teleost	Choeroichthys latispinosus	37282044	Syngnathidae	Muiron Island Pipefish	TEP
388	Teleost	Choeroichthys brachysoma	37282042	Syngnathidae	Pacific Short-bodied Pipefish, Short-bodied pipefish	TEP
389	Teleost	Choeroichthys suillus	37282046	Syngnathidae	Pig-snouted Pipefish	TEP
390	Teleost	Lissocampus fatiloquus	37282084	Syngnathidae	Prophet's Pipefish	TEP
401	Teleost	Cosmocampus banneri	37282053	Syngnathidae	Roughridge Pipefish	TEP
452	Teleost	Corythoichthys schultzi	37282052	Syngnathidae	Schultz's Pipefish	TEP
454	Teleost	Halicampus spinirostris	37282070	Syngnathidae	Spiny-snout Pipefish	TEP
546	Teleost	Campichthys tricarinatus	37282040	Syngnathidae	Three-keel Pipefish	TEP
547	Teleost	Micrognathus micronotopterus	37282088	Syngnathidae	Tidepool Pipefish	TEP
548	Teleost	Hippocampus subelongatus	37282123	Syngnathidae	West Australian Seahorse	TEP
549	Teleost	Hippocampus angustus	37282005	Syngnathidae	Western Spiny Seahorse	TEP
563	Teleost	Corythoichthys amplexus	37282047	Syngnathidae	Fijian Banded Pipefish, Brown-banded Pipefish	TEP
566	Teleost	Corythoichthys conspicillatus	37282032	Syngnathidae	Yellow-banded Pipefish, Network Pipefish	TEP
568	Teleost	Doryrhamphus malus	37282060	Syngnathidae	Flagtail Pipefish, Negros Pipefish	TEP
569	Teleost	Doryrhamphus melanopleura	37282058	Syngnathidae	Bluestripe Pipefish	TEP
578	Teleost	Corythoichthys ocellatus	37282050	Syngnathidae	Orange-spotted Pipefish, Ocellated Pipefish	TEP
904	Teleost	Festucalex cinctus	37282061	Syngnathidae	Girdled Pipefish	TEP
914	Teleost	Filicampus tigris	37282064	Syngnathidae	Tiger Pipefish	TEP
938	Teleost	Halicampus grayi	37282030	Syngnathidae	Mud Pipefish, Gray's Pipefish	TEP
942	Teleost	Heraldia nocturna	37282071	Syngnathidae	Upside-down Pipefish	TEP
943	Teleost	Hippichthys cyanospilos	37282072	Syngnathidae	Blue-speckled Pipefish, Blue-spotted Pipefish	TEP

Species ID	Taxa	Scientific name	CAAB code	Family name	Common name	Role in fishery
944	Teleost	Hippichthys heptagonus	37282073	Syngnathidae	Madura Pipefish	TEP
945	Teleost	Hippichthys penicillus	37282075	Syngnathidae	Beady Pipefish, Steep-nosed Pipefish	TEP
946	Teleost	Hippocampus bleekeri	37282010	Syngnathidae	pot bellied seahorse	TEP
947	Teleost	Hippocampus breviceps	37282026	Syngnathidae	Short-head Seahorse, Short-snouted Seaho	TEP
949	Teleost	Hippocampus taeniopterus	37282033	Syngnathidae	Spotted Seahorse, Yellow Seahorse	TEP
951	Teleost	Hippocampus planifrons	37282078	Syngnathidae	Flat-face Seahorse	TEP
953	Teleost	Histiogamphelus briggsii	37282011	Syngnathidae	Briggs' Crested Pipefish, Briggs' Pipefish	TEP
954	Teleost	Histiogamphelus cristatus	37282081	Syngnathidae	Rhino Pipefish, Macleay's Crested Pipefish	TEP
960	Teleost	Hypselognathus horridus	37282082	Syngnathidae	Shaggy Pipefish, Prickly Pipefish	TEP
961	Teleost	Hypselognathus rostratus	37282012	Syngnathidae	Knife-snouted Pipefish	TEP
966	Teleost	Kaupus costatus	37282014	Syngnathidae	Deep-bodied Pipefish	TEP
978	Teleost	Leptoichthys fistularius	37282013	Syngnathidae	Brushtail Pipefish	TEP
979	Teleost	Lissocampus caudalis	37282016	Syngnathidae	Australian Smooth Pipefish, Smooth Pipefish	TEP
980	Teleost	Lissocampus runa	37282009	Syngnathidae	Javelin Pipefish	TEP
983	Teleost	Maroubra perserrata	37282085	Syngnathidae	Sawtooth Pipefish	TEP
995	Teleost	Mitotichthys semistriatus	37282015	Syngnathidae	Half-banded Pipefish	TEP
996	Teleost	Mitotichthys tuckeri	37282025	Syngnathidae	Tucker's Pipefish	TEP
1001	Teleost	Notiocampus ruber	37282095	Syngnathidae	Red Pipefish	TEP
1010	Teleost	Phycodurus eques	37282001	Syngnathidae	Leafy Seadragon	TEP
1011	Teleost	Phyllopteryx taeniolatus	37282002	Syngnathidae	Weedy Seadragon, Common Seadragon	TEP
1026	Teleost	Stigmatopora argus	37282017	Syngnathidae	Spotted Pipefish	TEP
1027	Teleost	Stigmatopora nigra	37282018	Syngnathidae	Wide-bodied Pipefish, Black Pipefish	TEP
1028	Teleost	Stipecampus cristatus	37282019	Syngnathidae	Ring-backed Pipefish	TEP

Species ID	Taxa	Scientific name	CAAB code	Family name	Common name	Role in fishery
1029	Teleost	Syngnathoides biaculeatus	37282100	Syngnathidae	Double-ended Pipehorse, Alligator Pipefish	TEP
1061	Teleost	Pugnaso curtirostris	37282021	Syngnathidae	Pug-nosed Pipefish	TEP
1071	Teleost	Solegnathus sp. 1 [in Kuiter, 2000]	37282099	Syngnathidae	Pipehorse	TEP
1072	Teleost	Solegnathus robustus	37282004	Syngnathidae	Robust Spiny Pipehorse, Robust Pipehorse	TEP
1073	Teleost	Solegnathus spinosissimus	37282029	Syngnathidae	spiny pipehorse	TEP
1089	Teleost	Trachyrhamphus bicoarctatus	37282006	Syngnathidae	Bend Stick Pipefish, Short-tailed Pipefish	TEP
1092	Teleost	Urocampus carinirostris	37282008	Syngnathidae	Hairy Pipefish	TEP
1093	Teleost	Vanacampus margaritifer	37282102	Syngnathidae	Mother-of-pearl Pipefish	TEP
1094	Teleost	Vanacampus phillipi	37282023	Syngnathidae	Port Phillip Pipefish	TEP
1095	Teleost	Vanacampus poecilolaemus	37282024	Syngnathidae	Australian Long-snout Pipefish, Long-snouted Pipefish	TEP
1096	Teleost	Vanacampus vercoi	37282103	Syngnathidae	Verco's Pipefish	TEP
1242	Teleost	Nannocampus subosseus	37282094	Syngnathidae	Bony-headed Pipefish	TEP
1243	Teleost	Mitotichthys meraculus	37282092	Syngnathidae	Western Crested Pipefish	TEP
1548	Teleost	Heraldia sp. 1 [in Kuiter, 2000]	37282130	Syngnathidae	Western upsidedown pipefish	TEP
1584	Teleost	Choeroichthys cinctus	37282043	Syngnathidae	[a pipefish]	TEP
1586	Teleost	Corythoichthys haematopterus	37282048	Syngnathidae	[a pipefish]	TEP
1589	Teleost	Cosmocampus maxweberi	37282056	Syngnathidae	[a pipefish]	TEP
1592	Teleost	Halicampus macrorhynchus	37282067	Syngnathidae	[a pipefish]	TEP
1593	Teleost	Halicampus mataafae	37282068	Syngnathidae	[a pipefish]	TEP
1595	Teleost	Hippichthys spicifer	37282076	Syngnathidae	[a pipefish]	TEP
1596	Teleost	Hippocampus alatus	37282118	Syngnathidae	[a pipefish]	TEP
1597	Teleost	Hippocampus bargibanti	37282106	Syngnathidae	pygmy seahorse	TEP
1598	Teleost	Hippocampus dahli	37282114	Syngnathidae	[a pipefish]	TEP
1600	Teleost	Hippocampus multispinus	37282124	Syngnathidae	[a pipefish]	TEP
1603	Teleost	Hippocampus zebra	37282080	Syngnathidae	[a pipefish]	TEP
1604	Teleost	Micrognathus pygmaeus	37282087	Syngnathidae	[a pipefish]	TEP

Species ID	Taxa	Scientific name	CAAB code	Family name	Common name	Role in fishery
1605	Teleost	Micrognathus natans	37282089	Syngnathidae	[a pipefish]	TEP
1606	Teleost	Microphis brachyurus	37282090	Syngnathidae	[a pipefish]	TEP
1607	Teleost	Nannocampus lindemanensis	37282093	Syngnathidae	[a pipefish]	TEP
1608	Teleost	Phoxocampus diacanthus	37282096	Syngnathidae	[a pipefish]	TEP
1609	Teleost	Siokunichthys breviceps	37282097	Syngnathidae	[a pipefish]	TEP
1664	Teleost	Hippocampus abdominalis	37282120	Syngnathidae	Big-bellied / southern potbellied seahorse	TEP
1665	Teleost	Hippocampus histrix		Syngnathidae	Spiny Seahorse	TEP
1667	Teleost	Hippocampus kuda		Syngnathidae	Spotted Seahorse, Yellow Seahorse	TEP
1668	Teleost	Hippocampus subelongatus		Syngnathidae	West Australian Seahorse	TEP
1669	Teleost	Idiotropiscis larsonae		Syngnathidae	Helen's Pygmy Pipehorse	TEP
1675	Teleost	Hippichthys parvicarinatus	37282074	Syngnathidae	Short-keeled Pipefish	TEP
1676	Teleost	Hippocampus biocellatus	37282115	Syngnathidae	False-eyed seahorse	TEP
1677	Teleost	Hippocampus tuberculatus	37282116	Syngnathidae	Knobby Seahorse	TEP
1678	Teleost	Hippocampus grandiceps	37282126	Syngnathidae	Bighead Seahorse	TEP
1699	Teleost	Idiotropiscis australe		Syngnathidae	Southern Pygmy Pipehorse	TEP

Scoping Document S2B1. Benthic Habitats

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

A list of the benthic habitats occurring within the jurisdictional boundary of the Western Tuna and Billfish Fishery. Longlining effort is pelagic, the benthos is not contacted.

ERAEF record No.	ERAEF Habitat Number	Sub-biome	Feature	Habitat type	SGF Score	Depth (m)	Image available	Reference image location
2136	010	inner shelf	Shelf	Coarse sediments, current rippled, no fauna	210	25-100	Y	WA Image Collection
0111	011	inner shelf	Shelf	coarse sediments, wave rippled, large sponges	221	25- 100	Y	SE Image Collection
2157	017	outer shelf	Shelf	Fine, subcrop, large sponges	151	100- 200	3	WA Image Collection
0197	019	outer shelf	Terrace	coarse sediments, subcrop, large sponges	251	100- 200	Y	GAB habitat image collection
2162	023	outer shelf	Shelf	Sedimentary rock (?), low outcrop, large sponges	671	100- 200	2	WA Image Collection
0258	025	outer shelf	shelf	coarse sediments, wave rippled, no fauna	220	100- 200	Y	SE Image Collection
0283	027	outer shelf	shelf	coarse sediments, current rippled, no fauna	210	100- 200	Y	SE Image Collection
2186	035	upper slope	Slope	Sedimentary, outcrop, small encrustors	666	200- 700	Y	WA Image Collection
2184	036	upper slope	Slope	Sedimentary, subcrop, small encrustors (hydroids?)	656	200- 700	Y	WA Image Collection
2174	041	upper slope	Slope	fine, irregular, bioturbators	139	200- 700	3	WA Image Collection
2102	044	upper slope	Terrace	Fine sediments, Unrippled, Distinct infauna bioturbators	109	200-700	Y	GAB habitat image collection
2103	059	mid-slope	Seamount	Coarse sediments, Highly irregular, Small encrustors	236	700-	Y	GAB habitat image

ERAEF record No.	ERAEF Habitat Number	Sub-biome	Feature	Habitat type	SGF Score	Depth (m)	Image available	Reference image location
						1500		collection
2104	071	upper slope	Canyon, Shelf break	Sedimentary rock, Low Outcrop, Small encrustors	676	200-700	Y	GAB habitat image collection
2176	072	upper slope	Slope	Coarse, rippled, bioturbators	239	200- 700	Y	WA Image Collection
2105	073	upper slope	Terrace	Fine sediments, irregular, Small encrustors	136	200-700	Y	GAB habitat image collection
2171	078	upper slope	Slope, Terrace	Fine sediments, unrippled, Solitary epifauna	107	200- 700	2	WA Image Collection
2107	080	mid-slope	Terrace	Sedimentary rock, Low Outcrop, Small encrustors	676	700-1500	Y	GAB habitat image collection
2108	084	mid-slope	Canyon	Sedimentary rock, Low Outcrop, Sedentary	677	700-1500	Y	GAB habitat image collection
2137	089	inner shelf	Shelf	Coarse sediments, irregular, bryozoan turf	236	25-100	Y	WA Image Collection
2133	095	inner shelf	Shelf	Fine sediments, Wave rippled, No fauna	120	25-100	Y	WA Image Collection
0932	096	inner shelf	shelf	fine sediments, wave rippled, small sponges	122	25- 100	N	SE Image Collection
2151	100	outer shelf	Shelf	Mud, flat, sedentary (eg seapens)	007	100- 200	2	WA Image Collection
0993	101	outer shelf	shelf	coarse sediments, subcrop, small sponges	252	100- 200	N	SE Image Collection
1055	106	outer shelf	shelf	fine sediments, irregular, no fauna	130	100- 200	N	SE Image Collection
1068	107	outer shelf	shelf	fine sediments, irregular, small sponges	132	100- 200	N	SE Image Collection
1093	109	outer shelf	shelf	fine sediments, subcrop, small sponges	152	100- 200	Y	SE Image Collection
1106	110	outer shelf	shelf	fine sediments, unrippled, bioturbators	109	100- 200	Y	SE Image Collection
2156	111	outer shelf	Shelf	Fine sediments, unrippled, large/ erect sponges	101	100- 200	3	WA Image Collection
1131	112	outer shelf	shelf	fine sediments, unrippled, no fauna	100	100- 200	Y	SE Image Collection
1144	113	outer shelf	shelf	fine sediments, unrippled, small sponges	102	100- 200	Y	SE Image Collection
1157	114	outer shelf	shelf	fine sediments, wave rippled, bioturbators	129	100- 200	Y	SE Image Collection
1194	117	outer shelf	shelf	fine sediments, wave rippled, no fauna	120	100- 200	N	SE Image Collection
1231	120	outer shelf	shelf	gravel, current rippled, bioturbators	319	100- 200	N	SE Image Collection
1244	121	outer shelf	shelf	gravel, wave rippled, bioturbators	329	100- 200	Y	SE Image Collection

ERAEF record No.	ERAEF Habitat Number	Sub-biome	Feature	Habitat type	SGF Score	Depth (m)	Image available	Reference image location
1269	123	outer shelf	shelf	gravel, wave rippled, large sponges	321	100- 200	N	SE Image Collection
1282	124	outer shelf	shelf	gravel, wave rippled, no fauna	320	100- 200	N	SE Image Collection
1295	125	outer shelf	shelf	mud, subcrop, small sponges	052	100- 200	Y	SE Image Collection
2160	126	outer shelf	Shelf	Sedimentary rock (?), subcrop, large erect sponges	651	100- 200	3	WA Image Collection
1320	127	outer shelf	shelf	Sedimentary rock, subcrop, small sponges	652	100- 200	Y	SE Image Collection
2219	128	upper slope	slope	Bryozoan based communities	xx6	200- 700	N	SE Image Collection
2172	133	upper slope	Slope	Fine, current rippled, no fauna	110	200- 700	Y	WA Image Collection
2169	141	upper slope	Slope	mud, unrippled, distinct infaunal bioturbators	009	200- 700	Y	WA Image Collection
2110	144	upper slope	Canyon	Mud, Unrippled, Sedentary	007	200-700	Y	GAB habitat image collection
2188	145	upper slope	Canyon	Sedimentary, low outcrops, large sponges	671	200- 700	2	WA Image Collection
2111	148	upper slope	Terrace	Sedimentary rock, Subcrop, Octocorals (gold corals)	655	200-700	Y	GAB habitat image collection
2112	152	mid-slope	Slope	Coarse sediments, directed scour, Sedentary	217	700-1500	Y	GAB habitat image collection
2113	156	mid-slope	Slope, Terrace	Fine sediments, Unrippled, No fauna	100	700-1500	Y	GAB habitat image collection
2211	157	mid-slope	Slope	Igneous rock, high outcrop, octocoral	595	700-1500	Y	WA Image Collection
2199	159	mid-slope	Slope	Mud, irregular, bioturbators	039	700-1500	Y	WA Image Collection
2114	163	mid-slope	Terrace	Sedimentary rock, High Outcrop, Octocorals (gold corals)	695	700-1500	Y	GAB habitat image collection
2212	165	mid-slope	Slope	Sedimentary, subcrop, octocoral	655	700-1500	Y	WA Image Collection
2220	166	outer shelf	shelf-break	Bryozoan based commmunities	xx6	100-200, 200- 700	N	SE Image Collection
1883	177	outer shelf	shelf	mud, unrippled, low encrusting sponges	002	100- 200	N	SE Image Collection
1892	178	outer shelf	shelf	mud, unrippled, bioturbators	009	100- 200	N	SE Image Collection

ERAEF record No.	ERAEF Habitat Number	Sub-biome	Feature	Habitat type	SGF Score	Depth (m)	Image available	Reference image location
1901	179	outer shelf	shelf	mud, subcrop, erect sponges	051	100- 200	N	SE Image Collection
1910	180	outer shelf	shelf	mud, subcrop, low encrusting mixed fauna	056	100- 200	N	SE Image Collection
1919	181	outer shelf	shelf	fine sediments, unrippled, encrustors	106	100- 200	N	SE Image Collection
1928	183	outer shelf	shelf	fine sediments, current rippled, no fauna	110	100- 200	N	SE Image Collection
1937	184	outer shelf	shelf	fine sediments, current rippled, low/ encrusting sponges	112	100- 200	N	SE Image Collection
1946	185	outer shelf	shelf	fine sediments, irregular, low encrusting mixed fauna	136	100- 200	N	SE Image Collection
1955	187	outer shelf	shelf	fine sediments, irregular, bioturbators	139	100- 200	N	SE Image Collection
1964	188	outer shelf	shelf	fine sediments, rubble banks, low encrusting sponges	142	100- 200	N	SE Image Collection
1973	189	outer shelf	shelf	fine sediments, subcrop, mixed low fauna	156	100- 200	N	SE Image Collection
1982	190	outer shelf	shelf	coarse sediments, unrippled, no fauna	200	100- 200	N	SE Image Collection
1993	191	inner shelf	shelf	coarse sediments, wave rippled, small sponges	222	25- 100	N	SE Image Collection
2004	192	outer shelf	shelf	gravel/ pebble, current rippled, large sponges	311	100- 200	N	SE Image Collection
2013	193	outer shelf	shelf	gravel/ pebble, current rippled, mixed low fauna	316	100- 200	N	SE Image Collection
2022	194	outer shelf	shelf	gravel/ pebble, wave rippled, low encrusting sponges	322	100- 200	N	SE Image Collection
2031	195	outer shelf	shelf	gravel, wave rippled, encrustors	326	100- 200	N	SE Image Collection
2040	196	outer shelf	shelf	gravel, wave rippled, encrustors	346	100- 200	N	SE Image Collection
2049	197	outer shelf	shelf	cobble, unrippled, low/ encrusting mixed fauna	406	100- 200	N	SE Image Collection
2058	198	outer shelf	shelf	cobble, current rippled, low/ encrusting mixed fauna	416	100- 200	N	SE Image Collection
2069	199	inner shelf	shelf	cobble, wave rippled, low/ encrusting mixed fauna	426	25- 100	N	SE Image Collection
2082	200	inner shelf	shelf	coarse sediments, wave rippled, encrustors	226	25- 100	N	SE Image Collection
2093	201	inner shelf	shelf	fine sediments, wave rippled, encrustors	126	25- 100	N	SE Image Collection
2141	202	upper slope	Slope	mud, unrippled, no fauna	000	200- 700	Y	WA Image Collection
2116	203	Inner shelf	shelf	Fine sediments, Unrippled, Small encrustors	106	25- 100	Y	GAB habitat image collection
2117	204	Inner shelf	shelf	Fine sediments, Subcrop, Mixed faunal community (sponges, seawhips, ascidians)	153	25- 100	Y	GAB habitat image collection

ERAEF record No.	ERAEF Habitat Number	Sub-biome	Feature	Habitat type	SGF Score	Depth (m)	Image available	Reference image location
2118	205	inner shelf	shelf	Coarse sediments, Unrippled, Small encrustors / erect forms (including bryozoans)	206	25- 100	Y	GAB habitat image collection
2134	205	inner shelf	Shelf	Coarse sediments, current swept, mixed low epifauna	206	25-100	Y	WA Image Collection
2119	206	Inner shelf	shelf	Coarse sediments, Current rippled / directed scour, large sponges	211	25- 100	Y	GAB habitat image collection
2120	207	mid-slope	Terrace	Coarse sediments, Current rippled / directed scour, Small encrustors / erect forms (including bryozoans)	216	700-1500	Y	GAB habitat image collection
2121	208	mid-slope	Seamount	Coarse sediments, Highly irregular, Mixed faunal community (sponges, seawhips, ascidians)	233	700-1500	Y	GAB habitat image collection
2122	209	Outer shelf	Terrace	Coarse sediments, Subcrop, Mixed faunal community	253	100- 200	Y	GAB habitat image collection
2123	210	mid-slope	Seamount	Cobble/ boulder, Debris flow / rubble banks, Sedentary: e.g. seapens	447	700-1500	Y	GAB habitat image collection
2124	211	mid-slope	Seamount	Igneous / metamorphic rock, Subcrop, Small encrustors	556	700-1500	Y	GAB habitat image collection
2125	212	mid-slope	Seamount	Igneous / metamorphic rock, Subcrop, Sedentary: e.g. seapens	557	700-1500	Y	GAB habitat image collection
2126	213	mid-slope	Seamount	Igneous / metamorphic rock, Low Outcrop, Octocorals (gold corals / seawhips)	575	700-1500	Y	GAB habitat image collection
2127	214	mid-slope	Seamount	Igneous / metamorphic rock, Low Outcrop, Small encrustors	576	700-1500	Y	GAB habitat image collection
2128	215	mid-slope	Seamount	Igneous / metamorphic rock, Low Outcrop, Sedentary: e.g. seapens	577	700-1500	Y	GAB habitat image collection
2129	216	upper slope	Canyon	Sedimentary rock, low outcrop, Octocorals (gold corals / seawhips)	675	200-700	Y	GAB habitat image collection
2130	217	upper slope	Canyon	Sedimentary rock, High Outcrop, Small encrustors / erect forms (including bryozoans)	686	200-700	Y	GAB habitat image collection
2131	218	upper slope	Canyon	Sedimentary rock, High Outcrop, Sedentary: e.g. seapens	687	200-700	Y	GAB habitat image collection
2149	219	outer shelf	Shelf	mud, unrippled, small or large sponges	001	100- 200	Y	WA Image Collection
2150	220	outer shelf	Shelf	Mud, flat, octocorals	005	100- 200	Y	WA Image Collection
2197	221	mid-slope	Slope	Mud, irregular (bioturbators), crinoids/ featherstars on whip	005	700-1500	Y	WA Image Collection

ERAEF record No.	ERAEF Habitat Number	Sub-biome	Feature	Habitat type	SGF Score	Depth (m)	Image available	Reference image location
2198	222	mid-slope	Slope	Mud, flat, solitary	007	700-1500	Y	WA Image Collection
2152	223	outer shelf	Shelf	mud, current rippled, bioturbators	019	100- 200	Y	WA Image Collection
2153	224	outer shelf	Shelf	mud, wave rippled, no fauna	020	100- 200	Y	WA Image Collection
2154	225	outer shelf	Shelf	Mud, irregular, bioturbators	039	100- 200	Y	WA Image Collection
2155	226	outer shelf	Shelf	Mud, subcrop, mixed faunal community	053	100- 200	Y	WA Image Collection
2170	227	upper slope	Slope	Fine sediments, unrippled, sponges	101	200- 700	Y	WA Image Collection
2201	228	mid-slope	Slope	Fine, unrippled, solitary	107	700-1500	Y	WA Image Collection
2132	229	inner shelf	Canyon	Fine sediments, current rippled, no fauna	110	25-100	Y	WA Image Collection
2202	230	mid-slope	Slope	fine sediments, irregular, no fauna	130	700-1500	Y	WA Image Collection
2173	231	upper slope	Slope	Fine sediments, irregular, glass sponge (stalked)	137	200- 700	Y	WA Image Collection
2203	232	mid-slope	Slope	Fine sediments, subcrop, octocorals	155	700-1500	Y	WA Image Collection
2158	233	outer shelf	Shelf	Coarse sediments, unrippled, octocoral/ and bryozoans??	205	100- 200	Y	WA Image Collection
2135	234	inner shelf	Shelf	Coarse sediments, unrippled, solitary epifauna	207	25-100	Y	WA Image Collection
2175	235	upper slope	Slope	Coarse sediments, rippled, no fauna	210	200- 700	Y	WA Image Collection
2175	236	upper slope	Slope	Coarse sand, rippled, solitary epifauna	217	200- 700	Y	WA Image Collection
2177	237	upper slope	Slope	Coarse sand, wave rippled, bryozoan turf	226	200- 700	Y	WA Image Collection
2178	238	upper slope	Slope	Coarse sediments, irregular, octocorals (matrix of solsomalia – dead corals)	235	200- 700	Y	WA Image Collection
2179	239	upper slope	Slope	Coarse sediments, subcrop, large (?) sponges	251	200- 700	Y	WA Image Collection
2180	240	upper slope	Slope	Sedimentary, subcrop, octocorals	255	200- 700	Y	WA Image Collection
2181	241	upper slope	Slope	Coarse sediments, subcrop, low encrusting community (ascidians)	256	200- 700	Y	WA Image Collection
2138	242	inner shelf	Shelf	Gravel, irregular, no fauna	330	25-100	Y	WA Image Collection
2204	243	mid-slope	Slope	Gravel, irregular, low encrustings	336	700-1500	2	WA Image Collection

ERAEF record No.	ERAEF Habitat Number	Sub-biome	Feature	Habitat type	SGF Score	Depth (m)	Image available	Reference image location
2205	244	mid-slope	Slope	Igneous rock/boulder, rubble bank, none	440	700-1500	Y	WA Image Collection
2206	245	mid-slope	Slope	boulders and slabs, subcropping, octocorals	455	700-1500	Y	WA Image Collection
2159	246	outer shelf	Shelf	cobble/boulder (slab), outcrop, mixed low encrustors	466	100- 200	Y	WA Image Collection
2182	247	upper slope	Slope	boulders, outcrop no fauna	470	200- 700	Y	WA Image Collection
2207	248	mid-slope	Slope	Igneous rock, rubble bank, no fauna	540	700-1500	Y	WA Image Collection
2208	249	mid-slope	Seamount	Igneous rock, rubble bank, octocorals	545	700-1500	Y	WA Image Collection
2209	250	mid-slope	Seamount	Igneous rock, low outcrop, no fauna	570	700-1500	Y	WA Image Collection
2183	251	upper slope	Slope	Sedimentary, subcrop, no fauna	650	200- 700	Y	WA Image Collection
2213	252	mid-slope	Slope	Sedimentary, subcrop, small encrustors	656	700-1500	2	WA Image Collection
2214	253	mid-slope	Slope	rock (conglomerate/sedimentary), subcrop, bioturbators	659	700-1500	Y	WA Image Collection
2216	254	outer shelf	Shelf	Sedimentary rock (?), low outcrop, large erect sponges	661	100- 201	Y	WA Image Collection
2161	255	outer shelf	Shelf	Sedimentary rock (?) low outcrop, mixed faunal community	663	100- 200	Y	WA Image Collection
2185	256	upper slope	Slope	Sedimentary, outcrop, octocorals	665	200- 700	Y	WA Image Collection
2187	257	upper slope	Shelf break	Sedimentary, low outcrop, no fauna	670	200- 700	3	WA Image Collection
2163	258	outer shelf	Shelf	Sedimentary rock (?), low outcrop, mixed faunal community	673	100- 200	Y	WA Image Collection
2164	259	outer shelf	Shelf	Rock (sedimentary?), outcrop (low, holes and cracks etc), encrustors	676	100- 200	Y	WA Image Collection
2165	260	outer shelf	Shelf	Rock (sedimentary?), outcrop, solitary	677	100- 200	Y	WA Image Collection
2190	261	upper slope	Slope	Sedimentary, outcrop, sedentary (anemones)	677	200- 700	Y	WA Image Collection
2215	262	mid-slope	Slope	sedimentary/mudstone, high outcrop, no fauna	680	700-1500	Y	WA Image Collection
2166	263	outer shelf	Shelf	Rock (sedimentary?), high outcrop, ?small sponges	682	100- 200	Y	WA Image Collection
2191	264	upper slope	Slope	Sedimentary, high outcrop, octocoral	683	200- 700	Y	WA Image Collection

ERAEF record No.	ERAEF Habitat Number	Sub-biome	Feature	Habitat type	SGF Score	Depth (m)	Image available	Reference image location
2193	265	upper slope	Slope	Sedimentary rock (mudstone?), high outcrop, no fauna	690	200- 700	3	WA Image Collection
2167	266	outer shelf	Shelf	Rock (sedimentary?),, high outcrop, large sponges	691	100- 200	Y	WA Image Collection
2194	267	upper slope	Slope	Sedimentary rock (mudstone?), high outcrop, small sponges	692	200- 700	Y	WA Image Collection
2168	268	outer shelf	Shelf	Sedimentary rock (?), high outcrop, mixed faunal community	693	100- 200	Y	WA Image Collection
2195	269	upper slope	Slope	Sedimentary, outcrop, octocorals	695	200- 700	Y	WA Image Collection
2196	270	upper slope	Slope	Sedimentary, high outcrop, solitary epifauna	697	200- 700	Y	WA Image Collection
2139	271	inner shelf	Shelf	Rock/ biogenic matrix, high outcrop, large sponges	719	25-100	Y	WA Image Collection
2140	272	inner shelf	Shelf	Rock/ biogenic matrix, Wave rippled, No fauna	720	25-100	Y	WA Image Collection
2145	273	inner shelf	Shelf	Rock/ biogenic matrix,subcrop, large sponges	751	25-100	3	WA Image Collection
2146	274	inner shelf	Shelf	Rock/ biogenic matrix, subcrop, small encrustors	756	25-100	Y	WA Image Collection
2142	275	inner shelf	Shelf	Rock/ biogenic matrix, low outcrop, mixed faunal community	763	25-100	Y	WA Image Collection
2143	276	inner shelf	Shelf	Rock/ biogenic matrix, low outcrop, octocorals	765	25-100	Y	WA Image Collection
2147	277	inner shelf	Shelf	Rock/ biogenic matrix, low outcrop (with holes/cracks), mixed faunal community	773	25-100	Y	WA Image Collection
2144	278	inner shelf	Shelf	Rock/ biogenic matrix, outcrop low (with holes/ cracks), mixed faunal community	793	25-100	Y	WA Image Collection
2148	279	outer shelf	Shelf	mud, current rippled, no fauna	010	100- 200	Y	WA Image Collection
2217	280	outer shelf		Rock (sedimentary?), high outcrop, solitary	681	100- 201	Y	WA Image Collection
2218	281	outer shelf	Shelf	Rock/ biogenic matrix, low outcrop, mixed faunal community	763	100-200	Y	WA Image Collection

Scoping Document S2B2. Pelagic Habitats

A list of the pelagic habitats occurring within the jurisdictional boundary of the (Southern and) Western Tuna and Billfish Fishery. Shading denotes pelagic habitats not subject to effort.

ERAEF Habitat Number	Pelagic Habitat type	Depth (m)	Comments	Reference
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
P10	Western Pelagic Province - Coastal	0 – 200		dow167A1, A2, A4
P7	Southern Pelagic Province - Coastal	0 – 200	this is a compilation of the range covered by Coastal pelagic Tas and GAB	dow167A1, A2, A4
P8	Southern Pelagic Province - Oceanic	0 – > 600	this is a compilation of the range covered by Oceanic Communities (1, 2 and 3)	dow167A1, A2, A4
P11	Western Pelagic Province - Oceanic	0 – > 400	this is a compilation of the range covered by 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 which underlie the pelagic communities in the Southern and Western Tuna and Billfish subfishery (x). Shaded cells indicate all communities within the province. [1]

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

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

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

Scoping Document S2C2. Pelagic Communities

Pelagic communities in which fishing activity occurs in the Southern and Western Tuna and Billfish subfishery (x). Shaded cells indicate all communities that exist in the province. [1]

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

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

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

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

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

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

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

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

Scoping Document S3 Components and Sub-components Identification of Objectives

Table (Note: Operational objectives that are eliminated should be shaded out and a rationale provided as for the retained operational objectives)

Component	Core Objective	Sub-component	Example Operational Objectives	Example Indicators	Rationale
	"What is the general goal?"	*As shown in sub-component model diagrams at the beginning of this section.*	*"What you are specifically trying to achieve"*	*"What you are going to use to measure performance"*	*Rationale flagged as 'EMO' where Existing Management Objective in place, or 'AMO' where there is an existing AFMA Management Objective in place for other Commonwealth fisheries (assumed that 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 EMO. Management plan states that the fishery is conducted in manner consistent with principles of sustainable development. 1.3 AFMA Maintain catch at specified level
		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 AFMA To maintain integrity of natural lifecycle, migration and reproduction
		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 Manage each stock sustainably
		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 Age/size/sex structure can be used as one of a set of 'indicators' of stock status, especially for species with little data or assessment. Maintenance of proper functioning of population processes.

Component	Core Objective	Sub-component	Example Operational Objectives	Example Indicators	Rationale
		5. Reproductive Capacity	5.1 Fecundity of the population does not change outside acceptable bounds (e.g. more than X% of reference population fecundity) 2 Recruitment to the population does not change outside acceptable bounds	Egg production of population Abundance of recruits	5.1AFMA Ability of species to sustain fishing depends on ability to repopulate. 5.2 AFMA Sustainability of population determined by recruitment of new individuals into the fished population.
		6. Behaviour /Movement	6.1 Behaviour and movement patterns of the population do not change outside acceptable bounds	Presence of population across space, movement patterns within the population (e.g. attraction to bait, lights)	6.1 Changes in behaviour and movement may indicate stock is depleted. May make it harder for fishery to locate fish.
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 AFMA Fishing is conducted in a manner that does not threaten stocks of byproduct and bycatch species. 1.3 AFMA Maintain catch at specified level
		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	2.1AFMARange contraction can be used as one of a set of 'indicators' of stock status, especially for species with little data or assessment.
		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 Desirable to manage each stock sustainably
		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 Age/size/sex structure can be used as one of a set of 'indicators' of stock status, especially for species with little data or assessment. Maintenance of proper functioning of population processes.

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	5.1AFMA Ability of species to sustain fishing depends on ability to repopulate. 5.2 Sustainability of population determined by recruitment of new individuals into the fished population.
		6. Behaviour /Movement	6.1 Behaviour and movement patterns of the population do not change outside acceptable bounds	Presence of population across space, movement patterns within the population (e.g. attraction to bait, lights)	6.1 Changes in behaviour and movement may indicate stock is depleted
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 AFMA The fishery is conducted in a manner that avoids mortality of, or injuries to, endangered, threatened or protected species.
		2. Geographic range	2.1 Geographic range of the population, in terms of size and continuity does not change outside acceptable bounds	Presence of population across space, i.e. the GAB	2.1 Change in range of TEP species could have serious consequences.
		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 TEPs are sensitive to loss of genetic diversity.

Component	Core Objective	Sub-component	Example Operational Objectives	Example Indicators	Rationale
		4. Age/size/sex structure	4.1 Age/size/sex structure does not change outside acceptable bounds (e.g. more than X% from reference structure)	Biomass, numbers or relative proportion in age/size/sex classes Biomass of spawners Mean size, sex ratio	4.1 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.
		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 Reduction of reproductive capacity of TEP species is a threat to their survival.
		6. Behaviour /Movement	6.1 Behaviour and movement patterns of the population do not change outside acceptable bounds	Presence of population across space, movement patterns within the population (e.g. attraction to bait, lights)	6.1 Changes in behaviour and movement patterns of TEP species may impact on their survival.
		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 AFMA The fishery is conducted in a manner that avoids mortality of, or injuries to, endangered, threatened or protected species.
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 AFMA fishery is conducted in a manner that has regard to the long-term sustainability of the marine environment

Component	Core Objective	Sub-component	Example Operational Objectives	Example Indicators	Rationale
		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 Air quality does not change outside acceptable bounds
		3. Substrate quality	3.1 Sediment quality does not change outside acceptable bounds	Sediment chemistry, stability, particle size, debris, pollutant concentrations	3.1 AFMA Sediment quality does not change outside acceptable bounds
		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 AFMA Relative abundance of habitat types does not vary outside acceptable bounds
		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	5.1AFMA Size, shape and condition of habitat types does not vary outside acceptable bounds
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 AFMA The fishery is conducted on a manner that minimizes the impact of fishing on ecological communities
		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 The fishery is conducted in a manner that avoids changes in community range.

Component	Core Objective	Sub-component	Example Operational Objectives	Example Indicators	Rationale
		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 AFMA The fishery is conducted in a manner that does not change trophic dynamics, structure, productivity/flows
		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 Cycles do not vary outside acceptable bounds

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: WTBF
Sub-fishery Name: Longline
Date completed: August 25, 2003, reviewed May 29. 2006

Direct impact of Fishing	Fishing Activity	Score (0/1)	Documentation of Rationale
Capture	Bait collection	1	Live bait blue mackerel and yellowtail scad 1%. Baitfish caught in embayments on south coast at night using small hand pulled purse seines
	Fishing	1	Fishing targets tuna and tuna like species – WTBF operators don't target SBT but can take SBT if they hold or lease quota for that species
	Incidental behaviour	1	Occasional but rare, can catch squid. Offshore fishery, so fishers do not go ashore on islands.
Direct impact without capture	Bait collection	1	Small hand pulled purse seines used, fate of those fish that interact with gear unknown, *
	Fishing	1	Interactions with birds and mammals. Fish species: Industry have expressed interest in trialing small scale FADs in the future. Several small FADs are currently in place to assist recreational fishers. http://www.westernangler.com.au/ click on the FAD link on the homepage
	Incidental behaviour	1	As for incidental behavior resulting in capture, but some of the species may escape before capture.
	Gear loss	1	Potential loss longline gear – industry is working with EA to develop protocols for retrieving gear from inside MPAs (at present hauling lost gear would be considered as fishing and be subject to sanction under the EPBC Act)
	Anchoring/ mooring	1	Pelagic fishery, parachute anchor may be used in bad weather. May occur while baiting.*
	Navigation/steaming	1	Steaming to and from port
Addition/ movement of biological material	Translocation of species (boat launching, reballasting)	1	Could occur incidentally via boat hulls. Translocation of dead and live bait. Dead bait from international sources. Water may be used as ballast for trimming purposes.
	On board processing	1	Discarding of unwanted sections of target and byproduct (within catch limits) species
	Discarding catch	1	Discarding occurs
	Stock enhancement	0	Does not occur
	Provisioning	1	Dead and live bait, guts and gills – regulations apply to limit the discharge of old bait and processing wastes to periodic release, the intent being to avoid a continuous flow of waste particles during hauling to reduce the attractiveness of the vessel to seabirds. Predation of caught fish on longlines occurs, pilot whales implicated.

Direct impact of Fishing	Fishing Activity	Score (0/1)	Documentation of Rationale
	Organic waste disposal	1	Disposal of organic wastes (food scraps, sewage) from boats
Addition of non-biological material	Debris	1	Chemical lightsticks. Disposal of garbage is strictly regulated but potential sources of plastic waste. Operators have reported many instances of bait strap entanglement to AFMA stressing that they generally use bait packaged without straps and follow MARPOL requirements carefully. Other domestic and international fisheries also use bait packaged with straps. Industry Code of Conduct is relevant for this fishery, requiring operators to bring back rubbish.
	Chemical pollution	1	Oil spills and anti fouling. Result of steaming to fishing grounds and fishing activities.
	Exhaust	1	Result of steaming to fishing grounds and fishing activities.
	Gear loss	1	Loss of longline gear occurs
	Navigation/ steaming	1	Will introduce noise and visual stimuli.
	Activity/ presence on water	1	Will introduce noise and visual stimuli into the environment from vessel and light sticks.
Disturb physical processes	Bait collection	1	Small purse seines can touch the bottom but the boat is generally stationary so hauling does not a have a forceful effect on benthos. WA scientists may have some experience from their state pilchard fisheries.
	Fishing	1	Minimal (all target species gear types are pelagic in nature)
	Boat launching	0	Boats come from ports, some recreational vessels presumably use boat ramps
	Anchoring/ mooring	1	Pelagic fishery, parachute anchor may be used in bad weather. May occur if white baiting.*
	Navigation/ steaming	1	Occurs *
External Hazards (specify the particular example within each activity area)	Other capture fishery methods State fisheries Indigenous High-seas	1	Other fishery capture methods occur in the same areas, in the AFZ there are state fisheries, recreational and charter fishing, access for traditional craft in the Indonesian MOU box and regular incursions by illegal foreign fishers (usually Indonesian) mainly targeting trochus and shark. There is also indigenous take of TEP species such as turtles and dugong. Outside the AFZ foreign fleets including non-IOTC members and some IUU vessels. High-seas purse seining occurs in the western Indian Ocean. Recreational fishers practice tag and release of gamefish species.
	Aquaculture	0	None currently within area of fishery or influencing the target species. Yellowfin tuna ranching is being considered –but this is not within AFMA's head of power to manage. The Federal Environment Minister Dr Kemp has decided the tuna farm proposal does not need to be assessed under the EPBC Act (see attached email)

Direct impact of Fishing	Fishing Activity	Score (0/1)	Documentation of Rationale
	Coastal development	1	Fishery covers a large area, so there could be impacts for example debris from river flow, removal of mangroves, changes in water flows due to dams in catchments.
	Other extractive activities	1	Fishery covers a large area there are activities such as: oil and gas on the NW Shelf; defense activities; removal of gauno from Christmas Island.
	Other non-extractive activities	1	Fishery covers a large area examples of activities includes the navy use in Rottnest Island canyons, and MPAs. Shipping also common within the area.
	Other anthropogenic activities	1	Fishery covers a large area wide range of uses such as tourism and recreational use

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

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

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

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

2.2.5 Bibliography (Step 5)

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

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

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

Other publications that may provided information include

- BRS Fishery Status Reports
- Strategic Plans

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

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

In this case, 24 out of 26 possible internal activities were identified as occurring in this fishery. Five out of 6 external activities were identified. Thus, a total of 29 activity-component scenarios will be considered at Level 1. This results in 145 total scenarios (of 160 possible) to be developed and evaluated using the unit lists (species, habitats, communities).

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

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

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

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

Step 11. Summary of SICA results
Step 12. Evaluation/discussion of Level 1
Step 13. Components to be examined at Level 2

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

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

2.3.2 Score spatial scale of activity (Step 2)

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

Spatial scale score of activity

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

Maps and graphs may be used to supplement the information (e.g. sketches of the distribution of the activity relative to the distribution of the component) and additional notes describing the nature of the activity should be provided. The spatial scale score at Step 2 is not used directly, but the analysis is used in making judgments about level of intensity at Step. 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 11**) (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

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

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

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

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

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

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

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

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

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

documented. The confidence will reflect the levels of uncertainty for each score at steps 2, 3, 7 and 8.

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

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

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

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

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

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

Direct impact of fishing	Fishing Activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
Capture	Bait collection	1	6	6	Population size	Blue mackerel, yellowtail scad	1.1	1	1	1	Bait collection is permitted for own use in fishing for scheduled species. Fishery occurs throughout year and covers a large area VIC westward to Cape York QLD. Live bait used for 1% shots. Embayment fishing on the south coast. Permit conditions restrict to small scale purse seine nets, which are hand hauled (no power-blocks). May affect baitfish but unlikely to affect target species (food source). Intensity: because current live bait catch is low impact expected to be negligible, unlikely to be detectable against background variability. Consequence: negligible because scale and intensity low, level of bait catch it is unlikely to impact population size. Confidence: low because of insufficient knowledge on live baitfish distribution, and capture. Need to consider overall stock status of baitfish with regard to capture by 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 (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
	Fishing	1	6	6	Population size	Broadbill swordfish and Bigeye (Yellowfin and striped marlin discussed in worshops)	1.1	4	4	1	Fishery occurs throughout year and covers a large area (VIC westward to Cape York QLD.) for all species. BRS (2004) raised some issues on the status of some species, bigeye tuna is not overfished but over fishing occurring, particularly in western Indian ocean. Broadbill swordfish this species is fully fished in Indian ocean and the WTBF, and that it should be monitored closely in the WTBF for localised depletion associated with intensive fishing. The IOTC expressed concerns about increasing pressure on juvenile yellowfin and bigeye by purse seiners fishing on FADs. Intensity: major the domestic fishery has grown rapidly since 1998 (start) and is greater than Japanese catches (1987-1997). Because of this the level of fishing may affect the state of stocks. Consequence: is considered major because recognition that stocks maybe at full exploitation rate, IOTC stated that the broadbill swordfish fishery is growing rapidly and no increases in catch or effort should be allowed. Confidence: low as lack of data
	Incidental behaviour	1	6	6	Population size	Broadbill swordfish, Yellowfin tuna	1.1	1	1	1	Discussed at meeting this fishery offshore unlikely there would be activities that might impact target species. Intensity: at this stage assumed negligible Consequence: negligible, unlikely to affect population size. Confidence: low at this stage as the information collection system is in the development stage. To be reviewed once results of the Data Collection Programme and BRS scientific monitoring are complete.
Direct impact without capture	Bait collection	1	6	6	Population size	Blue mackerel, yellowtail scad	1.1	1	1	1	Embayment fishing on the south coast. Permit conditions restrict to small scale purse seine nets, which are hand hauled (no power-blocks) Some baitfish may be impacted by interactions with gear but unlikely to affect target species (food source). Intensity: because current live bait catch is low, impact expected to be negligible, unlikely to be detectable against background variability. Consequence: negligible because scale and intensity of bait catch is low (escape even lower) it is unlikely to impact population size of bait species or target species. Confidence: low because of

Direct impact of fishing	Fishing Activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
											insufficient knowledge on live baitfish distribution, and capture. Need to consider overall stock status of baitfish with regard to capture by other fisheries.
	Fishing	1	6	6	Population size	Broadbill swordfish, Bigeye and Yellowfin tuna	1.1	2	2	1	Yellowfin school in size classes. Small bigeye school with yellowfin and skipjack, adult bigeye tend to be solitary. Large Broadbill swordfish tend to be solitary. There might be some interaction with gear without capture. Intensity: minor because impact to those that escape gear is considered low. However Yellowfin could be more susceptible because they school in size classes, and also small bigeye as they school with yellowfin. Consequence: minor because direct impact with out capture is expected to be low. Confidence: low as the information collection system is in development stages and is currently inadequate for the scale of the fishery.
	Incidental behaviour	1	6	6	Population size	Broadbill swordfish, Bigeye and Yellowfin tuna	1.1	1	1	1	Discussed at meeting this fishery offshore unlikely there would be activities that might impact target species. Intensity: negligible. Consequence: negligible; assumed unlikely too affect population size. Confidence: low at this stage as the information collection system is in the development stage. To be reviewed once results of the Data Collection Programme and BRS scientific monitoring Programme are completed.

Direct impact of fishing	Fishing Activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
	Gear loss	1	6	6	Population size	Broadbill swordfish, Bigeye and Yellowfin tuna	1.1	1	1	1	Longline gear is lost. Method of targeting yellowfin gear set shallow, big eye set deep. Target species may be caught as gear drifts. GPS radio beacons assist recovery gear. Lost gear tends to ball up reducing likelihood of entanglement. Intensity: Even though lost gear can continue to fish once lost, for this fishery direct impact expected to be minimal because of this it has been scored negligible, as it is unlikely to be detectable against background variability. Consequence: because the scale and intensity of direct impacts without capture is perceived to be low in scale and intensity consequence is expected to be negligible as level of catch unlikely to impact population size. Confidence: low because of a lack of data on interactions.
	Anchoring/ mooring	1	6	6	Population size	Broadbill swordfish, Bigeye and Yellowfin tuna	1.1	1	1	2	Use sea anchors occasionally, longline vessels rarely anchor or moor in anchorages. but unlikely to impact target species i.e. kill fish. Intensity: because the likelihood of impact is expected to be very unlikely, intensity is considered negligible, to be detectable against background variability. Consequence: because the scale and intensity is considered negligible it is unlikely to impact population size and so is considered to have a negligible consequence. Confidence scored high due to consensus.
	Navigation/ steaming	1	6	6	Population size, Behavior and movement	Broadbill swordfish, Bigeye and Yellowfin tuna	1.1, 6.1	1	1	2	Fishing activity hence Navigation/ steaming occurs throughout the year over the entire fishery. Navigation/steaming is a large component of the operations. Intensity: negligible because it is unlikely to have measureable/detectable impact ie collisions. Consequence: negligible because interactions remote, and impact on population size or behaviour and movement of target species unlikely. Confidence: high because it was considered unlikely for there to be strong interactions between Navigation/steaming and target species.

Direct impact of fishing	Fishing Activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
Addition/ movement of biological material	Translocation of species	1	6	6	Population size	Target bait species, such as Pilchard. License to catch squid but currently do not catch for bait	1.1	2	2	1	Live bait 1% shots (blue mackerel, yellowtail scad), rest is dead bait. Broadbill swordfish and bigeye targeted using squid, other target species use pilchard, blue mackerel, yellowtail scad. Intensity: considered minor but currently 99% bait used is dead (is it imported). If dead bait imported disease could be a problem as occurred in SBT however considered minor because does not spread to target species. Consequence: considered minor but translocation of species through transmission of disease could possibly affect population size of target bait species. Confidence: low because of a lack of data.
	On board processing	1	6	6	Behavior and movement	Broadbill swordfish, Bigeye and Yellowfin tuna	6.1	1	1	1	On board processing occurs. Subject to TAP regulations prohibit discharge offal during line setting or hauling. Intensity: negligible impacts expected because waste expected to be taken up quickly by opportunistic scavengers or sink to benthos and scavenged by benthic species, target species in the area might scavenge. Not concentrated, relative amount not known but presume low. Consequence: negligible Unlikely to affect behaviour /movement of target species because of scavenging, if scavengers more likely to attract oceanic sharks. Confidence: low because of a lack of verified observer data.
	Discarding catch	1	6	6	Behaviour and movement	Broadbill swordfish, Bigeye and Yellowfin tuna	6.1	1	1	1	Discarding of target species due to high grading and damage by sharks or marine mammals, and discarding byproduct species of low value or lack of markets, occurs. Intensity: negligible because waste expected to be taken up quickly by opportunistic scavengers or sink to benthos and scavenged by benthic species, target species in the area might scavenge. Consequence: negligible Unlikely to affect behaviour /movement of target species because of scavenging, if scavengers more likely to attract oceanic sharks. Confidence: low because of a lack of verified observer data.
	Stock enhancement										

Direct impact of fishing	Fishing Activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
	Provisioning	1	6	6	Behaviour and movement	Broadbill swordfish, Bigeye and Yellowfin tuna	6.1	1	1	1	Provisioning occurs through bait and discarding. Shark and cetacean predation on longline fish relatively common. Intensity: negligible because waste expected to be taken up quickly by opportunistic scavengers or sink to benthos and scavenged by benthic species, target species in the area might scavenge. Consequence: negligible. Unlikely to affect behaviour /movement of target species because of scavenging, if scavengers more likely to attract oceanic sharks. Confidence: low because of a lack of verified observer data.
	Organic waste disposal	1	6	6	Behaviour and movement	Broadbill swordfish, Bigeye and Yellowfin tuna	6.1	1	1	2	Domestic boasts ave 3-7 days at sea but increasingly maybe 7-20 days at sea. Boats subject to MARPOL. Intensity: negligible if MARPOL rules followed. Consequence: negligible because organic waste likely to be scavenged or break down quickly so unlikely to change behaviour or movement of target species. Confidence: Limited domestic observer data indicated crews diligent re waste, so high confidence
Addition of non-biological material	Debris	1	6	6	Population size	Broadbill swordfish, Bigeye and Yellowfin tuna	1.1	1	1	2	Plastics may be an issue. Boats subject to MARPOL rules. Intensity: negligible if MARPOL rules followed. Consequence: negligible because debris by this fishery expected to be accidental not routine. Confidence Limited domestic observer data indicated crews diligent re waste therefore high confidence
	Chemical pollution	1	6	6	Population size	Broadbill swordfish, Bigeye and Yellowfin tuna	1.1	1	1	2	Light sticks maybe ingested. Chemicals used during fishing activities may be an issue as boats maybe out at sea up to 20 days. Target species unlikely to be affected unless a major spill. but localized impact due to size of vessels. Boats subject to MARPOL rules. Intensity: negligible if MARPOL rules followed. Consequence: considered negligible because chemical pollution impacts expected to be minimal and therefore unlikely to directly affect target species such that there are detectable changes in population size. Confidence: Limited domestic observer data indicated crews diligent waste therefore high confidence.

Direct impact of fishing	Fishing Activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
	Exhaust	1	6	6	Behaviour and movement	Broadbill swordfish, Bigeye and Yellowfin tuna	6.1	1	1	2	Exhaust from running engine hazard occurs over a large range/scale. Intensity: negligible because exhaust considered low impact to target species i.e. physically affected, unlikely to be measurable, effects more likely to be short term and affect air quality (habitat component). Consequence: considered negligible because species in water column so unlikely to affect behaviour and movement of target species. Confidence: considered high because exhaust unlikely to impact on behaviour/movement of target species
	Gear loss	1	6	6	Population size	Broadbill swordfish, Bigeye and Yellowfin tuna	1.1	1	1	1	Longline gear is lost. GPS radio beacons assist recovery gear. Lost gear tends to ball up reducing likelihood of entanglement. Intensity: Unlikely to affect target species but some impacts likely because lost gear can continue to fish once lost, for this fishery direct impact expected to be negligible. Consequence: negligible impact on population size. Confidence: low because of a lack of data on interactions.
	Navigation/ steaming	1	6	6	Behaviour and movement	Broadbill swordfish, Bigeye and Yellowfin tuna	6.1	1	1	2	Fishing activity hence Navigation/ steaming occurs throughout the year over the entire fishery. Navigation/steaming is a large component of the operations and will introduce noise and visual stimuli into the environment. Intensity: negligible because it is unlikely to have measurable/detectable impact on target species. Consequence: negligible because impact on behaviour and movement of target species unlikely. Some species may move away at the time but no change to long term patterns. Confidence: high because it was considered unlikely for there to be strong impacts between Navigation/steaming and target species.
	Activity/ presence on water	1	6	6	Behaviour and movement	Broadbill swordfish, Bigeye and Yellowfin tuna	6.1	1	1	2	The environment will be impacted by noise and visual stimuli could temporarily effect movement. Intensity: negligible because it is unlikely to have measurable/detectable impact on target species. Consequence: negligible because impact on behaviour and movement of target species unlikely. Some species may move away at the time but no change to long term patterns. Confidence: high

Direct impact of fishing	Fishing Activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
											because it was considered unlikely for there to be strong impacts between activity and presence and target species.
Disturb physical processes	Bait collection	1	6	6	Behaviour/movement	Broadbill swordfish, Bigeye and Yellowfin tuna	6.1	1	1	1	Currently only 1% live bait caught and used. Embayment fishing on the south coast. Permit conditions restrict to small scale purse seine nets, which are hand hauled (no power-blocks. Mixing of water may occur, but rare for gear to touch bottom. Intensity: negligible only 1% caught unlikely to have measurable/detectable impact on physical processes because water expected to return quickly to usual state. Consequence: negligible because considered to have remote impact on physical process that might change behaviour and movement of target species. Confidence: low because of insufficient knowledge on live baitfish distribution, and capture, and possible effects on the physical processes
	Fishing	1	6	6	Behaviour/movement	Broadbill swordfish, Bigeye and Yellowfin tuna	6.1	1	1	1	This is a pelagic fishery using longlines. Intensity: negligible unlikely to have measurable/detectable impact spatially or temporally on physical processes because one the gear is removed water conditions expected to return to usual state. Consequence: negligible because considered to have remote impact on physical processes that might change behaviour and movement of target species. Confidence: recorded as low because of insufficient knowledge for this fishery
	Boat launching	0									Boats come from ports
	Anchoring/ mooring	1	6	6	Behaviour/movement	Broadbill swordfish, Bigeye and Yellowfin tuna	6.1	1	1	1	Use sea anchors occasionally, longline vessels rarely anchor or moor in anchorages. Intensity: Expected to be negligible. Intensity likely to be related to time at sea. However unlikely to directly affect target species but may effect benthic processes which may indirectly affect target species Consequence: negligible because considered to have remote impact on physical processes that might

Direct impact of fishing	Fishing Activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
											change behaviour and movement of target species. Confidence: low lack of information for this fishery
	Navigation/steaming	1	6	6	Behaviour and movement	Broadbill swordfish, Bigeye and Yellowfin tuna	6.1	1	1	2	Navigation/ steaming occurs throughout the year over the entire fishery. Navigation/steaming is a large component of the operations. Intensity: negligible because unlikely to have measurable/detectable impact on physical processes, water mixing may occur and in shallow water stir up sediments but expected to return to normal state quickly after disturbance. Consequence: negligible because considered to have remote impact on physical processes that might affect conditions that then change behaviour or movement of target species. Confidence: high because it was considered unlikely to be strong interactions between Navigation/steaming, physical processes and target species.

Direct impact of fishing	Fishing Activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
External Impacts (specify the particular example within each activity area)	Other fisheries Other fisheries SBT Southern Shark Western Deep Water Trawl Western Aust southern demersal gillnet and longline fishery Western Australian Shark Fishery South Australian Pilchard Fishery Recreational Fisheries International fisheries in Indian Ocean	1	6	6	Population size	Broadbill swordfish, (Bigeye and Yellowfin tuna, and striped marlin discussed)	1.1	4	4	1	Fishery covers a large spatial area in which many other state fisheries occur using wide range targeting methods and catch species. Some species migratory and interact with international fishing operations in Indian ocean. Uncertainties re mixing between Indian Ocean and Australian EEZ, and re stock assessments. These catches may affect domestic fishery, and domestic catches can affect these stocks (links). Require analysis existing data to get overview. The IOTC expressed concerns about increasing pressure on juvenile yellowfin and bigeye by purse seiners fishing on FADs. Intensity: could have measurable major impact both direct and indirect on target species once linkages understood. Consequence: cumulative effects could be major and affect population size of target species IOTC stated that the broadbill swordfish fishery is growing rapidly and no increases in catch or effort should be allowed. Confidence:until there is better information difficult to score therefore low confidence.
	Aquaculture	0									
	Coastal development	1	6	6	Population size	Broadbill swordfish, Bigeye and Yellowfin tuna	1.1	1	1	1	Fishery covers a large spatial area and occurs throughout the year. Sewage from major settlements. Eutrophication, algal blooms. May affect target species at different life stages. Assumed to be low impact. Intensity: assumed to have negligible impact both direct and indirect on target species, maybe different around major population centre but linkages need to be better understood. Consequence: cumulative effects expected to be negligible and not affect population size of target species. Confidence: Until there is better information difficult to score therefore low confidence.

Direct impact of fishing	Fishing Activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
	Other extractive activities	1	6	6	Population size, Behaviour and movement	Broadbill swordfish, Bigeye and Yellowfin tuna	1.1, 6.1	1	1	1	Fishery covers a large spatial area and occurs through out the year. Oil and gas industry off NWS. May be pollution from petrochemical industry in both shallow and deep water Noise and visual stimuli resulting from vessel operations. Oil rig structures may act as FADs and change the distribution of some species; information on this type of interaction was not found. Intensity: assumed to have negligible impact both direct and indirect on target species, but linkages need to be better understood. Consequence: cumulative effects expected to be negligible and not affect population size of target species. Confidence: Until there is better information difficult to score therefore low confidence.
	Other non-extractive activities	1	6	6	Behaviour and movement	Broadbill swordfish, Bigeye and Yellowfin tuna	6.1	1	1	1	Fishery covers a large spatial area and occurs throughout the year. Species may be disturbed by tourism (whale watching) charter boats. Intensity: assumed to have negligible impact both direct and indirect on target species, but linkages need to be better understood. Consequence: cumulative effects expected to be negligible and not affect population size of target species. Confidence: Until there is better information difficult to score therefore low confidence.
	Other anthropogenic activities	1	6	6	Behaviour and movement	Broadbill swordfish, Bigeye and Yellowfin tuna	6.1	1	1	1	Shipping occurs in the area Intensity negligibel. Consequence: neglibible. Confidence: low lack of information

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

Direct impact of fishing	Fishing Activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
Capture	Bait collection	1	6	6	Population size	Any species dependent on blue makerel	1.1	1	1	1	Bait collection is permitted for own use in fishing for scheduled species. Fishery occurs throughout year and covers a large area VIC westward to Cape York QLD. Live bait used for 1% shots. Purse seine method. According to AFMAs strategic assessment if catch of live bait increases it will be monitored. These levels unlikely to affect bycatch and bycatch species (food source). Intensity: negligible because current live bait catch is low impact expected to be negligible, unlikely to be detectable against background variability. Consequence: negligible because scale and intensity low, level of bait catch it is unlikely to impact population size. Confidence: low because of insufficient knowledge on live baitfish distribution, and capture. Need to consider overall stock status of baitfish with regard to capture by other fisheries.
	Fishing	1	6	6	Population size	Dusky shark, and Crocodile and Blue shark may also be an issue. (Oilfish, Escolar, Rudderfish, Blue and Black marlin lancet fish discussed)	1.1	3	4	1	Fishery occurs throughout year and covers a large area (VIC westward to Cape York QLD.) year for all species. Migratory species, need to consider impacts to these stocks re interactions with Indian Ocean fisheries The Dusky shark is considered at risk by McAuley and Thomas (2005). Fish base highly migratory species, resilience very low, minimum population doubling time more than 14 years, Red list lower risk near threatened. Intensity: moderate; the domestic fishery has grown rapidly since 1998. Consequence: This level of fishing may affect the state of non-target stocks, considered moderate, although range of species and change is size/growth rate is difficult to detect. As a precautionary, scored as major. Reasonable numbers are captured but population numbers not known. Need to establish this level of catch is sustainable so that population sizes are not affected over time. Crocodile and Blue sharks recognized as vulnerable and large numbers caught recently. WA state fisheries considers that the dusky shark species cannot tolerate less than a 4% increase in adult mortality. Confidence low information considered inadequate for

Direct impact of fishing	Fishing Activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
											the scale of the fishery.
	Incidental behaviour	1	6	6	Population size	Oilfish	1.1	1	1	1	Oilfish chosen because valuable and fish can be sold, and so might be captured by crew in down time. Was difficult to choose any species that the crew might target. Intensity: negligible. Consequence: unlikely to affect population size and Confidence: low as no routine obsever programme in place
Direct impact without capture	Bait collection	1	6	6	Population size	Blue mackerel	1.1	1	1	1	Purse seine method. Some baitfish may be impacted by interactions with gear but unlikely to affect non-target species (food source) Intensity: negligible because current live bait catch is low, unlikely to be detectable against background variability. Consequence: negligible because scale and intensity of bait catch is low it is unlikely to impact population size of bait species or non-target species. Confidence: low because of insufficient knowledge on live baitfish distribution, and capture. Need to consider overall stock status of baitfish with regard to capture by 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 (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
	Fishing	1	6	6	Population size	Dusky shark	1.1	2	2	1	There is definitely interaction with the gear. Tuna circle hooks from longline gear used in the WTBF has been recorded in dusky sharks caught within state-managed fisheries. While these occurrences of the WTBF hooks indicate some percentage of dusky sharks survive escape from WTBF longlines, there is no basis for assessing whether that level of survival is high or low. Intensity: minor because impact to those that escape gear is considered minimal. Already concern re dusky shark. Consequence: minor; assumed minimal impact on population size. Confidence: low as a routine observer proramme is not in place
	Incidental behaviour	1	6	6	Population size	Oilfish	1.1	1	1	1	This fishery offshore unlikely any activities that might impact non-target species. Intensity: at this stage assumed negligible. Consequence: negligible; unlikely too affect population size. Confidence: recorded as low a routine pbserver programme os not in place
	Gear loss	1	6	6	Population size	Rudderfish, Blue shark, Dusky shark, Escolar, Chosen because most common bycath species	1.1	2	1	1	Longline gear is lost. Non-target species may be caught as gear drifts. GPS radio beacons assist recovery gear. Lost gear tends to ball up reducing likelihood of entanglement. Intensity: Even though lost gear can continue to fish once lost, for this fishery direct impact expected to be minimal because of this it has been scored minor, as it is unlikely to be detectable against background variability. Consequence: because the scale and intensity of direct impacts without capture is perceived to be low in scale and intensity consequence is expected to be negligible as level of catch unlikely to impact population size. Confidence: low because of a lack of data on interactions.
	Anchoring/ mooring	1	6	6	Population size	Dusky sharkBlue shark, Escolar	1.1	1	1	2	Use sea anchors occasionally, longline vessels rarely anchor or moor in anchorages. Even if used unlikely to impact non-target species i.e. kill/damage fish. Intensity: negligible because the likelihood of impact is expected to be very unlikely, is to be detectable against background variability. Consequence: negligible because the scale and intensity is considered negligible it is

Direct impact of fishing	Fishing Activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
											unlikely to impact population size. Confidence scored high because interactions unlikely.
	Navigation/steaming	1	6	6	Population size	Dusky shark, Blue shark, Moonfish	1.1	1	1	2	Fishing activity hence Navigation/ steaming occurs throughout the year over the entire fishery. Navigation/steaming is a large component of the operations. Intensity: negligible because it is unlikely to have measurable/detectable impact ie collisions. Consequence: negligible because interactions remote, and impact on population size or behaviour and movement of non-target species unlikely. Confidence: high because it was considered unlikely for there to be strong interactions between Navigation/steaming and non-target species.
Addition/ movement of biological material	Translocation of species	1	6	6	Population size, Behavior and movement	Any species that might be susceptible to disease from imported bait	1.1 6.1	2	2	1	Live bait 1% shots (blue mackerel, yellowtail scad) rest dead bait. Broadbill swordfish and bigeye targeted using squid, other target species use pilchard, blue mackerel, yellowtail scad. Intensity: considered minor but currently 99% bait used is dead. If dead bait imported disease could be a problem as occurred in SBT however considered minor because does not occur often. Consequence: considered minor but translocation of species through transmission of disease could possibly affect population size of non-target species. Confidence: low because of a lack of data
	On board processing	1	6	6	Behaviour and movement	Sharks and any other scavenging species	6.1	1	1	1	On board processing occurs. Subject to TAP regulations prohibit discharge offal during line setting or hauling. Intensity: negligible impacts expected because waste expected to be taken up quickly by opportunistic scavengers or sink to benthos and scavenged by benthic species, non-target species in the area might scavenge. Consequence: negligible Unlikely to affect behaviour /movement of non-target species because of scavenging, if scavengers more likely to attract oceanic sharks. Confidence: low because of a lack of verified observer data.

Direct impact of fishing	Fishing Activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
	Discarding catch	1	6	6	Population size	Blue shark and Crocodile shark	1.1	1	1	1	Discarding non-target species due to high grading and damage by sharks or marine mammals, and discarding byproduct species of low value or lack of markets, occurs. High numbers for blue and crocodile sharks. Intensity: negligible sften released alive Consequence: negligible Confidence: low because of a lack of verified observer data.
	Stock enhancement	0									
	Provisioning	1	6	6	Behaviour and movement	Sharks and any other scavenging species	6.1	1	1	1	Provisioning occurs through use bait and discarding. Shark and cetacean predation on longline fish relatively common. Intensity: negligible expected because waste expected to be taken up quickly by opportunistic scavengers or sink to benthos and scavenged by benthic species, non-target species in the area might scavenge. Consequence: negligible Unlikely to affect behaviour movement of non-target species because of scavenging, if scavengers more likely to attract oceanic sharks. Confidence: low because of a lack of verified observer data.
	Organic waste disposal	1	6	6	Behaviour and movement	Sharks and any other scavenging species	6.1	1	1	2	Domestic boasts ave 3-7 days at sea but increasingly maybe 7-20 days at sea. Boats subject to MARPOL rules. Intensity: negligible if MARPOL rules followed. Consequence: negligible because organic waste likely to be scavenged or break down quickly so unlikely to change behaviour or movement of non-target species. Confidence: Limited domestic observer data indicated crews diligent re waste, so high confidence.
Addition of non-biological material	Debris	1	6	6	Population size	any non target species	1.1	1	1	2	Plastics may be an issue, entanglement, ingestion.Light sticks maybe ingested. Boats subject to MARPOL. Intensity: negligible if MARPOL rules followed.Consequence: negligible because debris by this fishery expected to be accidental not routine. Confidence Limited domestic observer data indicated crews diligent re waste therefore high confidence

Direct impact of fishing	Fishing Activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
	Chemical pollution	1	6	6	Population size	Non-target species, any scavenging species?	1.1	1	1	2	Chemicals used during fishing activities may be an issue as boats maybe out at sea up to 20 days. Non-target species unlikely to be affected unless a major spill, but localized impact. Boats subject to MARPOL rules. Intensity: negligible if MARPOL rules followed. Lightsticks may be a problem that needs further investigation. Consequence: considered negligible because chemical pollution impacts expected to be minimal and therefore unlikely to directly affect non-target species such that there are detectable changes in population size. Confidence: Limited domestic observer data indicated crews diligent waste therefore high confidence
	Exhaust	1	6	6	Behaviour and movement	Non-target species, Any species that is at the surface at the time	6.1	1	1	2	Exhaust from running engine hazard occurs over a large range/scale. Intensity: negligible because exhaust considered low impact to non-target species i.e. physically affected, unlikely to be measurable, effects more likely to be short term and effect air quality. Consequence: considered negligible because species in water column so unlikely to affect behaviour and movement of non-target species. Confidence: considered high because exhaust unlikely to impact on behaviour/movement of non-target species
	Gear loss	1	6	6	Population size	Non-target species	1.1	1	1	1	Longline gear is lost. GPS radio beacons assist recovery gear. Lost gear tends to ball up reducing likelihood of entanglement. Intensity: Some impacts likely because lost gear can continue to fish once lost, for this fishery direct impact expected to be minimal because of this it has been scored negligible, as it is unlikely to be detectable against background variability. Consequence: because the scale and intensity of direct impacts without capture is perceived to be low in scale and intensity consequence is expected to be negligible as level of impact is unlikely to impact population size. Confidence: low because of a lack of data on interactions

Direct impact of fishing	Fishing Activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
	Navigation/ steaming	1	6	6	Behaviour and movement	Non-target species any other basking species	6.1	1	1	2	Fishing activity hence Navigation/ steaming occurs throughout the year over the entire fishery. Navigation/steaming is a large component of the operations and will introduce noise and visual stimuli into the environment. Intensity: negligible because it is unlikely to have measurable/detectable impact on non-target species. Consequence: negligible because type of impact on behaviour and movement of non-target species unlikely they may move away at the time but not going to change long term patterns. Confidence: high because it was considered unlikely for there to be strong impacts between Navigation/steaming and non-target species.
	Activity/ presence on water	1	6	6	Behaviour and movement	Non-target species any other basking species	6.1	1	1	2	The environment will be impacted by noise and visual stimuli could temporarily effect movement. Intensity: negligible because it is unlikely to have measurable/detectable impact on non-target species. Consequence: negligible because type of impact on behaviour and movement of non-target species unlikely they may move away at the time but not going to change long term patterns. Confidence: high because it was considered unlikely for there to be strong impacts between activity and presence and non-target species.
Disturb physical processes	Bait collection	1	6	6	Behaviour and movement	Tiger shark, disturbed by turbidity in shallow water	6.1	1	1	1	Currently only 1% live bait caught and used. Caught using purse seine, mixing of water may occur, but rare for gear touch bottom. Intensity: negligible only 1% caught unlikely to have measurable/detectable impact on physical processes because water expected to return quickly to usual state. Consequence: negligible because considered to have remote impact on physical process that might change behaviour and movement of non-target species. Confidence: low because of insufficient knowledge on live baitfish distribution, and capture, and possible effects on the physical processes

Direct impact of fishing	Fishing Activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
	Fishing	1	6	6	Behaviour and movement	Not likely to impact any non-target species	6.1	1	1	1	This fishery is a pelagic fishery using longlines. Intensity: negligible unlikely to have measurable/detectable impact spatially or temporally on physical processes because once the gear is removed water conditions expected to return to usual state. Consequence: negligible because considered to have remote impact on physical processes that might change behaviour and movement of non-target species. Confidence: recorded as low because of limited information for this fishery
	Boat launching	0									Boats come from ports
	Anchoring/ mooring	1	6	6	Behaviour and movement	Tiger shark	6.1	1	1	1	Use sea anchors occasionally, longline vessels rarely anchor or moor in anchorages. Intensity: Expected to be negligible. Intensity likely to be related to time at sea. However unlikely to directly effect non-target species but may effect benthic processes which may indirectly effect non-target species. Consequence: negligible because considered to have remote impact on physical processes that might change behaviour and movement of non-target species. Confidence: low lack of information for this fishery.
	Navigation/steaming	1	6	6	Behaviour and movement	Non-target species any other basking species	6.1	1	1	2	Navigation/ steaming occurs throughout the year over the entire fishery. Navigation/steaming is a large component of the operations. Intensity: negligible because unlikely to have measurable/detectable impact on physical processes, water mixing may occur and in shallow water stir up sediments but expected to return to normal state quickly after disturbance. Consequence: negligible because considered to have remote impact on physical processes that might affect conditions that then change behaviour or movement non-target species. Confidence: high because it was considered unlikely for there to be strong interactions between Navigation/steaming, physical processes and non-target species.

Direct impact of fishing	Fishing Activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
External Impacts (specify the particular example within each activity area)	Other fisheries SBT Southern Shark Western Deep Water Trawl Western Aust southern demersal gillnet and longline fishery Western Australian Shark Fishery South Australian Pilchard Fishery Recreational Fisheries International fisheries in Indian Ocean	1	6	6	Population size	Dusky shark, (Blue shark discussed)	1.1	4	4	1	Fishery covers a large spatial area in which many other state fisheries occur using wide range targeting methods and catch species. Dusky sharks already overfished and additional mortality is of concern. Intensity: could have measurable major impact both direct and indirect on non-target species once linkages understood. Consequence: cumulative effects could be major and affect population size of non-target species. Confidence: Until there is better information difficult to score therefore low confidence.
	Aquaculture	0									
	Coastal development	1	6	6	Population size	Tiger shark, Inshore species	1.1	1	1	1	Fishery covers a large spatial area and occurs through out the year. Sewage from major settlements. Eutrophication, algal blooms. May affect non-target species at different life stages. Intensity: assumed to have negligible impact both direct and indirect on non-target species, maybe different around major population centre but linkages need to be better understood. Consequence: cumulative effects expected to be negligible and not affect population size of non-target species. Confidence: Until there is better information difficult to score therefore low confidence.
	Other extractive activities	1	6	6	Population size, Behaviour and movement	Non-target species	1.1, 6.1	1	1	1	Fishery covers a large spatial area and occurs through out the year. Oil and gas industry off NWS. May be pollution from petrochemical industry in both shallow and deep water Noise and visual stimuli. re operations. Intensity: assumed to have negligible impact both direct and indirect on non-target species, but linkages need to be better understood. Consequence: cumulative effects expected to be negligible and not affect population size of non-target species. Confidence: Until there is better information

Direct impact of fishing	Fishing Activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
											difficult to score therefore low confidence.
	Other non-extractive activities	1	6	6	Behaviour and movement	whales	6.1	1	1	1	Fishery covers a large spatial area and occurs through out the year. Species may be disturbed by tourism (whale watching) charter boats. Intensity: assumed to have negligible impact both direct and indirect on non-target species, but linkages need to be better understood. Consequence: cumulative effects expected to be negligible and not affect population size of non-target species. Confidence: Until there is better information difficult to score therefore low confidence.
	Other anthropogenic activities	1	6	6	Behaviour and movement	whales	6.1	1	1	1	Shipping occurs in the area Intensity negligibel. Consequence: neglibible. Confidence: low lack of information

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

Direct impact of fishing	Fishing Activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
Capture	Bait collection	1	6	6	Population size	Sygnathids, (Seabirds, crested tern discussed)	1.1	1	1	1	Bait collection is permitted for own use in fishing for scheduled species. Species caught are Blue mackerel, yellowtail scad. Fishery occurs throughout year and covers a large area VIC westward to Cape York QLD. Live bait used for 1% shots. Purse seine, hand hauled method, set at night. May affect baitfish but unlikely to affect TEP species (food source). Intensity: negligible because current live bait catch is low, purse seine shots short so time for sygnathids to aggregate on gear low. However would need to check, and identify other species at risk if collection of live bait increases. Consequence: considered negligible because scale and intensity currently low, level of bait catch it is unlikely to impact TEP species in terms population size. Confidence: low because of insufficient knowledge on live baitfish distribution, and capture. Need to consider overall stock status of baitfish with regard to capture by other fisheries.
	Fishing	1	6	6	Population size	Leatherback and loggerhead turtles, (Seabirds, Albatross and mutton birds, turtles and seals discussed)	1.1	2	3	1	Fishery occurs throughout year and covers a large area (VIC westward to Cape York QLD.) Bycatch action plan 2001 to address issues bycatch Seabirds not considered a problem as most cases night setting, swivels, dyed bait and tori poles used south 30^0. Intensity: although the domestic fishery has grown rapidly since 1998 (start), considered minor because range of species and documented frequency of interactions low. Consequence: moderate because reports of interactions low and turtles able to swim to surface for air and can be released alive. (* WTBF conservation member argued for a higher consequence (3), as too little data at present to be sure of minor consequence). Confidence: recorded as low as the information currently considered inadequate and finalresults from piolt observer not yet available . Some species migratory, need to consider impacts to stocks re interactions with Indian Ocean 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 (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
	Incidental behaviour	1	6	6	Behaviour and movement	Seabirds , (Seals, discussed)	6.1	1	1	1	Offshore fishery seabirds may be attracted by visual stimuli or discards from occasional recreational fishing in down time. Intensity: Negligible because rare events. Consequence: negligible unlikely to affect behaviour or movement. Confidence: low at this stage as no routine observer programme in place
Direct impact without capture	Bait collection	1	6	6	Population size	TEP species for which blue mackerel or yellow tail scad a food source	1.1	1	1	1	Purse seine method. Some TEP species may interact with gear. May affect TEP species if primary food source. Intensity: because current live bait catch is low, impact expected to be negligible at this stage. Consequence: negligible because scale and intensity of bait catch is low it is unlikely to impact population size of TEP species. Many can probably be released alive because short duration shots. Confidence: low because of insufficient knowledge on live baitfish distribution, and capture and therefore any impacts to TEP species
	Fishing	1	6	6	Population size	Turtles, leatherback , and loggerhead, marine mammals and (Seabirds, Albatross and mutton birds discussed)	1.1	2	2	1	TEP species do interact with gear. Intensity: although the domestic fishery has grwon rapidly since 1998 (start) , considered minor because range of species and documented frequency of interactions low. Consequence: minor because impact to population size minimal. Confidence: low as no routine obsever programme in place
	Incidental behaviour	1	6	6	Behaviour and movement	Seabirds , (Seals discussed)	6.1	1	1	1	Offshore fishery seabirds may be attracted by visual stimulii or discards from occasional recreational fishing in down time. Intensity: Negligible because unlikely to have any impact. Consequence: at this stage assumed negligible unlikely to affect behaviour or movement. Confidence:ow as no routine obsever programme in place
	Gear loss	1	6	6	Population size	Turtles, Leatherback and loggerhead, seals	1.1	2	2	1	Longline gear is lost. TEP species may be entangled or caught as gear drifts. GPS radio beacons assist recovery gear. Lost gear tends to ball up reducing likelihood of entanglement. Intensity: considered minor because only occurs occasionally, gear is recovered whenever possible, GPS beacons used. Consequence: minor because although it can continue to fish it soon forms a

Direct impact of fishing	Fishing Activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
											ball . Confidence: ow as no routine obsever programme in place
	Anchoring/ mooring	1	6	6	Population size Behaviour and movement	Turtles seabirds	1.1 6.1	1	1	2	Offshore fishery does use sea anchors occasionally, however, longline vessels rarely anchor or moor in anchorages and in these cases the activity is unlikely to impact TEP species through killing individuals. Behavior and movement might be affected if animals/birds respond to presence of anchored vessels. Intensity: negligible. Consequence: because the scale and intensity is considered negligible it is unlikely to impact population size or behaviour and is considered to have a negligible consequence. Confidence scored high due to logical consideration.
	Navigation/steaming	1	6	6	Population, Behavior and movement	Seabirds, Cetaceans, Seals (attracted)	1.1, 6.1	1	1	2	Navigation/ steaming occurs throughout the year over the entire fishery. Intensity: negligible because it is unlikely to have measurable/detectable impact e.g. through collisions. Consequence: negligible because interactions remote, and impact on population size or behaviour and movement of TEP species unlikely. Confidence: high because it was considered unlikely for there to be strong interactions between Navigation/steaming and TEP species.
Addition/ movement of biological material	Translocation of species	1	6	6	Population	TEP speceis dependent on blue mackerel or pilcahrds (Turtles, Seals, dolphins,whales discussed)	1.1	2	2	1	Live bait 1% shots (blue mackerel, yellowtail scad) rest dead bait. Frozen imported bait could carry disease that might spread to local baitfish populations. Intensity: considered minor as currently 99% bait used is dead and some imported. Consequence: considered minor because transmission of disease to local bait like species rare event but could affect population size of TEP species dependent on these as a food source. Confidence: low because of a lack of data and understanding of pathogens and marine diseases.

Direct impact of fishing	Fishing Activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
	On board processing	1	6	6	Behaviour and movement	Seabirds, sharks	6.1	2	2	1	On board processing occurs. Subject to TAP regulations prohibit discharge offal during line setting or hauling. Aimed to reduce attractiveness to seabirds. Intensity minor waste expected to be taken up quickly by opportunistic scavengers or sink to benthos and scavenged by benthic species. TEP species in the area might scavenge. Consequence: minor unlikely to affect behaviour movement of TEP species because of scavenging. Confidence: low because of a lack of verified observer data.
	Discarding catch	1	6	6	Behaviour and movement	sharks and whales	6.1	2	1	1	Discarding of target species due to high grading and damage by sharks or marine mammals, and discarding byproduct species of low value or lack of markets, and bycatch species occurs. Intensity minor. Consequence: negligible as behaviour and movement of TEP species modified only while vessels in the area and discards expected to be taken up quickly by opportunistic scavengers or sink to benthos. Confidence: low because of a lack of verified observer data.
	Stock enhancement	0									
	Provisioning	1	6	6	Behaviour and movement	Seabirds, sharks, whales	6.1	2	2	1	Provisioning occurs through use bait and discarding. In some areas according to Japanese study high predation on longline by whales and sharks. Pilot whales able to detect beacons. Intensity minor, TEP species in the area might take food while boats present. Consequence: negligible unlikely to affect behaviour movement of TEP species because of opportunistic scavenging,. Confidence: low because of a lack of verified observer data.
	Organic waste disposal	1	6	6	Behaviour and movement	Seabirds	6.1	1	1	2	Domestic boasts ave 3-7 days at sea but increasingly maybe 7-20 days at sea. Boats subject to MARPOL. Intensity: negligible if MARPOL rules followed. Consequence: negligible because organic waste likely to be scavenged or break down quickly so unlikely to change behaviour or movement of TEP species. Confidence: Limited domestic observer data indicated crews diligent re waste, so high confidence

Direct impact of fishing	Fishing Activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
Addition of non-biological material	Debris	1	6	6	Population size	Seabirds, Seals, Turtles,	1.1	1	2	1	Plastics may be an issue, entanglement, light sticks, ingestion. Boats subject to MARPOL rules . Intensity: negligible if MARPOL rules followed. Consequence: minor because debris by this fishery expected to be accidental not routine . Confidence: low because lack of verified observer data
	Chemical pollution	1	6	6	Population size	any TEP spcies	1.1	1	1	2	Chemicals used during fishing activities may be an issue as boats maybe out at sea up to 20 days. TEP species unlikely to be affected unless a major spill, but then localized impact. Boats subject to MARPOL . Intensity: negligible if MARPOL rules followed. Consequence: considered negligible because chemical pollution impacts expected to be minimal and therefore unlikely to directly affect TEP species such that there are detectable changes in population size. Confidence: Limited domestic observer data indicated crews diligent waste therefore high confidence
	Exhaust	1	6	6	Behaviour and movement	Seabirds, Albatross, and mutton birds,	6.1	1	1	2	Exhaust from running engine hazard occurs over a large range/scale. Air quality most likely affected. Intensity: negligible because exhaust considered low impact to TEP species i.e. physically affected, unlikely to be measurable, effects more likely to be short term and effect air quality. Consequence: considered negligible. Confidence: considered high because exhaust unlikely to impact on behaviour/movement of TEP species, logical consideration.
	Gear loss	1	6	6	Population size	Turtles leatherback and loggerhead, Seals	1.1	2	1	1	Longline gear is lost. Interactions with TEP species may occur GPS radio beacons assist recovery gear. Lost gear tends to ball up reducing likelihood of entanglement. Intensity: minor because lost gear can continue to fish once lost, and there has been entanglements reported. Consequence: negligible because gear stops fishing as it soon balls. Confidence: low because of a lack of verified data on interactions and persistence of gear, conservatively scored as a result.

Direct impact of fishing	Fishing Activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
	Navigation/ steaming	1	6	6	Behaviour and movement	Seabirds, whales	6.1	1	1	2	Fishing activity hence Navigation/ steaming occurs throughout the year over the entire fishery. Navigation/steaming is a large component of the operations and will introduce noise and visual stimuli into the environment. Intensity: negligible, because type of impact on behaviour and movement of species unlikely; they may move to/away at the time but not going to change long term patterns. Consequence: negligible impacts on behavior and movement with regard to temporal scale of changed behavior. Confidence: high due to consensus of group.
	Activity/ presence on water	1	6	6	Behaviour and movement	Seabirds: Albatross, mutton birds, Seals	6.1	1	1	1	The environment will be impacted by noise and visual stimuli could temporarily affect movement and behavior through attraction to vessels. Intensity: negligible because type of impact on behaviour and movement of TEP species unlikely; they may move away or be attracted at the time but not going to change long term patterns. Consequence: negligible; unlikely change original behavior. Confidence: low due to lack on information on persistence/avoidance of TEP species around vessels.
Disturb physical processes	Bait collection	1	6	6	Behaviour/movement	any small marine mammals or reptile species in area where bait species caught	6.1	1	1	1	Currently only 1% live bait caught and used. Caught using purse seine, mixing of water may occur, but rare for gear touch bottom. Intensity: negligible only 1% caught unlikely to have measurable/detectable impact on physical processes because water expected to return quickly to usual state. Consequence: negligible because considered to have remote impact on physical process that might change behaviour and movement of TEP species. Confidence: low, insufficient knowledge on live baitfish distribution, and capture, and possible effects on the physical processes
	Fishing	1	6	6	Behaviour/movement	any small marine mammals or reptile species in area where bait species caught	6.1	1	1	2	This fishery a pelagic fishery using longlines, disturbing the water column only. Intensity: negligible unlikely to have measurable/detectable impact spatially or temporally on physical processes because once the gear is removed water conditions expected to return to usual state. Consequence: negligible because considered to have remote impact on physical processes

Direct impact of fishing	Fishing Activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
											that might change behaviour and movement of TEP species. Confidence: high, logical consideration
	Boat launching	0									Boats come from ports
	Anchoring/ mooring	1	6	6	Behaviour/movement	Sygnathids,	6.1	1	1	2	Use sea anchors occasionally, longline vessels rarely anchor or moor in anchorages. Intensity: Expected to be negligible. Intensity likely to be related to time at sea. However unlikely to directly effect TEP species but may effect benthic processes which may indirectly effect TEP species. Consequence: negligible because considered to have remote impact on physical processes that might change behaviour and movement of TEP species. Confidence: high; logical consideration
	Navigation/steaming	1	6	6	Behaviour and movement	whales and sharks	6.1	1	1	2	Navigation/ steaming occurs throughout the year over the entire fishery. Intensity: negligible because unlikely to have measurable/detectable impact on physical processes, water mixing may occur and in shallow water stir up sediments but expected to return to normal state quickly after disturbance. Consequence: negligible because considered to have remote impact on physical processes that might affect conditions that then change behaviour or movement of TEP species. Confidence: high, logical consideration.
External Impacts (specify the particular example within each activity area)	Other fisheries (see Hazard ID for list)	1	6	6	Population size	Turtles, Leatherback and loggerheads, (Seabirds, Albatross, And mutton birds, Seals discussed)	1.1	3	3	1	Fishery covers a large spatial area in which many other state fisheries occur using wide range targeting methods and catch species. Some species migratory and interact with international fishing operations in Indian ocean. Uncertainties re mixing between Indian Ocean and Australian EEZ, and re stock assessments these catches may affect domestic fishery, and domestic catches can affect these stocks (links). Require analysis existing data to get overview. Intensity: moderate could have measurable impact both direct and indirect on TEP species once linkages understood. Consequence: moderate as

Direct impact of fishing	Fishing Activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
											cumulative effects could affect population size. Confidence: Until there is better information difficult to score therefore low confidence.
	Aquaculture	0									
	Coastal development	1	6	6	Population size,	Dugong, Turtles nesting on beach, Shearwater, gannets beach access	1.1	3	3	1	Fishery covers a large spatial area and occurs through out the year. Sewage from major settlements. Eutrophication, algal blooms. May affect target species at different life stages. An example might be loss of seagrass which in turn will effect dugongs, turtles, shearwaters, gannets. Intensity: moderate as there may be both direct and indirect impacts on TEP species, especially around major population centre but linkages need to be better understood. Consequence: moderate because cumulative effects could affect population size of TEP species . Confidence: Until there is better information difficult to score therefore low confidence.
	Other extractive activities	1	6	6	Population size, Behaviour and movement	Seabirds, Albatross, And mutton birds, Turtles, Leatherback and loggerheads, seals	1.1, 6.1	2	1	1	Fishery covers a large spatial area and occurs through out the year. Oil and gas industry off NWS. May be pollution from petrochemical industry in both shallow and deep water Noise and visual stimuli. re operations. Intensity: assumed to have minor impact both direct and indirect on TEP species, but linkages need to be better understood. Consequence: cumulative effects expected to be neglible and not affect population size or behaviour or movement of TEP species . Confidence: Until there is better information difficult to score therefore low confidence.

Direct impact of fishing	Fishing Activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
	Other non-extractive activities	1	6	6	Behaviour and movement	Whales	6.1	1	1	1	Fishery covers a large spatial area and occurs through out the year. Species may be disturbed by tourism (whale watching) charter boats. Intensity: assumed to have negligible impact, although boat propellers for example could impact surfacing whales and there may be direct and indirect impacts on TEP species, but linkages need to be better understood. Consequence: cumulative effects expected to be negligible and not affect population size of TEP species . Confidence: Until there is better information difficult to score therefore low confidence.
	Other anthropogenic activities	1	6	6	Behaviour and movement	Whales	6.1	1	1	1	Shipping occurs in the area Intensity negligibel. Consequence: neglibible. Confidence: low lack of information

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 (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
Capture	Bait collection	1	6	6	Habitat structure and function	fine sediments, wave rippled, large sponges, inner-shelf	5.1	1	1	1	Fishery occurs throughout year and covers a large area (SA/VIC border westward to Cape York QLD). Bait collection is permitted for own use in fishing for scheduled species. Live bait used for 1% shots. Embayment fishing occurs on the south coast. Permit conditions restrict to small purse seine nets, which are hand hauled (no power-blocks) mixing of water may occur, and some contact with soft bottom will impact benthic habitats, but fauna should recover relatively rapidly at these depths Intensity: negligible because current live bait catch is low and unlikely to be any effects from water mixing, benthic habitats maybe damaged or disturbed at very small scale. Consequence: negligible because scale and intensity low, level of bait catch it is unlikely to impact water quality or habitats long term. Confidence: low because of insufficient knowledge on live baitfish distribution, and capture.
	Fishing	1	6	6	Habitat structure and function	Western Pelagic Province - Oceanic	5.1	1	1	2	Pelagic longline activity may result in disturbance of the pelagic habitat, mixing of water occurs when gear is fishing. Intensity: negligible, water expected to return to usual state once gear removed from water. Consequence: negligible fishing not likely to affect water quality. Confidence: high due to logical constraints.
	Incidental behaviour	1	6	6	Habitat structure and function	fine sediments, wave rippled, large sponges, inner-shelf	5.1	1	1	1	Recreational fishing activity by crew on way to and from offshore and during downtime unlikely to impact benthic habitats in any more than insignificant way. Intensity: negligible due to scale of activity. Consequence: negligible due to scale of activity, and minor light gear. Confidence: low, however information regarding crew activity not available.

Direct impact of fishing	Fishing Activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
Direct impact without capture	Bait collection	1	6	6	Habitat structure and function	fine sediments, wave rippled, large sponges, inner-shelf	5.1	1	1	1	Fishery occurs throughout year and covers a large area (SA/VIC border westward to Cape York QLD). Bait collection is permitted for own use in fishing for scheduled species. Live bait used for 1% shots. Embayment fishing occurs on the south coast. Permit conditions restrict to small purse seine nets, which are hand hauled (no power-blocks) mixing of water may occur, and some contact with soft bottom will impact benthic habitats, but fauna should recover relatively rapidly at these depths Intensity: negligible because current live bait catch is low and unlikely to be any effects from water mixing, benthic habitats maybe damaged or disturbed at very small scale. Consequence: negligible because scale and intensity low, level of bait catch it is unlikely to impact water quality or habitats long term. Confidence: low because of insufficient knowledge on live baitfish distribution, and capture.
	Fishing	1	6	6	Habitat structure and function	Western Pelagic Province - Oceanic	5.1	1	1	2	Pelagic longline activity may result in disturbance of the pelagic habitat, mixing of water occurs when gear is fishing, additions to the water column. Intensity: negligible, water expected to return to usual state once gear removed from water. Consequence: negligible fishing not likely to affect water quality. Confidence: high due to logical constraints.
	Incidental behaviour	1	6	6	Habitat structure and function	Western Pelagic Province - Oceanic	5.1	1	1	1	Recreational fishing activity by crew on way to and from offshore and during downtime unlikely to impact benthic habitats in any more than insignificant way. Intensity: negligible due to scale of activity. Consequence: negligible due to scale of activity, and minor light gear. Confidence: low, however information regarding crew activity not available.
	Gear loss	1	6	6	Habitat structure and function	Sedimentary rock, low outcrop, mixed faunal community	5.1	1	1	1	Longline gear is lost, although GPS radio beacons assist recovery of large sets of gear. Gear may drift in pelagic water, if it sinks can litter benthic habitats, becoming snagged on outcropping terrains. Intensity: minor; rare in space and time. Consequence: minor; some benthic habitats may be damaged by gear if it attaches to reefs or beds of faunas, however, while gear is floating it is modifying the pelagos, hence this scenario considered worst. Confidence: low because of a lack of data on extent of gear loss and breakdown times.

Direct impact of fishing	Fishing Activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
	Anchoring/ mooring	1	6	6	Habitat structure and function	fine sediments, wave rippled, large sponges, inner-shelf	5.1	2	2	2	Use sea anchors occasionally, longline vessels rarely anchor or moor in anchorages. If used likely to impact benthic habitats, reefs, sediments, sponge communities. Intensity: minor because habitat expected to recover from damage over short term in shallower waters (unless slow growing). Consequence: minor because the scale and intensity. Confidence: low, anchoring infrequent.
	Navigation/ steaming	1	6	6	Water quality	Western Pelagic Province - Oceanic	1.1	1	1	2	Fishing activity hence Navigation/ steaming occurs throughout the year over the entire fishery. Navigation/steaming is a large component of the operations. Intensity: negligible over scale of region, persistent whilst vessel in area. Consequence: because it is unlikely to have measurable/detectable impact on pelagic habitat water quality. Confidence: high constrained by logic.
Addition/ movement of biological material	Translocation of species	1	6	6	Water quality	Western Pelagic Province - Oceanic	1.1	2	1	2	Live bait 1% shots (blue mackerel, yellowtail scad) rest frozen (thawed) imported bait. Intensity: Minor impact on pelagic habitats, virus does not persist longer than hours out of host, more of a community issue if impacts species. If dead bait imported, disease could be a problem as occurred in SBT which might impact communities. Consequence: Negligible effect of pathogens on pelagos. Confidence:High data exists
	On board processing	1	6	6	Water quality	Western Pelagic Province - Oceanic	1.1	1	1	2	On board processing occurs. Intensity: negligible impacts expected because waste expected to be taken up quickly by opportunistic scavengers if sink to benthos scavenged by benthic species. Consequence: negligible Unlikely to impact habitats because of scavenging. Confidence: high, logical consensus.
	Discarding catch	1	6	6	Substrate quality	Western Pelagic Province - Oceanic	3.1	1	1	2	On board processing occurs in areas of greatest fishing effort. Discarding target species due to high grading, and damage by sharks or marine mammals, and non-target species of low value or lack of markets occurs. Intensity: negligible impacts expected because waste expected to be taken up quickly by opportunistic scavengers, if sink to benthos scavenged by benthic species within short time frames. Consequence: negligible Unlikely to impact habitats apart from short term increases in productivity. Confidence: high, expert consensus.
	Stock enhancement	0					0	0	0	0	

Direct impact of fishing	Fishing Activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
	Provisioning	1	6	6	Water quality	Western Pelagic Province - Oceanic	1.1	1	1	2	Provisioning occurs through use bait and discarding, but unlikely to impact pelagic habitats for long. Intensity: negligible impacts expected because waste expected to be taken up quickly by opportunistic scavengers if sink to benthos scavenged by benthic species. Consequence: negligible. Confidence: high, expert consensus.
	Organic waste disposal	1	6	6	Water quality	Western Pelagic Province - Oceanic	1.1	1	1	2	Domestic boasts spend 3-7 days at sea but increasingly maybe 7-20 days at sea. Boats subject to MARPOL rules. Organic waste disposal unlikely to impact benthic habitats, and will create transient short term disruption to pelagic habitats through addition of material, mixing and attraction of species. Intensity: negligible if MARPOL rules followed. Consequence: negligible because organic waste likely to be scavenged or break down quickly so unlikely to affect habitats. Confidence: Limited domestic observer data indicated crews diligent re waste, so high confidence.
Addition of non-biological material	Debris	1	6	6	Water quality	Western Pelagic Province - Oceanic	1.1	1	2	2	Plastics may be an issue, litter accumulation in water and on benthos. Boats subject to MARPOL, however small discards e.g. plastics may accumulate in pelagic environment. Intensity: negligible if MARPOL rules followed. Consequence: minor because debris by this fishery expected to be accidental not routine, but may be major if ingestion occurs by TEPs. Confidence Limited domestic observer data indicated crews diligent re waste therefore high confidence
	Chemical pollution	1	6	6	Water quality	Western Pelagic Province - Oceanic	1.1	1	1	2	Light sticks maybe litter issue. Chemicals used during fishing activities may be an issue as boats maybe out at sea up to 20 days. Habitats unlikely to be affected unless a major spill, but localized impact likely. Boats subject to MARPOL rules. Intensity: negligible if MARPOL rules followed. Consequence: considered negligible because chemical pollution impacts expected to be minimal and therefore unlikely to directly affect habitats. Confidence: Limited domestic observer data indicated crews diligent waste therefore high confidence.
	Exhaust	1	6	6	Air quality	Western Pelagic Province - Oceanic	2.1	1	1	2	Exhaust from running engine hazard occurs over a large range/scale. Intensity: negligible because exhaust considered low impact to water and air quality. Consequence: considered negligible because habitats unlikely to be impacted. Confidence: considered high because exhaust unlikely to impact habitats.

Direct impact of fishing	Fishing Activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
	Gear loss	1	6	6	Habitat structure and function	Western Pelagic Province - Oceanic	5.1	1	1	1	Longline gear is lost although GPS radio beacons assist recovery of large sets of gear. Gear may drift in pelagic water, if it sinks can litter benthic habitats, and persist in habitat if long breakdown times. Intensity: minor; rare in space and time. Consequence: minor; some benthic habitats may be damaged by gear if it attaches to reefs or sponge beds, however, while gear is floating it is modifying the pelagos, potentially affecting TEPs, hence this scenario considered worst. Confidence: low because of a lack of data on extent of gear loss and breakdown times.
	Navigation/ steaming	1	6	6	Water quality	Western Pelagic Province - Oceanic	1.1	1	1	2	Fishing activity hence Navigation/ steaming occurs throughout the year over the entire fishery. Navigation/steaming is a large component of the operations. Intensity: negligible because it is unlikely to have measurable/detectable impact on water or air quality. Consequence: negligible because unlikely to affect water or air quality. Confidence: high logical consideration.
	Activity/ presence on water	1	6	6	Water quality	Western Pelagic Province - Oceanic	1.1	1	1	2	The environment will be impacted by noise and visual stimuli temporarily. Intensity: negligible because it is unlikely to have measurable/detectable impact on water or air quality. Consequence: negligible because unlikely to impact habitats. Confidence: high logical consideration
Disturb physical processes	Bait collection	1	6	6	Substrate quality	fine sediments, wave rippled, large sponges, inner-shelf	3.1	1	1	1	Bait collection is permitted for own use in fishing for scheduled species, most fishers catch own live bait regularly. Embayment fishing occurs on the south coast. During hand hauling (no power-blocks) of small purse seine nets, mixing of water may occur, and some contact with soft bottom will impact benthic habitats Intensity: negligible. Small scale sediment disturbance and suspension will occur, with localized turbidity and some smothering but given net size and coarser sediments this should have minimal impact on benthic habitats. Consequence: negligible because scale and intensity low, level of bait catch it is unlikely to impact water quality or habitats long term. Confidence: low because of insufficient knowledge on live baitfish distribution, and capture.
	Fishing	1	6	6	Water quality	Western Pelagic Province - Oceanic	1.1	1	1	2	This fishery a pelagic fishery using longlines. Intensity: negligible unlikely to have measurable/detectable impact spatially or temporally on physical processes because once the gear is removed water conditions expected to return to usual state. Consequence: negligible because considered to have remote impact on physical processes that might change habitats. Confidence: high due to logic
	Boat launching	0						0	0	0	

Direct impact of fishing	Fishing Activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
	Anchoring/ mooring	1	6	6	Substrate quality	fine sediments, wave rippled, large sponges, inner-shelf	3.1	1	1	2	Low level disturbance to substratum of benthic habitats from anchoring or mooring in anchorages, likely to result in temporary suspension of sediments. Intensity: minor because habitat expected to recover from damage over short term in shallower waters (unless slow growing). Consequence: minor because the scale and intensity. Confidence: High constrained by logic.
	Navigation/steaming	1	6	6	Water quality	Western Pelagic Province - Oceanic	1.1	1	1	2	Fishing activity hence Navigation/ steaming occurs throughout the year over the entire fishery. Navigation/steaming is a large component of the operations. Intensity: negligible because it is unlikely to have measurable/detectable impact on water or air quality. Consequence: negligible because unlikely to affect water or air quality. Confidence: high because it was considered unlikely for there to be strong interactions between Navigation/steaming and habitats
External Impacts (specify the particular example within each activity area)	Other fisheries	1	6	6	Habitat structure and function	Western Pelagic Province - Oceanic	5.1	3	3	1	Fishery covers a large spatial area in which many other state, and commonwealth fisheries occur using a wide range of methods and target species. Many of these will impact benthic as well as pelagic habitats, eg Western deep water trawl. Cumulative impacts assessment will better outline the overall level of vulnerability for habitats. Intensity: moderate over scale of fishery Consequence: could have measurable impacts on some habitats, once linkages understood. Confidence: Until there is better information difficult to score therefore low confidence.
	Aquaculture	0						0	0	0	
	Coastal development	1	6	6	Water quality	Western coastal pelagic	1.1	3	3	1	Fishery covers a large spatial area and occurs through out the year. Sewage from major settlements; eutrophication; algal blooms. May effect water quality of pelagic habitats especially. Intensity: assumed to have moderate impact both direct and indirect on habitats, especially around major population centre but linkages need to be better understood, particulary degree of effect apparent in areas beyond state waters. Consequence: moderate because of cumulative effects. Confidence: Until there is better information difficult to score therefore low confidence.

Direct impact of fishing	Fishing Activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
	Other extractive activities	1	6	6	Habitat structure and function	Western Pelagic Province - Oceanic	5.1	2	3	1	Oil and gas industry off NWS. May be pollution from petrochemical industry in both shallow and deep water. Noise and visual stimuli. Re operations (light). Intensity: assumed to have minor impact both direct and indirect on habitats, but linkages need to be better understood. Consequence: cumulative effects expected to be moderate. Confidence: Until there is better information difficult to score therefore low confidence.
	Other non-extractive activities	1	6	6	Habitat structure and function	Western oceanic (1) pelagic	5.1	2	2	1	Fishery covers a large spatial area and occurs through out the year. Habitats may be disturbed by tourism (walking on corals, (whale watching) charter boats anchoring, litter. Intensity: assumed to have minor impact both direct and indirect on habitats, but linkages need to be better understood. Consequence: cumulative effects expected to be minor as increasingly tourism subject to regulations codes of conduct. Confidence: Until there is better information difficult to score therefore low confidence.
	Other anthropogenic activities	1	6	6	Habitat structure and function	Western oceanic (1) pelagic	5.1	1	1	1	Fishery covers a large area wide range of uses and so activities like whale watching and recreational boating may cause impacts in the same region. Probably too far offshore for overlap with the majority of other anthropogenic activities

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

Direct impact of fishing	Fishing Activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
Capture	Bait collection	1	6	6	Species composition	Western coastal pelagic	1	1	1	1	Bait collection is permitted for own use in fishing for scheduled species. Embayment fishing occurs on the south coast. Permit conditions restrict to small purse seine nets, which are hand hauled (no power-blocks) mixing of water may occur. Fishery occurs throughout year and covers a large area (SA/VIC border westward to Cape York QLD) but effort highest in western oceanic pelagic zone therefore assume highest bait collection on adjacent shelf. Live bait used for 1% shots. Purse seine method. According to AFMA's strategic assessment if catch of live bait increases it will be monitored. May affect baitfish communities but at these levels unlikely to affect communities (food source). **Intensity**: Negligible because current live bait catch is low impact expected to be negligible, unlikely to be detectable against background variability. **Consequence**: Negligible because scale and intensity low, level of bait catch it is unlikely to impact community composition. **Confidence**: Low because of insufficient knowledge on live baitfish distribution, and capture. Need to consider overall stock status of baitfish with regard to capture by 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 (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
	Fishing	1	6	6	Trophic/size structure	Western oceanic (1) pelagic	4	4	3	1	Fishery occurs throughout year and covers a large area (SA/VIC border westward to Cape York QLD) for all species. However, most fishing occurs in areas of greatest fishing effort (oceanic pelagic off WA). Most target and non-target species taken in WTBF as a result of pelagic longline activity. Refer to scoping document re changes in catch from Japanese statistics to domestic statistics. **Intensity**: Major the domestic fisherygrew rapidly from 1998 but now reducing in effort and range. The level of fishing may have affected the state of some communities. **Consequence**: Moderate because of the intensity and spatial scale of the fishery. Need to establish this level of catch is sustainable so that communities are not affected over time. Fishing targets apex predators which might result in change trophic/size structure. **Confidence**: Low as the information collection system is in development stage and is currently considered inadequate for the scale of the fishery.
	Incidental behaviour	1	6	6	Species composition	Western oceanic (1) pelagic	1	1	1	1	Greatest fishing effort occurs in the oceanic pelagic waters off WA. Incidental behavior might impact communities. **Intensity**: Assumed negligible (at this stage). **Consequence**: Negligible at this stage assumed unlikely to affect communities. **Confidence**: Low at this stage as the information collection system is in the development stage. To be reviewed once results of the Data Collection Programme and Observer Programme are completed.

Direct impact of fishing	Fishing Activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
Direct impact without capture	Bait collection	1	6	6	Species composition	Western coastal pelagic	1	1	1	1	Bait collection is permitted for own use in fishing for scheduled species. Fishery occurs throughout year. Live bait used for 1% shots. Purse seine method. According to AFMA's strategic assessment If catch of live bait increases it will be monitored. May affect baitfish communities but at these levels unlikely to affect target and non-target communities (food source). **Intensity**: Negligible because current live bait catch is low impact expected to be negligible, unlikely to be detectable against background variability. **Consequence**: Negligible because scale and intensity low, level of bait catch it is unlikely to impact community composition. **Confidence**: Low because of insufficient knowledge on live baitfish distribution, and capture. Need to consider overall stock status of baitfish with regard to capture by other fisheries.
	Fishing	1	6	6	Trophic/size structure	Western oceanic (1) pelagic	4	2	2	1	Fishery occurs throughout year and covers a large area (SA/VIC border westward to Cape York QLD) for all species. However, greatest fishing effort is on the slope off WA (oceanic pelagic, off WA). Most target and non-target species taken in WTBF result from pelagic longline activity. **Intensity**: Minor. **Consequence**: Minor because of the intensity and spatial scale of the fishery. Need to establish this level of catch is sustainable so that communities are not affected over time. **Confidence**: Low as the information collection system is in development stage and is currently considered inadequate for the scale of the fishery.
	Incidental behaviour	1	6	6	Species composition	Western oceanic (1) pelagic	1	1	1	1	Greatest fishing effort occurs in the oceanic pelagic waters off WA. Incidental behavior might impact communities. **Intensity**: Assumed negligible (at this stage). **Consequence**: Negligible at this stage assumed unlikely to affect communities. **Confidence**: Low as activities yet to be identified.

Direct impact of fishing	Fishing Activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
	Gear loss	1	6	6	Species composition	Western oceanic (1) pelagic	1	1	1	1	Longline gear is lost assumed in the area of greatest fishing effort. Target and non-target species may be caught as gear drifts. GPS radio beacons assist recovery gear. Lost gear tends to ball up reducing likelihood of entanglement; not likely to touch bottom. **Intensity**: Negligible even though lost gear can continue to fish once lost, for this fishery direct impact expected to be minimal unlikely to be detectable against background variability. **Consequence**: Negligible as level unlikely to impact community composition or change distribution of communities. **Confidence**: Low because of a lack of data on interactions.
	Anchoring/ mooring	1	6	6	Species composition	Western oceanic (1) pelagic	1	1	1	2	Longline vessels use sea anchors occasionally, assuming vessels anchor in areas of greatest fishing effort (i.e. offshore). Vessels rarely anchor or moor in anchorages. If occurs unlikely to impact communities. **Intensity**: Negligible because the likelihood of impact is expected to be very unlikely, to be detectable against background variability. **Consequence**: Negligible because the scale and intensity is considered negligible it is unlikely to impact communities. **Confidence**: High because interactions unlikely.
	Navigation/ steaming	1	6	6	Species composition	Western oceanic (1) pelagic	1	1	1	2	Navigation/steaming occur throughout the year. However, this mostly occurs in areas of greatest fishing effort. Navigation/steaming are a large component of the operations. **Intensity**: Negligible because it is unlikely to have measurable/detectable impact on species composition or distribution. **Consequence**: Negligible impact on communities. **Confidence**: High because it was considered unlikely for there to be strong interactions between navigation/steaming and communities

Direct impact of fishing	Fishing Activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
Addition/ movement of biological material	Translocation of species	1	6	6	Species composition	Western oceanic (1) pelagic	1	3	3	1	Over half the licences in this fishery allow access to more than one fishing area therefore translocation of species from hull fouling and ballast exchange possible. **Intensity**: Moderate becaue of the number of boats mving from area to area. **Consequence**: Moderate -if species were invasive pests or pathogens changes in species composition would be detectable at least 10% level**Confidence**: Low due to lack of data
	On board processing	1	6	6	Distribution of community	Central Western mid slope; South Western Transition mid slope; North Western mid slope; Western oceanic (1) pelagic	3	1	1	1	On board processing occurs in areas of greatest fishing effort. **Intensity**: Negligible impacts expected because waste expected to be taken up quickly by opportunistic scavengers or sink to benthos and scavenged by benthic species. **Consequence**: Negligible, unlikely to affect distribution of bio or geo chemical cycles of communities. **Confidence**: Low because of a lack of verified observer data.
	Discarding catch	1	6	6	Distribution of community	Central Western mid slope; South Western Transition mid slope; North Western mid slope; Western oceanic (1) pelagic	3	1	1	1	Discarding non-target species due to high grading and damage by sharks or marine mammals, and discarding byproduct species of low value or lack of markets occurs in areas of greatest fishing effort. **Intensity**: Negligible impacts expected because waste expected to be taken up quickly by opportunistic scavengers or sink to benthos and scavenged by benthic species. **Consequence**: Negligible, unlikely to affect distribution of communities. **Confidence**: Low because of a lack of verified observer data.
	Stock enhancement	0	0	0							

Direct impact of fishing	Fishing Activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
	Provisioning	1	6	6	Distribution of community	Central Western mid slope; South Western Transition mid slope; North Western mid slope; Western oceanic (1) pelagic	3	4	1	1	Live bait used for 1% shots (blue mackerel, yellowtail scad), rest dead bait. Broadbill swordfish and bigeye targeted using squid, other target species use pilchard, blue mackerel, yellowtail scad. **Intensity**: Major occurs throughout the fishery Consequence : minor although 98% bait is not self-caught locally and is "imported" from other areas as dead bait, most excess would be consumed by opportunistic scavengers or sink to benthos and scavenged by benthic species. **Consequence**: Negligible, unlikely to affect distribution of communities. **Confidence**: Low because of a lack of verified observer data.
	Organic waste disposal	1	6	6	Distribution of community	Central Western mid slope; South Western Transition mid slope; North Western mid slope; Western oceanic (1) pelagic	3	1	1	2	Domestic boats are 3-7 days at sea but increasingly maybe 7-20 days at sea. Boats subject to MARPOL rules. **Intensity**: Negligible if MARPOL rules followed. **Consequence**: Negligible because organic waste likely to be scavenged or break down quickly, so unlikely affect distribution of bio or geo chemical cycles of communities. **Confidence**: Domestic observer data indicated crew diligent regarding waste therefore high confidence.
Addition of non-biological material	Debris	1	6	6	Species composition	Central Western mid slope; South Western Transition mid slope; North Western mid slope; Western oceanic (1) pelagic	1.1, 5.1	1	1	2	Plastics may be an issue, entanglement, ingestion, litter. Boats subject to MARPOL. Intensity: Negligible if MARPOL rules followed. Consequence: Negligible because debris by this fishery expected to be accidental not routine. Confidence: Domestic observer data indicated crew diligent regarding waste therefore high confidence.

Direct impact of fishing	Fishing Activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
	Chemical pollution	1	6	6	Species composition	Western oceanic (1) pelagic	1	1	1	2	Light sticks maybe ingested. Chemicals used during fishing activities may be an issue as boats maybe out at sea up to 20 days. Greatest fishing effort occurs in oceanic pelagic region off WA. Communities unlikely to be affected unless a major spill. Boats subject to MARPOL rules. I**ntensity**: Negligible if MARPOL rules followed. Light sticks may be a problem needs further investigation. **Consequence**: Negligible because chemical pollution impacts expected to be minimal and therefore unlikely to directly impact communities. **Confidence**:domestic observer data indicated crews diligent waste therefore high confidence.
	Exhaust	1	6	6	Distribution of community	Western oceanic (1) pelagic	3	1	1	2	Exhaust from running engine hazard occurs over a large range/scale. **Intensity**: Negligible because exhaust considered low impact to communities i.e. physically affected, unlikely to be measurable, effects more likely to be short term and effect air quality. **Consequence**: Negligible because distribution communities not likely to be affected. **Confidence**: High because exhaust unlikely to impact on communities.
	Gear loss	1	6	6	Distribution of community	Western oceanic (1) pelagic	3	1	1	1	Longline gear is lost, assumed in the area of greatest fishing effort. Target and non-target species may be caught as gear drifts. GPS radio beacons assist recovery gear. Lost gear tends to ball up reducing likelihood of entanglement; unlikely to touch bottom. **Intensity**: Negligible Gear unlikely to alter habitat and consequently species distribution **Consequence**: Since the scale and intensity of direct impacts is perceived to be low, consequence is expected to be negligible as level unlikely to impact community composition or change distribution of communities. **Confidence**: Low because of a lack of data on interactions.

Direct impact of fishing	Fishing Activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
	Navigation/ steaming	1	6	6	Distribution of community	Western oceanic (1) pelagic	3	1	1	2	Navigation/steaming occur throughout the year over the entire fishery. However, this mostly occurs in areas of greatest fishing effort. Navigation/steaming are a large component of the operations. **Intensity**: Negligible because it is unlikely to have measurable/detectable impact on community distribution i.e. seabirds. **Consequence**: Negligible because interactions remote, and impact on communities unlikely. **Confidence**: High because it was considered unlikely for there to be strong interactions between navigation/steaming and communities.
	Activity/ presence on water	1	6	6	Distribution of community	Western oceanic (1) pelagic	3	1	1	2	The environment will be impacted by noise and visual stimuli could temporarily effect distribution of some communities. **Intensity**: Negligible because it is unlikely to have measurable/detectable impact on communities. **Consequence**: Negligible because type of impact on communities. **Confidence**: High because it was considered unlikely for there to be strong impacts between activity and presence and communities.
Disturb physical processes	Bait collection	1	6	6	Distribution of community	Western coastal pelagic	3	1	1	1	Currently only 1% of bait is caught live. Embayment fishing on the south coast. Permit conditions restrict to small purse seine nets, which are hand hauled (no power-blocks) mixing of water may occur. **Intensity**: Negligible. **Consequence**: Negligible because considered unlikely to have measurable/detectable impact on physical processes that might impact communities. Expected to recover after disturbance. **Confidence**: Low because of insufficient knowledge on live baitfish distribution and capture, and possible effects on the physical processes

Direct impact of fishing	Fishing Activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
	Fishing	1	6	6	Distribution of community	Western oceanic (1) pelagic	3	1	1	2	Fishery occurs throughout year and covers a large area. However, area of greatest fishing effort is in the epipelagic waters over the mid-slope of WA (Western oceanic pelagic). Intensity: Negligible detectable effect on the physical processes important to the pelagic communities. **Consequence**: negligible. Confidence: high, logical consideration.
	Boat launching	0	0	0							Boats come from ports
	Anchoring/ mooring	1	6	6	Distribution of community	Western oceanic (1) pelagic	3	1	1	2	Longline vessels use sea anchors occasionally, assuming vessels anchor in areas of greatest fishing effort (i.e. offshore). Vessels rarely anchor or moor in anchorages. I**ntensity**: Negligible. **Consequence**: Negligible because scale and intensity physical processes expected to recover after disturbance. **Confidence**: High, logical consideration given scale of some other natural processes.
	Navigation/steaming	1	6	6	Distribution of community	Western oceanic (1) pelagic	3	1	1	2	Navigation/steaming occur throughout the year. However, this occurs mostly in areas of greatest fishing effort. **Intensity**: Negligible. **Consequence**: Negligible. **Confidence**: High because it was considered unlikely for there to be strong interactions between navigation/steaming and communities.
External Impacts (specify the particular example within each activity area)	Other fisheries ;Southern Bluefin Tuna Fishery (SBT), Small Pelagics Fishery (SPF), SESSF, Skipjack Fishery (SKJ).	1	6	6	Trophic/size structure	Western oceanic (1) pelagic	4	3	3	1	Fishery covers a large spatial area in which many other state fisheries occur, using wide range targeting methods and catch species. Some species migratory and interact with international fishing operations in Indian ocean. Uncertainties regarding mixing between Indian Ocean and Australian EEZ, and regarding stock assessments: these catches may affect domestic fishery and domestic catches can affect these stocks (links). Require analysis existing data to obtain an overview. **Intensity**: Moderate, could have measurable major impact both direct and indirect on communities once linkages understood. **Consequence**:

Direct impact of fishing	Fishing Activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
											Moderate cumulative effects could be major and affect many communities. **Confidence**: Until there is better information this is difficult to score therefore low confidence.
	Aquaculture	0	0								
	Coastal development	1	6	6	Bio- and geo-chemical cycles	Central Western inner shelf; Western coastal pelagic	5	3	3	1	Fishery covers a large spatial area and occurs throughout the year although not oninner shelf where impacts of coastal development likely to occur. Sewage from major settlements, eutrophication and algal blooms occur. **Intensity**: Moderate, impact both direct and indirect on communities. May be different around major population centre but linkages need to be better understood. **Consequence**: Cumulative effects could be moderate and impact many communities. **Confidence**: Until there is better information difficult to score therefore low confidence.
	Other extractive activities	1	6	6	Distribution of community	North western mid slope; North western oceanic (1) pelagic; North western oceanic (2) pelagic	3	2	2	1	Oil and gas industry occur off the NWS, pipelines and oil rig construction may physically alter habitat and consequently distribution of species. May be pollution from petrochemical industry in both shallow and deep water, noise and visual stimuli in the environment from seismic acvtivity may be acute but stand-by rig tenders and oil rigs considered to have minor noise effect. **Intensity**: Minor. **Consequence**: Assumed to have minor direct and indirect impacts on communities, but linkages need to be better understood. **Confidence**: Until there is better information difficult to score therefore low confidence.

Direct impact of fishing	Fishing Activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
	Other non-extractive activities	1	6	6	Distribution of community	Western oceanic (1) pelagic	3	2	2	1	Shipping and other similar activities not believed to play an important role in this offshore area. **Intensity:** minor. **consequence**: minor. **Confidence**: low, due to limited information for the group to consider.
	Other anthropogenic activities	1	6	6	Distribution of community	Western oceanic (1) pelagic	3	1	1	1	Communities may be disturbed by tourism (whale watching) using charter boats and shipping. **Intensity**: Assumed to have negligible impact on community, but linkages need to be better understood. **Consequence**: Cumulative effects expected to be negligible and may not affect community. **Confidence**: Until there is better information difficult to score therefore low confidence.

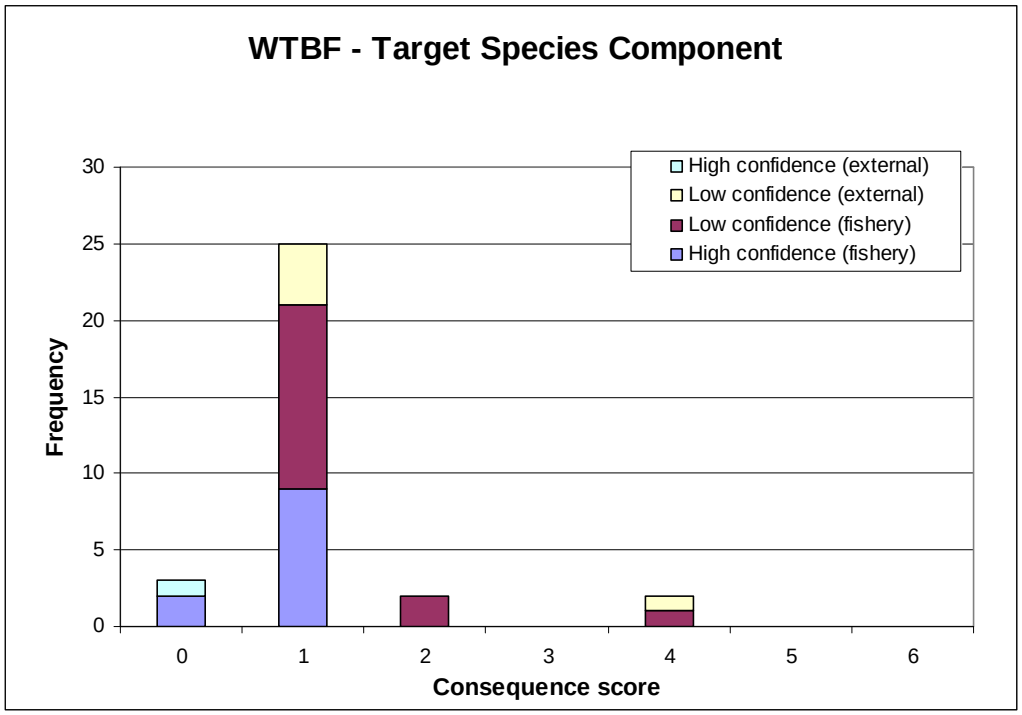
2.3.11 Summary of SICA results

The report provides a summary table (**Level 1 (SICA) Document L1.6**) of consequence scores for all activity/component combinations and a table showing those that scored 3 or above for consequence, and differentiating those that did so with high confidence (in bold).

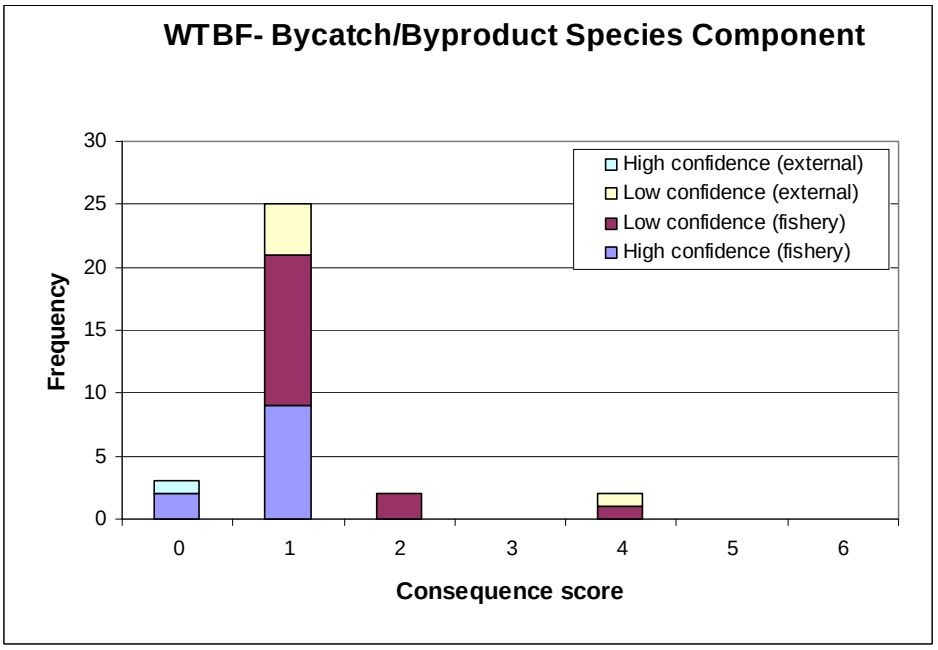
Level 1 (SICA) Document L1.6. Summary table of consequence scores for all activity/component combinations.

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

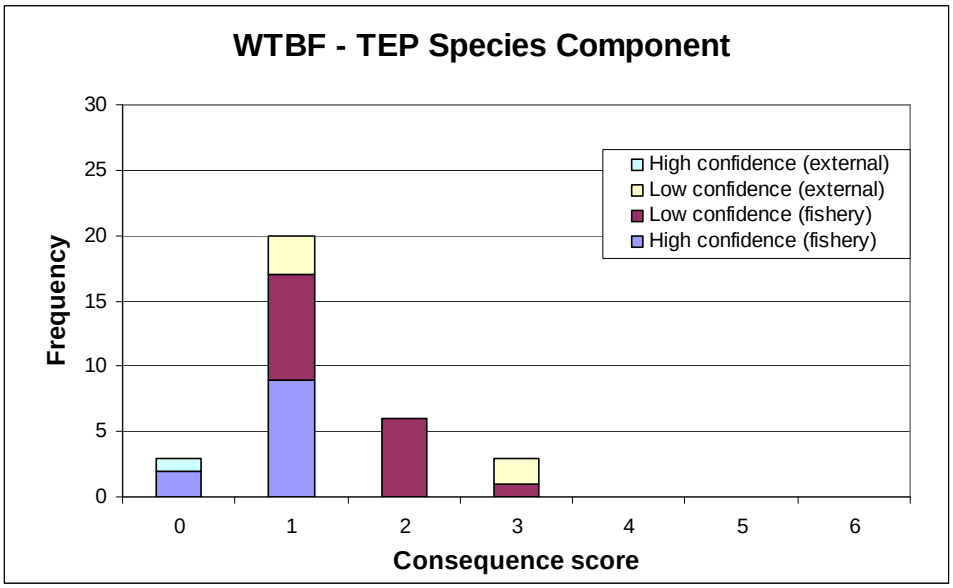
Target species: Frequency of consequence score differentiated between high and low confidence.



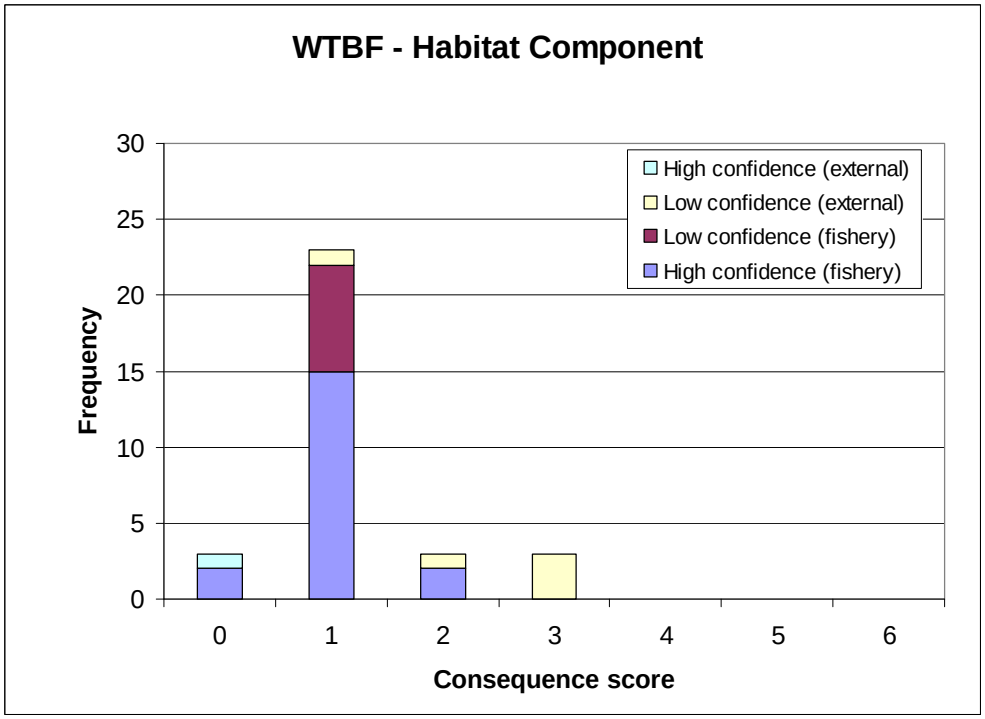
Byproduct and bycatch species: Frequency of consequence score differentiated between high and low confidence



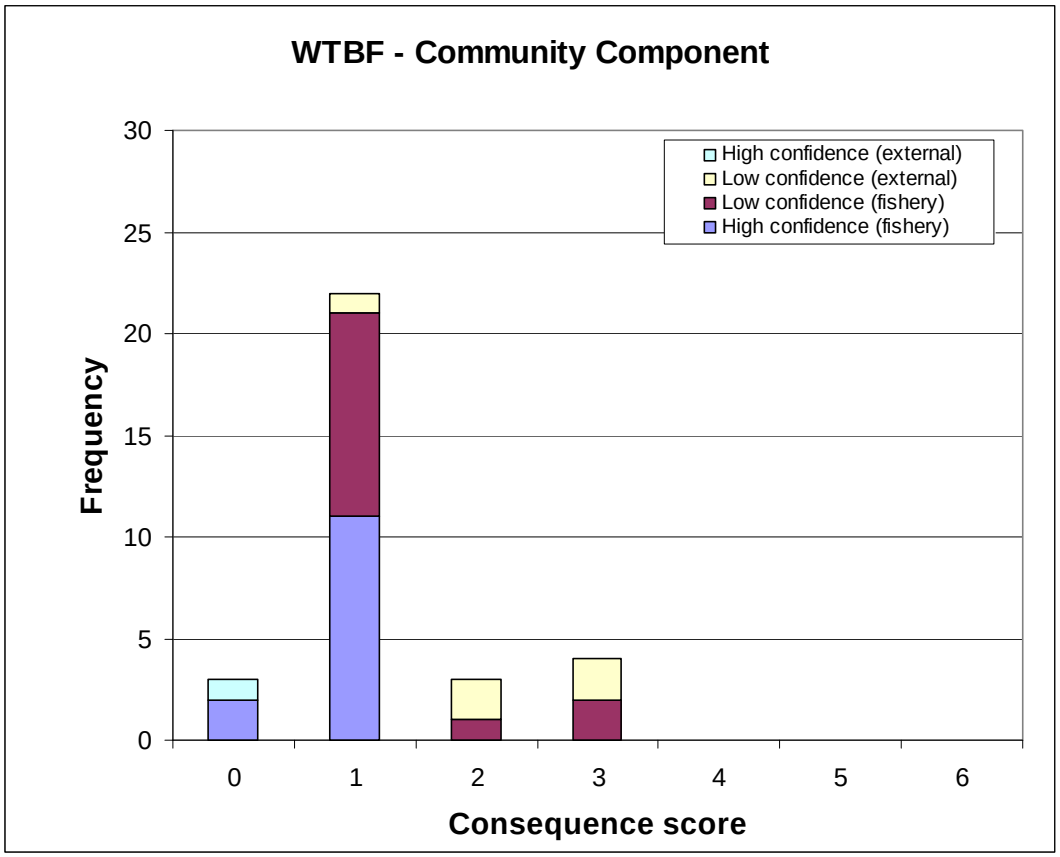
TEP species: Frequency of consequence score differentiated between high and low confidence (SICA excel workbook)



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



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



2.3.12 Evaluation/discussion of Level 1

The target species, byproduct/bycatch, TEP, habitats and community components all have consequence scores of 3 (moderate risk) for at least one activity.

Capture by fishing is assessed to potentially have a major impact on the target species and byproduct/bycatch species and a moderate impact on TEP species and Communities. The target species most vulnerable to capture by fishing in the scenarios is the broadbill swordfish. According to the BRS status report for 2004, this species is fully fished in the Indian Ocean and the WTBF, and should be monitored closely in the WTBF for localised depletion associated with intensive fishing. The WTBF Data summary for 2003 shows a trend for 1998-2003 of increased catches in both sectors but two thirds are caught in the western sector.

The byproduct species most vulnerable to capture by fishing is considered to be the Dusky shark. The dusky shark is considered at risk by McAuley and Thomas (2005). As Ward and Curren (2004) explain, this species is also caught by State WA fisheries, and there is concern over additional pressure from the WTBF. Two other bycatch species of concern are the Blue shark and the Crocodile shark, which are caught in large numbers. The blue shark is the most common species caught in the fishery (catches exceed those of any of the target species). The crocodile shark is the third most frequently caught species off W.A. and this species has low productivity.

The TEP species most vulnerable to fishing are turtles and some marine birds. Several species of turtles are captured by the fishery, with most recorded as released alive. Many species and groups of marine birds have been observed close to fishing boats, such as albatross, petrels, and shearwaters particularly during setting and retrieval Both the grey nurse shark and the white shark are classified as endangered and are occasionally caught in the fishery.

Significant external hazards included other fisheries in the region, coastal development, and other extractive 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
- Bycatch/byproduct
- TEP
- 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

- 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 from direct impacts of fishing only. Future iterations of the methodology will include PSAs modified to measure the risk due to other activities, such as gear loss.

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

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

Species

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

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

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

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

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

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

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

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

Habitats

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

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

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

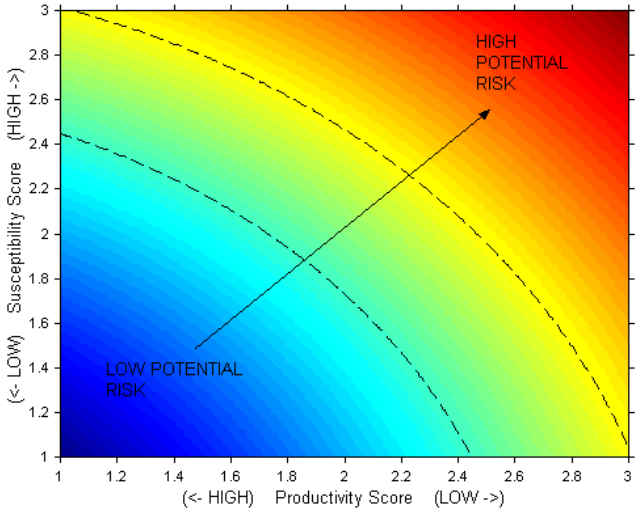


Figure 13. The axes on which risk to the ecological units is plotted. The *x*-axis includes attributes that influence the productivity of a unit, or its ability to recover after impact from fishing. The *y*-axis includes attributes that influence the susceptibility of the unit to impacts from fishing.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

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

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

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

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

ERA_SPECIES_ID	TAXA_NAME	SCIENTIFIC_NAME	CAAB_CODE	FAMILY_NAME	COMMON_NAME	CODE_ROLE_IN_FISHERY	EXPLANATION FOR WHY TAXA EXCLUDED
1758	Chondrichthyan	Sphyrnidae - undifferentiated	37019000	Sphyrnidae	hammerhead sharks	Not Assigned	group code
1765	Chondrichthyan	Sharks - other	37990003	Multi-family group	Sharks (other)	Not Assigned	group code
2038	Chondrichthyan	Scyliorhinidae - undifferentiated	37015000	Scyliorhinidae	catsharks	Not Assigned	group code
2042	Chondrichthyan	Squalidae - undifferentiated	37020000	Squalidae	dogfishes	Not Assigned	group code
2046	Chondrichthyan	Dasyatidae - undifferentiated	37035000	Dasyatidae	stingrays	Not Assigned	group code
2066	Teleost	Alepisauridae - undifferentiated	37128000	Alepisauridae	lancetfishes	Not Assigned	group code
2145	Chondrichthyan	Skates & rays, unspecified	37990018	Multi-family group	skates and rays	Not Assigned	group code
1757	Chondrichthyan	Carcharhinidae, Hemigaleidae - undifferentiated	37018000	Carcharhinidae, Hemigaleidae	whaler and weasel sharks	DI	group code

ERA_SPECIES_ID	TAXA_NAME	SCIENTIFIC_NAME	CAAB_CODE	FAMILY_NAME	COMMON_NAME	CODE_ROLE_IN_FISHERY	EXPLANATION FOR WHY TAXA EXCLUDED
2152	Chondrichthyan	Centroscymnus & Deania spp	37020904	Squalidae	roughskin dogfish	Not Assigned	group code
1696	Marine bird	Catharacta spp.	40128000	Laridae	Skuas	TEP	group code
1688	Marine reptile	Hydrophis vorisi	39125030	Hydrophiidae	A seasnake	TEP	group code
312	Chondrichthyan	Pristiophoridae - undifferentiated	37023000	Pristiophoridae	Saw Shark	Not Assigned	group code
810	Teleost	Lampris guttatus & Lampris immaculatus	37268900	Lampridae	Moonfish	Not Assigned	group code
1359	Chondrichthyan	Carcharhinus, Loxodon & Rhizoprionodon spp	37018901	Carcharhinidae	Blacktip sharks	Not Assigned	group code

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. There is no observer program currently in place for this fishery. A pilot scientific monitoring program ran from April 2003 to August 2004, and some of the data were used in the Level 2 PSA assessment.

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 species *WTB Fishery*

ERA species ID	Scientific name	Common name	Average logbook catch (kg) (2001-04)	Missing > 3 attributes (Y/N)	Missing productivity attributes (out of 7)	Missing susceptibility attributes (out of 4)	Productivity (additive) (1- low, 3-high)	Susceptibility (mult) (1- low, 3-high)	2D vulnerability value (P&S) (low-high range=1.41-4.24)	Susceptibility override used?	2D P&S vulnerability category	High/Med risk category (Refer 2.4.8)	Comments
Teleost													
213	Xiphias gladius	Broad Billed Swordfish	1,401,021	N	0	0	1.86	2.33	2.98	N	Med	Spatial uncertainty	
62	Thunnus obesus	Bigeye Tuna	270,291	N	0	0	1.71	1.89	2.55	N	Low		
895	Thunnus alalunga	Albacore	63,224	N	0	0	1.71	1.89	2.55	N	Low		
212	Thunnus albacares	Yellowfin Tuna	307,029	N	0	0	1.57	1.89	2.46	N	Low		
884	Tetrapturus audax	Striped marlin	197	N	0	0	1.86	1.44	2.35	N	Low		
64	Katsuwonus pelamis	Skipjack Tuna	53	N	0	0	1.57	1.44	2.13	N	Low		

Target bait species *WTB Fishery*

ERA species ID	Scientific name	Common name	Average logbook catch (kg) (2001-04)	Missing > 3 attributes (Y/N)	Missing productivity attributes (out of 7)	Missing susceptibility attributes (out of 4)	Productivity (additive) (1- low, 3-high)	Susceptibility (mult) (1- low, 3-high)	2D vulnerability value (P&S) (low-high range=1.41-4.24)	Susceptibility override used?	2D P&S vulnerability category	High/Med risk category (Refer 2.4.8)	Comments
Invertebrate													
46	Todarodes filippovae	Southern Ocean arrow squid	0	N	2	0	1.86	1.30	2.26	N	Low		
Teleost													
511	Arripis georgianus	Tommy rough	0	N	0	0	1.43	1.07	1.79	N	Low		
540	Trachurus novaezelandiae	Yellow tail scad	0	N	0	0	1.29	1.22	1.77	N	Low		
1088	Trachurus declivis	Jack Mackerel	0	N	0	0	1.29	1.22	1.77	N	Low		
210	Scomber australasicus	Blue Mackerel	4	N	0	0	1.29	1.22	1.77	N	Low		
825	Sardinops neopilchardus	Pilchard	0	N	0	0	1.00	1.22	1.58	N	Low		
872	Sardinella lemuru	Scaly Mackerel	0	N	0	0	1.14	1.07	1.57	N	Low		

Byproduct Species *WTB Fishery*

ERA species ID	Scientific name	Common name	Average logbook catch (kg) (2001-04)	Missing > 3 attributes (Y/N)	Missing productivity attributes (out of 7)	Missing susceptibility attributes (out of 4)	Productivity (additive) (1- low, 3-high)	Susceptibility (mult) (1- low, 3-high)	2D vulnerability value (P&S) (low-high range=1.41-4.24)	Susceptibility override used?	2D P&S vulnerability category	High/Med risk category (Refer 2.4.8)	Comments
Chondrichthyan													
808	Carcharhinus obscurus	Dusky Shark	760	N	0	0	3.00	1.67	3.43	N	High	Low overlap	
972	Lamna nasus	Porbeagle shark	49	N	0	0	2.71	1.67	3.19	N	High	Low overlap	
1039	Prionace glauca	Blue Shark	34,101	N	0	0	2.57	1.67	3.06	N	Med	Low overlap	
862	Pseudocarcharias kamoharai	Crocodile Shark	265	N	2	0	2.57	1.67	3.06	N	Med	Low attribute score	
625	Carcharhinus longimanus	Oceanic Whitetip Shark	2,142	N	0	0	2.43	1.67	2.95	N	Med	Low overlap	
964	Isurus oxyrinchus	Shortfinned Mako or Blue Pointer	3,143	N	0	0	2.43	1.67	2.95	N	Med	Low overlap	
963	Isistius brasiliensis	Cookie-cutter shark (cigar shark)	0	N	0	0	2.29	1.22	2.59	N	Low		
Teleost													
842	Lampris guttatus	Spotted moonfish	0	N	1	0	2.00	2.33	3.07	N	Med	*Other	
255	Thunnus maccoyii	Southern Bluefin Tuna	8,690	N	0	0	2.00	2.33	3.07	N	Med	Spatial uncertainty	
215	Centrolophus niger	Rudderfish	24,804	N	0	0	1.71	2.33	2.90	N	Med	*Other	
830	Gasterochisma melampus	Butterfly Mackerel	290	N	0	0	1.71	1.89	2.55	N	Low		

ERA species ID	Scientific name	Common name	Average logbook catch (kg) (2001-04)	Missing > 3 attributes (Y/N)	Missing productivity attributes (out of 7)	Missing susceptibility attributes (out of 4)	Productivity (additive) (1- low, 3-high)	Susceptibility (mult) (1- low, 3-high)	2D vulnerability value (P&S) (low-high range=1.41-4.24)	Susceptibility override used?	2D P&S vulnerability category	High/Med risk category (Refer 2.4.8)	Comments
836	Istiophorus platypterus	Sailfish	0	N	0	0	1.86	1.44	2.35	N	Low		
958	Hyperoglyphe antarctica	Blue Eye Trevalla	4	N	0	0	2.00	1.15	2.31	N	Low		
897	Thunnus orientalis	Northern Bluefin Tuna	295	N	0	0	1.86	1.30	2.26	N	Low		
1066	Rexea solandri	Gemfish	5	N	0	0	1.71	1.30	2.15	N	Low		
835	Gymnosarda unicolor	Dogtooth tuna	0	N	0	0	1.71	1.30	2.15	N	Low		
204	Ruvettus pretiosus	Oilfish	3,199	N	0	0	1.71	1.22	2.11	N	Low		
845	Lepidocybium flavobrunneum	Escolar or Black Oil fish	21,618	N	0	0	1.71	1.22	2.11	N	Low		
259	Acanthocybium solandri	Wahoo	1,862	N	0	0	1.57	1.30	2.04	N	Low		
899	Thunnus tonggol	Long-tail tuna	0	N	0	0	1.57	1.30	2.04	N	Low		
882	Taractichthys longipinnis	Long finned Bream (pomfret)	0	N	0	0	1.43	1.44	2.03	N	Low		
152	Brama brama	Ray's Bream	449	N	0	0	1.43	1.22	1.88	N	Low		
814	Coryphaena hippurus	Dolphin Fish (mahi mahi)	8,177	N	0	0	1.43	1.15	1.83	N	Low		

Bycatch Species *WTB Fishery*

ERA species ID	Scientific name	Common name	Average logbook catch (kg) (2001-04)	Missing > 3 attributes (Y/N)	Missing productivity attributes (out of 7)	Missing susceptibility attributes (out of 4)	Productivity (additive) (1- low, 3-high)	Susceptibility (mult) (1- low, 3-high)	2D vulnerability value (P&S) (low-high range=1.41-4.24)	Susceptibility override used?	2D P&S vulnerability category	High/Med risk category (Refer 2.4.8)	Comments
Chondrichthyan													
179	Alopias vulpinus	Thintail Thresher Shark, thresher shark	72	N	0	0	2.57	2.33	3.47	N	High	Low overlap	
875	Scymnodalatias albicauda	Sherwoods dogfish	0	Y	3	1	2.86	1.44	3.20	N	High	Missing data	
552	Sphyrna zygaena	Smooth hammerhead	0	N	0	0	2.71	1.67	3.19	N	High	Low overlap	
535	Carcharhinus brachyurus	Bronze Whaler	688	N	0	0	2.86	1.22	3.11	N	Med	Low overlap	
551	Galeocerdo cuvier	Tiger Shark	91	N	0	0	2.86	1.22	3.11	N	Med	Low overlap	
621	Carcharhinus falciformis	Silky Shark	39	N	0	0	2.57	1.67	3.06	N	Med	Low overlap	
609	Deania quadrispinosa	Platypus Shark	0	N	0	0	2.71	1.30	3.01	N	Med	Low attribute score	
469	Carcharhinus leucas	Bull Shark	0	N	0	0	2.71	1.22	2.98	N	Med	Low overlap	

ERA species ID	Scientific name	Common name	Average logbook catch (kg) (2001-04)	Missing > 3 attributes (Y/N)	Missing productivity attributes (out of 7)	Missing susceptibility attributes (out of 4)	Productivity (additive) (1- low, 3-high)	Susceptibility (mult) (1- low, 3-high)	2D vulnerability value (P&S) (low-high range=1.41-4.24)	Susceptibility override used?	2D P&S vulnerability category	High/Med risk category (Refer 2.4.8)	Comments
604	Deania calcea	Brier Shark	0	N	0	0	2.71	1.22	2.98	Y	Med	Low attribute score	Override: encounterability, deepwater species 800m+ selectivity low (R Daley)
346	Cetorhinus maximus	Basking shark	0	N	0	0	2.71	1.22	2.98	N	Med	Low overlap	
633	Centroscymnus plunketi	Plunket's shark	0	N	0	0	2.71	1.22	2.98	N	Med	Low overlap	
880	Sphyrna lewini	Scalloped Hammerhead	1,286	N	0	0	2.71	1.22	2.98	N	Med	Low overlap	
491	Centroscymnus owstoni	Owston's dogfish	0	N	0	0	2.57	1.44	2.95	N	Med	Low attribute score	
462	Alopias superciliosus	Bigeye thresher shark	0	N	0	0	2.43	1.67	2.95	N	Med	Low attribute score	
489	Centroscymnus crepidater	Deepwater dogfish	0	N	0	0	2.57	1.30	2.88	N	Med	Low attribute score	
629	Carcharhinus plumbeus	Sandbar shark	12	N	0	0	2.57	1.22	2.85	N	Med	Low overlap	

ERA species ID	Scientific name	Common name	Average logbook catch (kg) (2001-04)	Missing > 3 attributes (Y/N)	Missing productivity attributes (out of 7)	Missing susceptibility attributes (out of 4)	Productivity (additive) (1- low, 3-high)	Susceptibility (mult) (1- low, 3-high)	2D vulnerability value (P&S) (low-high range=1.41-4.24)	Susceptibility override used?	2D P&S vulnerability category	High/Med risk category (Refer 2.4.8)	Comments
647	Carcharhinus tilstoni	Australian blacktip	0	N	0	0	2.29	1.67	2.83	N	Med	Low overlap	
853	Manta birostris	Manta Ray	0	N	0	0	2.43	1.44	2.83	N	Med	Low overlap	
905	Zameus squamulosus	Velvet dogfish	0	N	0	0	2.43	1.44	2.83	Y	Med	Low attribute score	Override: encounterability, deepwater species 800m+ selectivity low (R Daley)
371	Centrophorus moluccensis (west)	Endeavour Dogfish	0	N	0	0	2.57	1.15	2.82	N	Med	Low overlap	
809	Centroscymnus coelolepis	Portuguese dogfish	0	N	2	0	2.57	1.15	2.82	N	Med	Low overlap	
1077	Squalus acanthias	White-spotted dogfish	0	N	0	0	2.57	1.15	2.82	N	Med	Low overlap	
816	Dasyatis violacea	Pelagic Stingray	0	N	0	0	2.14	1.67	2.71	N	Med	Low attribute score	
630	Carcharhinus sorrah	Sorrah shark	0	N	0	0	2.14	1.44	2.58	N	Low		
619	Carcharhinus dussumieri	Whitecheek shark	0	N	0	0	2.29	1.15	2.56	N	Low		
784	Myliobatis australis	Southern Eagle Ray	0	N	0	0	2.29	1.07	2.53	N	Low		
866	Rhizoprionodon acutus	Milk shark	0	N	0	0	2.14	1.15	2.43	N	Low		

ERA species ID	Scientific name	Common name	Average logbook catch (kg) (2001-04)	Missing > 3 attributes (Y/N)	Missing productivity attributes (out of 7)	Missing susceptibility attributes (out of 4)	Productivity (additive) (1- low, 3-high)	Susceptibility (mult) (1- low, 3-high)	2D vulnerability value (P&S) (low-high range=1.41-4.24)	Susceptibility override used?	2D P&S vulnerability category	High/Med risk category (Refer 2.4.8)	Comments
286	Callorhinchus milii	Elephantfish	0	N	0	0	1.71	1.15	2.06	N	Low		
Teleost													
1533	Mola ramsayi	[an ocean sunfish]	0	N	2	0	2.57	1.44	2.95	Y	Med	Low attribute score	Override: PCM. Can be released alive according to observer data
883	Tetrapturus angustirostris	Short Bill Spearfish	26	N	0	0	1.71	2.33	2.90	N	Med	Spatial uncertainty	
252	Mola mola	Ocean sunfish	1	N	1	0	2.29	1.67	2.83	N	Med	Low attribute score	
644	Lampris immaculatus	Southern moonfish	0	N	3	0	2.43	1.44	2.83	N	Med	Low attribute score	
373	Alepisaurus ferox	Long-nosed lancet fish	0	N	3	0	2.43	1.22	2.72	N	Med	Low attribute score	
851	Makaira indica	Black Marlin	0	N	0	0	1.86	1.89	2.65	N	Med	Spatial uncertainty	
852	Makaira mazara	Blue Marlin	0	N	0	0	2.00	1.44	2.47	N	Low		
377	Allothunnus fallai	Slender Tuna	0	N	0	1	1.57	1.89	2.46	N	Low		

ERA species ID	Scientific name	Common name	Average logbook catch (kg) (2001-04)	Missing > 3 attributes (Y/N)	Missing productivity attributes (out of 7)	Missing susceptibility attributes (out of 4)	Productivity (additive) (1- low, 3-high)	Susceptibility (mult) (1- low, 3-high)	2D vulnerability value (P&S) (low-high range=1.41-4.24)	Susceptibility override used?	2D P&S vulnerability category	High/Med risk category (Refer 2.4.8)	Comments
372	Alepisaurus brevirostris	Short-nosed Lancet Fish	0	N	3	0	2.14	1.15	2.43	N	Low		
148	Seriola lalandi	Yellowtail Kingfish	12	N	0	0	1.71	1.44	2.24	N	Low		
147	Rachycentron canadum	Cobia	6	N	0	0	1.71	1.44	2.24	N	Low		
208	Lepidopus caudatus	Southern Frostfish	3	N	1	0	1.71	1.30	2.15	N	Low		
879	Sphyraena jello	Slender Barracuda	0	N	1	0	1.86	1.07	2.15	N	Low		
162	Argyrosomus hololepidotus	Jewfish	1	N	0	0	1.71	1.07	2.02	N	Low		
1087	Thyrsites atun	Barracouta	9	N	0	0	1.57	1.15	1.95	N	Low		
63	Euthynnus affinis	Eastern Little Tuna/Mackerel tuna	0	N	0	0	1.57	1.15	1.95	N	Low		
211	Sarda australis	Australian bonito	0	N	0	0	1.57	1.15	1.95	N	Low		
664	Caranx sexfasciatus	Great Trevally	4	N	0	0	1.43	1.07	1.79	N	Low		
873	Scomber scombrus	Atlantic mackerel	6	N	0	0	1.29	1.22	1.77	Y	Low		Override: Availability: Likley to be a mis-identification (R. Daley)
908	Auxis thazard	Frigate mackerel	0	N	0	0	1.29	1.15	1.72	N	Low		

TEP Species *WTB Fishery*

ERA species ID	Scientific name	Common name	Average logbook catch (kg) (2001-04)	Missing > 3 attributes (Y/N)	Missing productivity attributes (out of 7)	Missing susceptibility attributes (out of 4)	Productivity (additive) (1- low, 3-high)	Susceptibility (mult) (1- low, 3-high)	2D vulnerability value (P&S) (low-high range=1.41-4.24)	Susceptibility override used?	2D P&S vulnerability category	High/Med risk category (Refer 2.4.8)	Comments
Chondrichthyan													
315	Carcharodon carcharias	White shark	0	N	0	0	2.86	1.89	3.43	Y	High	Low overlap	Override: encounterability, bathymetry overlap low
313	Carcharias taurus	Grey nurse shark	0	N	0	0	2.71	1.44	3.07	Y	Med	Low overlap	Override: encounterability, bathymetry overlap low
1067	Rhincodon typus	Whale shark	0	N	0	0	2.71	1.22	2.98	N	Med	Low overlap	
Marine bird													
889	Thalassarche eremita	Chatham albatross	0	Y	3	1	2.86	3.00	4.14	N	High	Missing data	
893	Thalassarche platei	Pacific albatross	0	N	2	0	2.71	3.00	4.05	N	High	Spatial uncertainty	
451	Diomedea exulans	Wandering Albatross	0	N	1	0	2.57	3.00	3.95	N	High	Spatial uncertainty	
628	Diomedea antipodensis	Antipodean Albatross	0	N	1	0	2.57	3.00	3.95	N	High	Spatial uncertainty	

ERA species ID	Scientific name	Common name	Average logbook catch (kg) (2001-04)	Missing > 3 attributes (Y/N)	Missing productivity attributes (out of 7)	Missing susceptibility attributes (out of 4)	Productivity (additive) (1- low, 3-high)	Susceptibility (mult) (1- low, 3-high)	2D vulnerability value (P&S) (low-high range=1.41-4.24)	Susceptibility override used?	2D P&S vulnerability category	High/Med risk category (Refer 2.4.8)	Comments
753	Diomedea epomophora	Southern Royal Albatross	0	N	1	0	2.57	3.00	3.95	N	High	Spatial uncertainty	
755	Diomedea gibsoni	Gibson's Albatross	0	N	1	0	2.57	3.00	3.95	N	High	Spatial uncertainty	
799	Diomedea sanfordi	Northern Royal Albatross	0	N	1	0	2.57	3.00	3.95	N	High	Spatial uncertainty	
1084	Thalassarche impavida	Campbell Albatross	0	N	1	0	2.57	3.00	3.95	N	High	Spatial uncertainty	
1428	Diomedea amsterdamensis	Amsterdam Albatross	0	N	1	0	2.57	3.00	3.95	N	High	Spatial uncertainty	
1429	Diomedea dabbenena	Tristan Albatross	0	N	1	0	2.57	3.00	3.95	N	High	Spatial uncertainty	
1055	Puffinus carneipes	Flesh-footed Shearwater	0	N	1	0	2.43	3.00	3.86	N	High	Spatial uncertainty	
1059	Puffinus pacificus	Wedge-tailed Shearwater	0	N	1	0	2.43	3.00	3.86	N	High	Spatial uncertainty	
894	Thalassarche salvini	Salvin's albatross	0	N	3	0	2.57	2.33	3.47	N	High	Spatial uncertainty	
1031	Thalassarche carteri	Indian Yellow-nosed Albatross	0	N	1	0	2.57	2.33	3.47	N	High	Spatial uncertainty	

ERA species ID	Scientific name	Common name	Average logbook catch (kg) (2001-04)	Missing > 3 attributes (Y/N)	Missing productivity attributes (out of 7)	Missing susceptibility attributes (out of 4)	Productivity (additive) (1- low, 3-high)	Susceptibility (mult) (1- low, 3-high)	2D vulnerability value (P&S) (low-high range=1.41-4.24)	Susceptibility override used?	2D P&S vulnerability category	High/Med risk category (Refer 2.4.8)	Comments
1009	Phoebetria palpebrata	Light-mantled Albatross	0	N	1	0	2.43	2.33	3.37	N	High	Spatial uncertainty	
1032	Thalassarche bulleri	Buller's Albatross	0	N	1	0	2.43	2.33	3.37	N	High	Spatial uncertainty	
1033	Thalassarche cauta	Shy Albatross	0	N	1	0	2.43	2.33	3.37	N	High	Spatial uncertainty	
1035	Thalassarche chrysostoma	Grey-headed Albatross	0	N	1	0	2.43	2.33	3.37	N	High	Spatial uncertainty	
1085	Thalassarche melanophrys	Black-browed Albatross	0	N	1	0	2.43	2.33	3.37	N	High	Spatial uncertainty	
1008	Phoebetria fusca	Sooty Albatross	0	N	1	0	2.29	2.33	3.27	N	High	Spatial uncertainty	
1034	Thalassarche chlororhynchos	Yellow-nosed Albatross, Atlantic Yellow-	0	N	1	0	2.29	2.33	3.27	N	High	Spatial uncertainty	
827	Fregata andrewsi	Christmas frigatebird	0	N	1	0	2.57	1.67	3.06	Y	Med	Low attribute score	Override: selectivity, scavenging birds (expert opinion, Hobday)
1431	Phaethon lepturus	White-tailed Tropicbird	0	N	3	0	2.57	1.67	3.06	Y	Med	Low attribute score	Override: Availability: not seen on fishing groundsBRS (2004) not observed. AFMA Data summ 2002 not observed

ERA species ID	Scientific name	Common name	Average logbook catch (kg) (2001-04)	Missing > 3 attributes (Y/N)	Missing productivity attributes (out of 7)	Missing susceptibility attributes (out of 4)	Productivity (additive) (1- low, 3-high)	Susceptibility (mult) (1- low, 3-high)	2D vulnerability value (P&S) (low-high range=1.41-4.24)	Susceptibility override used?	2D P&S vulnerability category	High/Med risk category (Refer 2.4.8)	Comments
1580	Calonectris leucomelas	streaked shearwater	0	N	3	0	2.57	1.67	3.06	N	Med	Low attribute score	
555	Garrodia nereis	Grey-backed storm petrel	0	N	3	0	2.43	1.67	2.95	N	Med	Low attribute score	
917	Fregetta tropica	Black-bellied Storm-Petrel	0	N	3	0	2.43	1.67	2.95	N	Med	Low attribute score	
918	Fregetta grallaria	White-bellied Storm-Petrel (Tasman Sea),	0	N	3	0	2.43	1.67	2.95	N	Med	Low attribute score	
325	Catharacta skua	Great Skua	0	N	1	0	2.43	1.67	2.95	Y	Med	Low attribute score	Override: Availability: not seen on fishing groundsBRS (2004) not observed. AFMA Data summ 2002 not observed
939	Halobaena caerulea	Blue Petrel	0	N	3	0	2.43	1.67	2.95	N	Med	Low attribute score	

ERA species ID	Scientific name	Common name	Average logbook catch (kg) (2001-04)	Missing > 3 attributes (Y/N)	Missing productivity attributes (out of 7)	Missing susceptibility attributes (out of 4)	Productivity (additive) (1- low, 3-high)	Susceptibility (mult) (1- low, 3-high)	2D vulnerability value (P&S) (low-high range=1.41-4.24)	Susceptibility override used?	2D P&S vulnerability category	High/Med risk category (Refer 2.4.8)	Comments
1003	Pachyptila turtur	Fairy Prion	0	N	3	0	2.43	1.67	2.95	N	Med	Low attribute score	
1042	Procellaria parkinsoni	Black Petrel; Parkinsons Petrel	0	N	2	0	2.43	1.67	2.95	N	Med	Low attribute score	
1046	Pterodroma leucoptera	Gould's Petrel	0	Y	4	0	2.43	1.67	2.95	N	Med	Missing data	
1047	Pterodroma macroptera	Great-winged Petrel	0	N	2	0	2.43	1.67	2.95	N	Med	Low attribute score	
1048	Pterodroma mollis	Soft-plumaged Petrel	0	N	3	0	2.43	1.67	2.95	N	Med	Low attribute score	
1053	Puffinus assimilis	Little Shearwater (Tasman Sea)	0	N	3	0	2.43	1.67	2.95	N	Med	Low attribute score	
1060	Puffinus tenuirostris	Short-tailed Shearwater	0	N	1	0	2.43	1.67	2.95	N	Med	Low attribute score	

ERA species ID	Scientific name	Common name	Average logbook catch (kg) (2001-04)	Missing > 3 attributes (Y/N)	Missing productivity attributes (out of 7)	Missing susceptibility attributes (out of 4)	Productivity (additive) (1- low, 3-high)	Susceptibility (mult) (1- low, 3-high)	2D vulnerability value (P&S) (low-high range=1.41-4.24)	Susceptibility override used?	2D P&S vulnerability category	High/Med risk category (Refer 2.4.8)	Comments
1692	Pterodroma arminjoniana	Round Island Petrel	0	N	3	0	2.43	1.67	2.95	N	Med	Low attribute score	
1693	Pterodroma baraui	Barau's Petrel	0	N	3	0	2.43	1.67	2.95	Y	Med	Low attribute score	Override: Availability: not seen on fishing groundsBRS (2004) not observed. AFMA Data summ 2002 not observed
861	Papasula abbotti	Abbots booby	0	N	2	0	2.43	1.67	2.95	Y	Med	Low attribute score	Override: Availability: not seen on fishing groundsBRS (2004) not observed. AFMA Data summ 2002 not observed
912	Phalacrocorax fuscescens	Black faced cormorant	0	N	1	0	2.57	1.22	2.85	Y	Med	Low attribute score	Override: Availability: not seen on fishing groundsBRS (2004) not observed. AFMA Data summ 2002 not observed
829	Fregata ariel	Lesser frigatebird	0	N	1	0	2.29	1.67	2.83	Y	Med	Low attribute score	Override: selectivity, scavenging birds (expert opinion, Hobday)
203	Anous stolidus	Common noddy	0	N	1	0	2.29	1.67	2.83	Y	Med	Low attribute score	Override: Availability: not seen on fishing groundsBRS (2004) not observed. AFMA Data

ERA species ID	Scientific name	Common name	Average logbook catch (kg) (2001-04)	Missing > 3 attributes (Y/N)	Missing productivity attributes (out of 7)	Missing susceptibility attributes (out of 4)	Productivity (additive) (1- low, 3-high)	Susceptibility (mult) (1- low, 3-high)	2D vulnerability value (P&S) (low-high range=1.41-4.24)	Susceptibility override used?	2D P&S vulnerability category	High/Med risk category (Refer 2.4.8)	Comments
													summ 2002 not observed
1017	Sterna bergii	Crested Tern	0	N	1	0	2.29	1.67	2.83	Y	Med	Low attribute score	Override: Availability: not seen on fishing groundsBRS (2004) not observed. AFMA Data summ 2002 not observed
1018	Sterna caspia	Caspian Tern	0	N	1	0	2.29	1.67	2.83	Y	Med	Low attribute score	Override: Availability: not seen on fishing groundsBRS (2004) not observed. AFMA Data summ 2002 not observed
1432	Phaethon rubricauda	Red-tailed Tropicbird	0	N	1	0	2.29	1.67	2.83	Y	Med	Low attribute score	Override: Availability: not seen on fishing groundsBRS (2004) not observed. AFMA Data summ 2002 not observed
494	Procellaria cinerea	Grey petrel	0	N	1	0	2.29	1.67	2.83	N	Med	Low attribute score	
504	Pterodroma lessoni	White-headed petrel	0	N	1	0	2.29	1.67	2.83	N	Med	Low attribute score	

ERA species ID	Scientific name	Common name	Average logbook catch (kg) (2001-04)	Missing > 3 attributes (Y/N)	Missing productivity attributes (out of 7)	Missing susceptibility attributes (out of 4)	Productivity (additive) (1- low, 3-high)	Susceptibility (mult) (1- low, 3-high)	2D vulnerability value (P&S) (low-high range=1.41-4.24)	Susceptibility override used?	2D P&S vulnerability category	High/Med risk category (Refer 2.4.8)	Comments
595	Daption capense	Cape Petrel	0	N	1	0	2.29	1.67	2.83	N	Med	Low attribute score	
1041	Procellaria aequinoctialis	White-chinned Petrel	0	N	1	0	2.29	1.67	2.83	Y	Med	Low attribute score	Override: selectivity, not a hook taker (expert opinion, stakeholder ws)
1057	Puffinus griseus	Sooty Shearwater	0	N	1	0	2.29	1.67	2.83	N	Med	Low attribute score	
881	Sula leucogaster	Brown boobies	0	N	1	0	2.29	1.67	2.83	Y	Med	Low attribute score	Override: Availability: not seen on fishing groundsBRS (2004) not observed. AFMA Data summ 2002 not observed
998	Morus serrator	Australasian Gannet	0	N	1	0	2.29	1.67	2.83	Y	Med	Low attribute score	Override: Availability: not seen on fishing groundsBRS (2004) not observed. AFMA Data summ 2002 not observed
1433	Sula dactylatra	Masked Booby	0	N	1	0	2.29	1.67	2.83	Y	Med	Low attribute score	Override: Availability: not seen on fishing groundsBRS (2004) not observed. AFMA Data summ 2002 not observed

ERA species ID	Scientific name	Common name	Average logbook catch (kg) (2001-04)	Missing > 3 attributes (Y/N)	Missing productivity attributes (out of 7)	Missing susceptibility attributes (out of 4)	Productivity (additive) (1- low, 3-high)	Susceptibility (mult) (1- low, 3-high)	2D vulnerability value (P&S) (low-high range=1.41-4.24)	Susceptibility override used?	2D P&S vulnerability category	High/Med risk category (Refer 2.4.8)	Comments
1434	Sula sula	Red-footed Booby	0	N	1	0	2.29	1.67	2.83	Y	Med	Low attribute score	Override: Availability: not seen on fishing groundsBRS (2004) not observed. AFMA Data summ 2002 not observed
1549	Morus capensis	Cape gannet	0	N	1	0	2.29	1.67	2.83	Y	Med	Low attribute score	Override: Availability: not seen on fishing groundsBRS (2004) not observed. AFMA Data summ 2002 not observed
314	Fulmarus glacialoides	Southern fulmar	0	N	1	0	2.43	1.44	2.83	Y	Med	Low attribute score	Override: Availability: outside main range (A. Hobday)
1435	Fregata minor	Great Frigatebird, Greater Frigatebird	0	N	1	0	2.14	1.67	2.71	N	Med	Low attribute score	
67	Anous tenuirostris	Lesser noddy	0	N	2	0	2.14	1.67	2.71	Y	Med	Low attribute score	Override: Availability: not seen on fishing groundsBRS (2004) not observed. AFMA Data summ 2002 not observed
1016	Sterna bengalensis	Lesser crested tern	0	N	2	0	2.14	1.67	2.71	Y	Med	Low attribute score	Override: Availability: not seen on fishing groundsBRS (2004) not observed. AFMA Data

ERA species ID	Scientific name	Common name	Average logbook catch (kg) (2001-04)	Missing > 3 attributes (Y/N)	Missing productivity attributes (out of 7)	Missing susceptibility attributes (out of 4)	Productivity (additive) (1- low, 3-high)	Susceptibility (mult) (1- low, 3-high)	2D vulnerability value (P&S) (low-high range=1.41-4.24)	Susceptibility override used?	2D P&S vulnerability category	High/Med risk category (Refer 2.4.8)	Comments
													summ 2002 not observed
1020	Sterna fuscata	Sooty tern	0	N	1	0	2.14	1.67	2.71	Y	Med	Low attribute score	Override: Availability: not seen on fishing groundsBRS (2004) not observed. AFMA Data summ 2002 not observed
1021	Sterna hirundo	Common tern	0	N	1	0	2.14	1.67	2.71	Y	Med	Low attribute score	Override: Availability: not seen on fishing groundsBRS (2004) not observed. AFMA Data summ 2002 not observed
1023	Sterna paradisaea	Arctic tern	0	N	1	0	2.14	1.67	2.71	Y	Med	Low attribute score	Override: Availability: not seen on fishing groundsBRS (2004) not observed. AFMA Data summ 2002 not observed
1025	Sterna sumatrana	Black-naped tern	0	N	2	0	2.14	1.67	2.71	Y	Med	Low attribute score	Override: Availability: not seen on fishing groundsBRS (2004) not observed. AFMA Data summ 2002 not observed

ERA species ID	Scientific name	Common name	Average logbook catch (kg) (2001-04)	Missing > 3 attributes (Y/N)	Missing productivity attributes (out of 7)	Missing susceptibility attributes (out of 4)	Productivity (additive) (1- low, 3-high)	Susceptibility (mult) (1- low, 3-high)	2D vulnerability value (P&S) (low-high range=1.41-4.24)	Susceptibility override used?	2D P&S vulnerability category	High/Med risk category (Refer 2.4.8)	Comments
1438	Anous minutus	Black Noddy	0	N	1	0	2.14	1.67	2.71	Y	Med	Low attribute score	Override: Availability: not seen on fishing groundsBRS (2004) not observed. AFMA Data summ 2002 not observed
1056	Puffinus gavia	Fluttering Shearwater	0	N	2	0	2.14	1.67	2.71	N	Med	Low attribute score	
1058	Puffinus huttoni	Hutton's Shearwater	0	N	2	0	2.14	1.67	2.71	N	Med	Low attribute score	
73	Macronectes giganteus	Southern Giant-Petrel	0	N	1	0	2.29	1.44	2.70	Y	Med	Low attribute score	Override: Availability: outside main range (A. Hobday)
981	Macronectes halli	Northern Giant-Petrel	0	N	1	0	2.29	1.44	2.70	Y	Med	Low attribute score	Override: Availability: outside main range (A. Hobday)
556	Oceanites oceanicus	Wilson's storm petrel (subantarctic)	0	N	1	0	2.00	1.67	2.60	N	Low		
1004	Pelagodroma marina	White-faced Storm-Petrel	0	N	1	0	2.00	1.67	2.60	N	Low		
1014	Sterna albifrons	Little tern	0	N	1	0	2.00	1.67	2.60	Y	Low		Override: Availability: not seen on fishing groundsBRS (2004) not observed. AFMA Data

ERA species ID	Scientific name	Common name	Average logbook catch (kg) (2001-04)	Missing > 3 attributes (Y/N)	Missing productivity attributes (out of 7)	Missing susceptibility attributes (out of 4)	Productivity (additive) (1- low, 3-high)	Susceptibility (mult) (1- low, 3-high)	2D vulnerability value (P&S) (low-high range=1.41-4.24)	Susceptibility override used?	2D P&S vulnerability category	High/Med risk category (Refer 2.4.8)	Comments
													summ 2002 not observed
1015	Sterna anaethetus	Bridled Tern	0	N	1	0	2.00	1.67	2.60	Y	Low		Override: Availability: not seen on fishing groundsBRS (2004) not observed. AFMA Data summ 2002 not observed
1019	Sterna dougallii	Roseate tern	0	N	1	0	2.00	1.67	2.60	Y	Low		Override: Availability: not seen on fishing groundsBRS (2004) not observed. AFMA Data summ 2002 not observed
975	Larus pacificus	Pacific Gull	0	N	1	0	2.29	1.22	2.59	Y	Low		Override: Availability: not seen on fishing groundsBRS (2004) not observed. AFMA Data summ 2002 not observed
974	Larus novaehollandiae	Silver Gull	0	N	3	0	2.14	1.22	2.47	Y	Low		Override: Availability: not seen on fishing groundsBRS (2004) not observed. AFMA Data summ 2002 not observed

ERA species ID	Scientific name	Common name	Average logbook catch (kg) (2001-04)	Missing > 3 attributes (Y/N)	Missing productivity attributes (out of 7)	Missing susceptibility attributes (out of 4)	Productivity (additive) (1- low, 3-high)	Susceptibility (mult) (1- low, 3-high)	2D vulnerability value (P&S) (low-high range=1.41-4.24)	Susceptibility override used?	2D P&S vulnerability category	High/Med risk category (Refer 2.4.8)	Comments
898	Eudyptula minor	Little Penguin	0	N	1	0	2.14	1.22	2.47	Y	Low		Override: Availability: not seen on fishing groundsBRS (2004) not observed. AFMA Data summ 2002 not observed
Marine mammal													
935	Globicephala melas	Long-finned Pilot Whale	0	N	0	0	2.86	1.44	3.20	Y	High	Low attribute score	Override: PCM. Somewhat likely to pull gear to surface. Fishery meeting feedback
985	Mesoplodon bowdoini	Andrew's Beaked Whale	0	N	1	0	2.86	1.44	3.20	Y	High	Low attribute score	Override: PCM. Likely to pull gear to surface. Fishery meeting feedback
987	Mesoplodon gingkodens	Gingko Beaked Whale	0	N	1	0	2.86	1.44	3.20	Y	High	Low attribute score	Override: PCM. Likely to pull gear to surface. Fishery meeting feedback
991	Mesoplodon mirus	True's Beaked Whale	0	N	0	0	2.86	1.44	3.20	Y	High	Low attribute score	Override: PCM. Likely to pull gear to surface. Fishery meeting feedback
1440	Indopacetus pacificus	Longman's Beaked Whale	0	Y	4	1	3.00	1.07	3.19	Y	High	Missing data	Override: PCM. Likely to pull gear to surface. Fishery meeting feedback

ERA species ID	Scientific name	Common name	Average logbook catch (kg) (2001-04)	Missing > 3 attributes (Y/N)	Missing productivity attributes (out of 7)	Missing susceptibility attributes (out of 4)	Productivity (additive) (1- low, 3-high)	Susceptibility (mult) (1- low, 3-high)	2D vulnerability value (P&S) (low-high range=1.41-4.24)	Susceptibility override used?	2D P&S vulnerability category	High/Med risk category (Refer 2.4.8)	Comments
902	Feresa attenuata	Pygmy Killer Whale	0	N	0	0	2.86	1.30	3.14	Y	Med	Low attribute score	Override: PCM. Somewhat likely to pull gear to surface. Fishery meeting feedback
934	Globicephala macrorhynchus	Short-finned Pilot Whale	0	N	0	0	2.86	1.30	3.14	Y	Med	Low attribute score	Override: PCM. Somewhat likely to pull gear to surface. Fishery meeting feedback
937	Grampus griseus	Risso's Dolphin	0	N	0	0	2.86	1.30	3.14	Y	Med	Low attribute score	Override: PCM. Somewhat likely to pull gear to surface. Fishery meeting feedback
1002	Orcinus orca	Killer Whale	0	N	0	0	2.86	1.30	3.14	Y	Med	Low attribute score	Override: PCM. Somewhat likely to pull gear to surface. Fishery meeting feedback
1044	Pseudorca crassidens	False Killer Whale	0	N	1	0	2.86	1.30	3.14	Y	Med	Low attribute score	Override: PCM. Somewhat likely to pull gear to surface. Fishery meeting feedback
1091	Tursiops truncatus	Bottlenose Dolphin	0	N	0	0	2.86	1.30	3.14	Y	Med	Low attribute score	Override: PCM. Somewhat likely to pull gear to surface. Fishery meeting feedback

ERA species ID	Scientific name	Common name	Average logbook catch (kg) (2001-04)	Missing > 3 attributes (Y/N)	Missing productivity attributes (out of 7)	Missing susceptibility attributes (out of 4)	Productivity (additive) (1- low, 3-high)	Susceptibility (mult) (1- low, 3-high)	2D vulnerability value (P&S) (low-high range=1.41-4.24)	Susceptibility override used?	2D P&S vulnerability category	High/Med risk category (Refer 2.4.8)	Comments
986	Mesoplodon densirostris	Blainville's Beaked Whale	0	N	0	0	2.86	1.30	3.14	Y	Med	Low attribute score	Override: PCM. Likely to pull gear to surface. Fishery meeting feedback
256	Balaenoptera acutorostrata	Minke Whale	0	N	0	0	2.86	1.22	3.11	Y	Med	Low attribute score	Override: PCM. Likely to pull gear to surface. Fishery meeting feedback, Selectivity: plankton feeder, not attracted to bait (R. Daley)
261	Balaenoptera borealis	Sei Whale	0	N	0	0	2.86	1.22	3.11	Y	Med	Low attribute score	Override: PCM. Likely to pull gear to surface. Fishery meeting feedback, Selectivity: plankton feeder, not attracted to bait (R. Daley)
268	Balaenoptera physalus	Fin Whale	0	N	0	0	2.86	1.22	3.11	Y	Med	Low attribute score	Override: PCM. Likely to pull gear to surface. Fishery meeting feedback, Selectivity: plankton feeder, not attracted to bait (R. Daley)
959	Hyperoodon planifrons	Southern Bottlenose Whale	0	N	1	0	2.86	1.22	3.11	Y	Med	Low attribute score	Override: PCM. Likely to pull gear to surface. Fishery meeting feedback

ERA species ID	Scientific name	Common name	Average logbook catch (kg) (2001-04)	Missing > 3 attributes (Y/N)	Missing productivity attributes (out of 7)	Missing susceptibility attributes (out of 4)	Productivity (additive) (1- low, 3-high)	Susceptibility (mult) (1- low, 3-high)	2D vulnerability value (P&S) (low-high range=1.41-4.24)	Susceptibility override used?	2D P&S vulnerability category	High/Med risk category (Refer 2.4.8)	Comments
988	Mesoplodon grayi	Gray's Beaked Whale	0	N	1	0	2.86	1.22	3.11	Y	Med	Low attribute score	Override: PCM. Likely to pull gear to surface. Fishery meeting feedback
990	Mesoplodon layardii	Strap-toothed Beaked Whale	0	N	1	0	2.86	1.22	3.11	Y	Med	Low attribute score	Override: PCM. Likely to pull gear to surface. Fishery meeting feedback
1439	Balaenoptera bonaerensis	Antarctic Minke Whale	0	N	1	0	2.86	1.15	3.08	Y	Med	Low attribute score	Override: PCM. Likely to pull gear to surface. Fishery meeting feedback, Selectivity: plankton feeder, not attracted to bait (R. Daley)
262	Balaenoptera edeni	Bryde's Whale	0	N	0	0	2.86	1.15	3.08	Y	Med	Low attribute score	Override: PCM. Likely to pull gear to surface. Fishery meeting feedback, Selectivity: plankton feeder, not attracted to bait (R. Daley)
1494	Tursiops aduncus	Indian Ocean bottlenose dolphin	0	N	1	0	2.86	1.15	3.08	Y	Med	Low attribute score	Override: PCM. Somewhat likely to pull gear to surface. Fishery meeting feedback

ERA species ID	Scientific name	Common name	Average logbook catch (kg) (2001-04)	Missing > 3 attributes (Y/N)	Missing productivity attributes (out of 7)	Missing susceptibility attributes (out of 4)	Productivity (additive) (1- low, 3-high)	Susceptibility (mult) (1- low, 3-high)	2D vulnerability value (P&S) (low-high range=1.41-4.24)	Susceptibility override used?	2D P&S vulnerability category	High/Med risk category (Refer 2.4.8)	Comments
968	Kogia breviceps	Pygmy Sperm Whale	0	N	0	0	2.86	1.15	3.08	Y	Med	Low attribute score	Override: PCM. Likely to pull gear to surface. Fishery meeting feedback
1036	Physeter catodon	Sperm Whale	0	N	0	0	2.86	1.15	3.08	Y	Med	Low attribute score	Override: PCM. Likely to pull gear to surface. Fishery meeting feedback
989	Mesoplodon hectori	Hector's Beaked Whale	0	N	0	0	2.86	1.15	3.08	Y	Med	Low attribute score	Override: PCM. Likely to pull gear to surface. Fishery meeting feedback
1098	Ziphius cavirostris	Cuvier's Beaked Whale	0	N	0	0	2.86	1.15	3.08	Y	Med	Low attribute score	Override: PCM. Likely to pull gear to surface. Fishery meeting feedback
969	Kogia simus	Dwarf Sperm Whale	0	N	0	0	2.71	1.44	3.07	Y	Med	Low attribute score	Override: PCM. Likely to pull gear to surface. Fishery meeting feedback
269	Berardius arnuxii	Arnoux's Beaked Whale	0	N	0	0	2.86	1.07	3.05	Y	Med	Low attribute score	Override: PCM. Likely to pull gear to surface. Fishery meeting feedback
1030	Tasmacetus shepherdi	Tasman Beaked Whale	0	N	1	0	2.86	1.07	3.05	Y	Med	Low attribute score	Override: PCM. Likely to pull gear to surface. Fishery meeting feedback

ERA species ID	Scientific name	Common name	Average logbook catch (kg) (2001-04)	Missing > 3 attributes (Y/N)	Missing productivity attributes (out of 7)	Missing susceptibility attributes (out of 4)	Productivity (additive) (1- low, 3-high)	Susceptibility (mult) (1- low, 3-high)	2D vulnerability value (P&S) (low-high range=1.41-4.24)	Susceptibility override used?	2D P&S vulnerability category	High/Med risk category (Refer 2.4.8)	Comments
970	Lagenodelphis hosei	Fraser's Dolphin	0	N	1	0	2.71	1.30	3.01	Y	Med	Low attribute score	Override: PCM. Somewhat likely to pull gear to surface. Fishery meeting feedback
1081	Stenella coeruleoalba	Striped Dolphin	0	N	0	0	2.71	1.30	3.01	Y	Med	Low attribute score	Override: PCM. Somewhat likely to pull gear to surface. Fishery meeting feedback
289	Caperea marginata	Pygmy Right Whale	0	N	1	0	2.71	1.22	2.98	Y	Med	Low attribute score	Override: PCM. Likely to pull gear to surface. Fishery meeting feedback, Selectivity: plankton feeder, not attracted to bait (R. Daley)
896	Eubalaena australis	Southern Right Whale	0	N	0	0	2.71	1.22	2.98	Y	Med	Low attribute score	Override: PCM. Likely to pull gear to surface. Fishery meeting feedback, Selectivity: plankton feeder, not attracted to bait (R. Daley)
61	Lissodelphis peronii	Southern Right Whale Dolphin	0	N	1	0	2.71	1.22	2.98	Y	Med	Low attribute score	Override: PCM. Likely to pull gear to surface. Fishery meeting feedback, Selectivity: plankton feeder, not attracted to bait (R. Daley)

ERA species ID	Scientific name	Common name	Average logbook catch (kg) (2001-04)	Missing > 3 attributes (Y/N)	Missing productivity attributes (out of 7)	Missing susceptibility attributes (out of 4)	Productivity (additive) (1- low, 3-high)	Susceptibility (mult) (1- low, 3-high)	2D vulnerability value (P&S) (low-high range=1.41-4.24)	Susceptibility override used?	2D P&S vulnerability category	High/Med risk category (Refer 2.4.8)	Comments
984	Megaptera novaeangliae	Humpback Whale	0	N	0	0	2.71	1.15	2.95	Y	Med	Low attribute score	Override: PCM. Likely to pull gear to surface. Fishery meeting feedback, Selectivity: plankton feeder, not attracted to bait (R. Daley)
295	Hydrurga leptonyx	Leopard seal	0	N	0	0	2.71	1.15	2.95	Y	Med	Low attribute score	Override: PCM. Somewhat likely to pull gear to surface. Availability: not in this range
1083	Steno bredanensis	Rough-toothed Dolphin	0	N	0	0	2.71	1.10	2.93	Y	Med	Low attribute score	Override: PCM. Somewhat likely to pull gear to surface. Fishery meeting feedback
1076	Sousa chinensis	Indo-Pacific Humpback Dolphin	0	N	0	0	2.71	1.05	2.91	Y	Med	Low attribute score	Override: PCM. Somewhat likely to pull gear to surface. Fishery meeting feedback
813	Dugong dugon	Dugong	0	N	1	0	2.71	1.05	2.91	Y	Med	Low attribute score	Override: PCM. Somewhat likely to pull gear to surface. Availability: not in this range

ERA species ID	Scientific name	Common name	Average logbook catch (kg) (2001-04)	Missing > 3 attributes (Y/N)	Missing productivity attributes (out of 7)	Missing susceptibility attributes (out of 4)	Productivity (additive) (1- low, 3-high)	Susceptibility (mult) (1- low, 3-high)	2D vulnerability value (P&S) (low-high range=1.41-4.24)	Susceptibility override used?	2D P&S vulnerability category	High/Med risk category (Refer 2.4.8)	Comments
1007	Peponocephala electra	Melon-headed Whale	0	N	1	0	2.57	1.30	2.88	Y	Med	Low attribute score	Override: PCM. Somewhat likely to pull gear to surface. Fishery meeting feedback
1080	Stenella attenuata	Spotted Dolphin	0	N	1	0	2.57	1.30	2.88	Y	Med	Low attribute score	Override: PCM. Somewhat likely to pull gear to surface. Fishery meeting feedback
216	Arctocephalus forsteri	New Zealand Fur-seal	0	N	0	0	2.43	1.44	2.83	Y	Med	Low attribute score	Override: PCM. Somewhat likely to pull gear to surface. Fishery meeting feedback
1000	Neophoca cinerea	Australian Sea-lion	0	N	0	0	2.43	1.44	2.83	Y	Med	Low attribute score	Override: PCM. Somewhat likely to pull gear to surface. Fishery meeting feedback
265	Balaenoptera musculus	Blue Whale	0	N	0	0	2.57	1.15	2.82	Y	Med	Low attribute score	Override: PCM. Likely to pull gear to surface. Fishery meeting feedback, Selectivity: plankton feeder, not attracted to bait (R. Daley)
253	Arctocephalus pusillus doriferus	Australian Fur Seal	0	N	0	0	2.29	1.59	2.79	Y	Med	Spatial uncertainty	Override: PCM. Somewhat likely to pull gear to surface. Availability: not so far

ERA species ID	Scientific name	Common name	Average logbook catch (kg) (2001-04)	Missing > 3 attributes (Y/N)	Missing productivity attributes (out of 7)	Missing susceptibility attributes (out of 4)	Productivity (additive) (1- low, 3-high)	Susceptibility (mult) (1- low, 3-high)	2D vulnerability value (P&S) (low-high range=1.41-4.24)	Susceptibility override used?	2D P&S vulnerability category	High/Med risk category (Refer 2.4.8)	Comments
													offshore (Fishery meeting feedback)
860	Orcaella brevirostris	Irrawaddy dolphin	0	N	1	0	2.57	1.05	2.78	Y	Med	Low attribute score	Override: PCM. Somewhat likely to pull gear to surface. Fishery meeting feedback
1082	Stenella longirostris	Long-snouted Spinner Dolphin	0	N	0	0	2.43	1.30	2.75	Y	Med	Low attribute score	Override: PCM. Somewhat likely to pull gear to surface. Fishery meeting feedback
263	Arctocephalus tropicalis	Subantarctic fur seal	0	N	0	0	2.29	1.44	2.70	Y	Med	Low attribute score	Override: PCM. Somewhat likely to pull gear to surface. Fishery meeting feedback
612	Delphinus delphis	Common Dolphin	0	N	0	0	2.29	1.30	2.63	Y	Low		Override: PCM. Somewhat likely to pull gear to surface. Fishery meeting feedback
864	Delphinus capensis	Common dolphin, long-beaked	0	N	1	0	2.29	1.30	2.63	Y	Low		Override: PCM. Somewhat likely to pull gear to surface. Fishery meeting feedback
971	Lagenorhynchus obscurus	Dusky Dolphin	0	N	0	0	2.29	1.15	2.56	Y	Low		Override: PCM. Somewhat likely to pull gear to surface. Fishery

ERA species ID	Scientific name	Common name	Average logbook catch (kg) (2001-04)	Missing > 3 attributes (Y/N)	Missing productivity attributes (out of 7)	Missing susceptibility attributes (out of 4)	Productivity (additive) (1- low, 3-high)	Susceptibility (mult) (1- low, 3-high)	2D vulnerability value (P&S) (low-high range=1.41-4.24)	Susceptibility override used?	2D P&S vulnerability category	High/Med risk category (Refer 2.4.8)	Comments
													meeting feedback
Marine reptile													
613	Dermochelys coriacea	Leathery turtle	0	N	1	0	2.57	1.44	2.95	Y	Med	Low attribute score	Override: PCM. Sometimes released alive according to observer reports
1408	Acalyptophis peronii	Horned Seasnake	0	N	3	0	2.71	1.07	2.92	Y	Med	Low attribute score	Override: selectivity: not caught on hooks (A. Hobday)
1410	Aipysurus duboisii	Dubois' Seasnake	0	N	3	0	2.71	1.07	2.92	Y	Med	Low attribute score	Override: selectivity: not caught on hooks (A. Hobday)
1415	Aipysurus tenuis	Brown-lined Seasnake	0	Y	4	1	2.71	1.07	2.92	Y	Med	Missing data	Override: selectivity: not caught on hooks (A. Hobday)
1416	Disteira major	Olive-headed Seasnake	0	N	3	0	2.71	1.07	2.92	Y	Med	Low attribute score	Override: selectivity: not caught on hooks (A. Hobday)
1421	Hydrophis coggeri	Slender-necked Seasnake	0	Y	4	0	2.71	1.07	2.92	Y	Med	Missing data	Override: selectivity: not caught on hooks (A. Hobday)

ERA species ID	Scientific name	Common name	Average logbook catch (kg) (2001-04)	Missing > 3 attributes (Y/N)	Missing productivity attributes (out of 7)	Missing susceptibility attributes (out of 4)	Productivity (additive) (1- low, 3-high)	Susceptibility (mult) (1- low, 3-high)	2D vulnerability value (P&S) (low-high range=1.41-4.24)	Susceptibility override used?	2D P&S vulnerability category	High/Med risk category (Refer 2.4.8)	Comments
1422	Hydrophis mcdowelli	seasnake	0	N	3	0	2.71	1.07	2.92	Y	Med	Low attribute score	Override: selectivity: not caught on hooks (A. Hobday)
1423	Hydrophis ornatus	seasnake	0	N	3	0	2.71	1.07	2.92	Y	Med	Low attribute score	Override: selectivity: not caught on hooks (A. Hobday)
1530	Disteira kingii	Spectacled seasnake	0	Y	3	1	2.71	1.07	2.92	Y	Med	Missing data	Override: selectivity: not caught on hooks (A. Hobday)
1531	Hydrophis czeblukovi	Fine-spined seasnake	0	Y	4	1	2.71	1.07	2.92	Y	Med	Missing data	Override: selectivity: not caught on hooks (A. Hobday)
1681	Hydrophis atriceps	Black-headed seasnake	0	Y	3	1	2.71	1.07	2.92	Y	Med	Missing data	Override: selectivity: not caught on hooks (A. Hobday)
1686	Hydrophis melanosoma	Black-banded robust seasnake	0	Y	4	1	2.71	1.07	2.92	Y	Med	Missing data	Override: selectivity: not caught on hooks (A. Hobday)
1687	Hydrophis pacificus	Large-headed Seasnake	0	Y	4	1	2.71	1.07	2.92	Y	Med	Missing data	Override: selectivity: not caught on hooks (A. Hobday)
1689	Parahydrophis mertoni	Northern mangrove seasnake	0	Y	4	0	2.71	1.07	2.92	Y	Med	Missing data	Override: selectivity: not caught on hooks (A. Hobday)

ERA species ID	Scientific name	Common name	Average logbook catch (kg) (2001-04)	Missing > 3 attributes (Y/N)	Missing productivity attributes (out of 7)	Missing susceptibility attributes (out of 4)	Productivity (additive) (1- low, 3-high)	Susceptibility (mult) (1- low, 3-high)	2D vulnerability value (P&S) (low-high range=1.41-4.24)	Susceptibility override used?	2D P&S vulnerability category	High/Med risk category (Refer 2.4.8)	Comments
844	Lepidochelys olivacea	Olive Ridley turtle	0	N	1	0	2.43	1.44	2.83	Y	Med	Low attribute score	Override: PCM. Sometimes released alive according to observer reports
1409	Aipysurus apraefrontalis	Short-nosed Seasnake	0	Y	4	0	2.57	1.07	2.79	Y	Med	Missing data	Override: selectivity: not caught on hooks (A. Hobday)
1411	Aipysurus eydouxii	Spine-tailed Seasnake	0	Y	3	1	2.57	1.07	2.79	Y	Med	Missing data	Override: selectivity: not caught on hooks (A. Hobday)
1413	Aipysurus fuscus	Dusky Seasnake	0	Y	4	0	2.57	1.07	2.79	Y	Med	Missing data	Override: selectivity: not caught on hooks (A. Hobday)
1420	Hydrelaps darwiniensis	Black-ringed Seasnake	0	Y	4	1	2.57	1.07	2.79	Y	Med	Missing data	Override: selectivity: not caught on hooks (A. Hobday)
324	Caretta caretta	Loggerhead	0	N	1	0	2.43	1.30	2.75	Y	Med	Low attribute score	Override: PCM. Sometimes released alive according to observer reports
541	Chelonia mydas	Green turtle	0	N	1	0	2.43	1.30	2.75	Y	Med	Low attribute score	Override: PCM. Sometimes released alive according to observer reports

ERA species ID	Scientific name	Common name	Average logbook catch (kg) (2001-04)	Missing > 3 attributes (Y/N)	Missing productivity attributes (out of 7)	Missing susceptibility attributes (out of 4)	Productivity (additive) (1- low, 3-high)	Susceptibility (mult) (1- low, 3-high)	2D vulnerability value (P&S) (low-high range=1.41-4.24)	Susceptibility override used?	2D P&S vulnerability category	High/Med risk category (Refer 2.4.8)	Comments
822	Eretmochelys imbricata	Hawksbill turtle	0	N	1	0	2.43	1.30	2.75	Y	Med	Low attribute score	Override: PCM. Sometimes released alive according to observer reports
857	Natator depressus	Flatback turtle	0	N	2	0	2.43	1.30	2.75	Y	Med	Low attribute score	Override: PCM. Sometimes released alive according to observer reports
1414	Aipysurus laevis	Olive Seasnake, Golden Seasnake	0	N	1	1	2.29	1.07	2.53	Y	Low		Override: selectivity: not caught on hooks (A. Hobday)
1417	Emydocephalus annulatus	Turtle-headed Seasnake	0	N	3	0	2.29	1.07	2.53	Y	Low		Override: selectivity: not caught on hooks (A. Hobday)
957	Hydrophis elegans	Elegant seasnake	0	N	2	0	2.14	1.07	2.40	Y	Low		Override: selectivity: not caught on hooks (A. Hobday)
1424	Lapemis hardwickii	Spine-bellied Seasnake	0	N	1	1	2.14	1.07	2.40	Y	Low		Override: selectivity: not caught on hooks (A. Hobday)
1418	Enhydrina schistosa	Beaked Seasnake	0	N	0	0	2.00	1.07	2.27	Y	Low		Override: selectivity: not caught on hooks (A. Hobday)
Teleost													
308	Heteroclinus perspicillatus	Common weedfish	0	N	3	0	2.29	1.07	2.53	N	Low		

ERA species ID	Scientific name	Common name	Average logbook catch (kg) (2001-04)	Missing > 3 attributes (Y/N)	Missing productivity attributes (out of 7)	Missing susceptibility attributes (out of 4)	Productivity (additive) (1- low, 3-high)	Susceptibility (mult) (1- low, 3-high)	2D vulnerability value (P&S) (low-high range=1.41-4.24)	Susceptibility override used?	2D P&S vulnerability category	High/Med risk category (Refer 2.4.8)	Comments
1074	Solenostomus cyanopterus	Blue-finned Ghost Pipefish, Robust Ghost	0	N	3	0	2.14	1.07	2.40	N	Low		
55	Doryrhamphus janssi	Cleaner Pipefish, Janss' Pipefish	0	N	0	0	1.57	1.07	1.90	N	Low		
361	Dunckerocampus dactyliophorus	Ringed Pipefish	0	N	0	0	1.57	1.07	1.90	N	Low		
386	Dunckerocampus pessuliferus	Many-banded Pipefish	0	N	0	0	1.57	1.07	1.90	Y	Low		Override: Availability: inshore species (source unknown)
568	Doryrhamphus malus	Flagtail Pipefish, Negros Pipefish	0	N	0	0	1.57	1.07	1.90	N	Low		
569	Doryrhamphus melanopleura	Bluestripe Pipefish	0	N	0	0	1.57	1.07	1.90	N	Low		
949	Hippocampus taeniopterus	Spotted Seahorse, Yellow Seahorse	0	N	0	0	1.57	1.07	1.90	N	Low		
983	Maroubra perserrata	Sawtooth Pipefish	0	N	0	0	1.57	1.07	1.90	N	Low		
1010	Phycodurus eques	Leafy Seadragon	0	N	0	0	1.57	1.07	1.90	N	Low		
1011	Phyllopteryx taeniolatus	Weedy Seadragon, Common Seadragon	0	N	0	0	1.57	1.07	1.90	N	Low		
1667	Hippocampus kuda	Spotted Seahorse, Yellow Seahorse	0	N	0	0	1.57	1.07	1.90	Y	Low		Override: Availability: inshore species (source unknown)
52	Corythoichthys intestinalis	Australian Messmate Pipefish, Banded Pipefish	0	N	0	0	1.43	1.07	1.79	N	Low		
53	Bulbonaricus brauni	Braun's Pughead Pipefish, Pug-headed Pipefish	0	N	0	0	1.43	1.07	1.79	N	Low		
54	Halicampus brocki	Brock's Pipefish	0	N	0	0	1.43	1.07	1.79	N	Low		
56	Bhanotia fasciolata	Corrugated Pipefish, Barbed Pipefish	0	N	0	0	1.43	1.07	1.79	N	Low		
57	Halicampus nitidus	Glittering Pipefish	0	N	0	0	1.43	1.07	1.79	N	Low		

ERA species ID	Scientific name	Common name	Average logbook catch (kg) (2001-04)	Missing > 3 attributes (Y/N)	Missing productivity attributes (out of 7)	Missing susceptibility attributes (out of 4)	Productivity (additive) (1- low, 3-high)	Susceptibility (mult) (1- low, 3-high)	2D vulnerability value (P&S) (low-high range=1.41-4.24)	Susceptibility override used?	2D P&S vulnerability category	High/Med risk category (Refer 2.4.8)	Comments
105	Acentronura australe	Southern Pygmy Pipehorse	0	N	0	0	1.43	1.07	1.79	N	Low		
114	Acentronura breviperula	Hairy Pygmy Pipehorse	0	N	0	0	1.43	1.07	1.79	N	Low		
287	Campichthys galei	Gale's Pipefish	0	N	0	0	1.43	1.07	1.79	N	Low		
288	Campichthys tryoni	Tryon's Pipefish	0	N	0	0	1.43	1.07	1.79	N	Low		
318	Hippocampus spinosissimus	Hedgehog Seahorse	0	N	0	0	1.43	1.07	1.79	Y	Low		Override: Availability: inshore species (source unknown)
319	Acentronura larsonae	Helen's Pygmy Pipehorse	0	N	0	0	1.43	1.07	1.79	N	Low		
320	Solegnathus guentheri	Indonesian Pipefish, Gunther's Pipehorse	0	N	0	0	1.43	1.07	1.79	N	Low		
321	Festucalex scalaris	Ladder Pipefish	0	N	0	0	1.43	1.07	1.79	N	Low		
322	Trachyrhamphus longirostris	Long-nosed Pipefish, Straight Stick Pipefish	0	N	0	0	1.43	1.07	1.79	N	Low		
359	Halicampus dunckeri	Red-hair Pipefish, Duncker's Pipefish	0	N	0	0	1.43	1.07	1.79	N	Low		
360	Haliichthys taeniophorus	Ribboned Seadragon, Ribboned Pipefish	0	N	0	0	1.43	1.07	1.79	N	Low		
362	Phoxocampus belcheri	Rock Pipefish	0	N	0	0	1.43	1.07	1.79	N	Low		
387	Choeroichthys latispinosus	Muiron Island Pipefish	0	N	0	0	1.43	1.07	1.79	N	Low		
388	Choeroichthys brachysoma	Pacific Short-bodied Pipefish, Short-bodied pipefish	0	N	0	0	1.43	1.07	1.79	N	Low		
389	Choeroichthys suillus	Pig-snouted Pipefish	0	N	0	0	1.43	1.07	1.79	N	Low		
390	Lissocampus fatiloquus	Prophet's Pipefish	0	N	0	0	1.43	1.07	1.79	N	Low		
401	Cosmocampus banneri	Roughridge Pipefish	0	N	0	0	1.43	1.07	1.79	N	Low		

ERA species ID	Scientific name	Common name	Average logbook catch (kg) (2001-04)	Missing > 3 attributes (Y/N)	Missing productivity attributes (out of 7)	Missing susceptibility attributes (out of 4)	Productivity (additive) (1- low, 3-high)	Susceptibility (mult) (1- low, 3-high)	2D vulnerability value (P&S) (low-high range=1.41-4.24)	Susceptibility override used?	2D P&S vulnerability category	High/Med risk category (Refer 2.4.8)	Comments
452	Corythoichthys schultzi	Schultz's Pipefish	0	N	0	0	1.43	1.07	1.79	N	Low		
454	Halicampus spinirostris	Spiny-snout Pipefish	0	N	0	0	1.43	1.07	1.79	N	Low		
546	Campichthys tricarinatus	Three-keel Pipefish	0	N	0	0	1.43	1.07	1.79	N	Low		
547	Micrognathus micronotopterus	Tidepool Pipefish	0	N	0	0	1.43	1.07	1.79	N	Low		
548	Hippocampus subelongatus	West Australian Seahorse	0	N	0	0	1.43	1.07	1.79	N	Low		
549	Hippocampus angustus	Western Spiny Seahorse	0	N	0	0	1.43	1.07	1.79	N	Low		
563	Corythoichthys amplexus	Fijian Banded Pipefish, Brown-banded Pipefish	0	N	0	0	1.43	1.07	1.79	N	Low		
566	Corythoichthys conspicillatus	Yellow-banded Pipefish, Network Pipefish	0	N	0	0	1.43	1.07	1.79	N	Low		
578	Corythoichthys ocellatus	Orange-spotted Pipefish, Ocellated Pipefish	0	N	0	0	1.43	1.07	1.79	N	Low		
904	Festucalex cinctus	Girdled Pipefish	0	N	0	0	1.43	1.07	1.79	N	Low		
914	Filicampus tigris	Tiger Pipefish	0	N	0	0	1.43	1.07	1.79	N	Low		
938	Halicampus grayi	Mud Pipefish, Gray's Pipefish	0	N	0	0	1.43	1.07	1.79	N	Low		
942	Heraldia nocturna	Upside-down Pipefish	0	N	0	0	1.43	1.07	1.79	N	Low		
943	Hippichthys cyanospilos	Blue-speckled Pipefish, Blue-spotted Pipefish	0	N	0	0	1.43	1.07	1.79	N	Low		
944	Hippichthys heptagonus	Madura Pipefish	0	N	0	0	1.43	1.07	1.79	N	Low		
945	Hippichthys penicillus	Beady Pipefish, Steep-nosed Pipefish	0	N	0	0	1.43	1.07	1.79	N	Low		
946	Hippocampus bleekeri	Pot bellied seahorse	0	N	0	0	1.43	1.07	1.79	N	Low		
947	Hippocampus breviceps	Short-head Seahorse, Short-snouted Seaho	0	N	0	0	1.43	1.07	1.79	N	Low		

ERA species ID	Scientific name	Common name	Average logbook catch (kg) (2001-04)	Missing > 3 attributes (Y/N)	Missing productivity attributes (out of 7)	Missing susceptibility attributes (out of 4)	Productivity (additive) (1- low, 3-high)	Susceptibility (mult) (1- low, 3-high)	2D vulnerability value (P&S) (low-high range=1.41-4.24)	Susceptibility override used?	2D P&S vulnerability category	High/Med risk category (Refer 2.4.8)	Comments
951	Hippocampus planifrons	Flat-face Seahorse	0	N	0	0	1.43	1.07	1.79	N	Low		
953	Histiogamphelus briggsii	Briggs' Crested Pipefish, Briggs' Pipefish	0	N	0	0	1.43	1.07	1.79	N	Low		
954	Histiogamphelus cristatus	Rhino Pipefish, Macleay's Crested Pipefish	0	N	0	0	1.43	1.07	1.79	N	Low		
960	Hypselognathus horridus	Shaggy Pipefish, Prickly Pipefish	0	N	0	0	1.43	1.07	1.79	N	Low		
961	Hypselognathus rostratus	Knife-snouted Pipefish	0	N	0	0	1.43	1.07	1.79	N	Low		
966	Kaupus costatus	Deep-bodied Pipefish	0	N	0	0	1.43	1.07	1.79	N	Low		
978	Leptoichthys fistularius	Brushtail Pipefish	0	N	0	0	1.43	1.07	1.79	N	Low		
979	Lissocampus caudalis	Australian Smooth Pipefish, Smooth Pipefish	0	N	0	0	1.43	1.07	1.79	N	Low		
980	Lissocampus runa	Javelin Pipefish	0	N	0	0	1.43	1.07	1.79	N	Low		
995	Mitotichthys semistriatus	Half-banded Pipefish	0	N	0	0	1.43	1.07	1.79	N	Low		
996	Mitotichthys tuckeri	Tucker's Pipefish	0	N	0	0	1.43	1.07	1.79	N	Low		
1001	Notiocampus ruber	Red Pipefish	0	N	0	0	1.43	1.07	1.79	N	Low		
1026	Stigmatopora argus	Spotted Pipefish	0	N	0	0	1.43	1.07	1.79	N	Low		
1027	Stigmatopora nigra	Wide-bodied Pipefish, Black Pipefish	0	N	0	0	1.43	1.07	1.79	N	Low		
1028	Stipecampus cristatus	Ring-backed Pipefish	0	N	0	0	1.43	1.07	1.79	N	Low		
1029	Syngnathoides biaculeatus	Double-ended Pipehorse, Alligator Pipefish	0	N	0	0	1.43	1.07	1.79	N	Low		
1061	Pugnaso curtirostris	Pug-nosed Pipefish	0	N	0	0	1.43	1.07	1.79	N	Low		
1071	Solegnathus sp. 1 [in Kuiter, 2000]	Pipehorse	0	N	0	0	1.43	1.07	1.79	N	Low		

ERA species ID	Scientific name	Common name	Average logbook catch (kg) (2001-04)	Missing > 3 attributes (Y/N)	Missing productivity attributes (out of 7)	Missing susceptibility attributes (out of 4)	Productivity (additive) (1- low, 3-high)	Susceptibility (mult) (1- low, 3-high)	2D vulnerability value (P&S) (low-high range=1.41-4.24)	Susceptibility override used?	2D P&S vulnerability category	High/Med risk category (Refer 2.4.8)	Comments
1072	Solegnathus robustus	Robust Spiny Pipehorse, Robust Pipehorse	0	N	0	0	1.43	1.07	1.79	N	Low		
1073	Solegnathus spinosissimus	Spiny pipehorse	0	N	0	0	1.43	1.07	1.79	N	Low		
1089	Trachyrhamphus bicoarctatus	Bend Stick Pipefish, Short-tailed Pipefish	0	N	0	0	1.43	1.07	1.79	N	Low		
1092	Urocampus carinirostris	Hairy Pipefish	0	N	0	0	1.43	1.07	1.79	N	Low		
1093	Vanacampus margaritifer	Mother-of-pearl Pipefish	0	N	0	0	1.43	1.07	1.79	N	Low		
1095	Vanacampus poecilolaemus	Australian Long-snout Pipefish, Long-snouted Pipefish	0	N	0	0	1.43	1.07	1.79	N	Low		
1096	Vanacampus vercoi	Verco's Pipefish	0	N	0	0	1.43	1.07	1.79	N	Low		
1242	Nannocampus subosseus	Bony-headed Pipefish	0	N	0	0	1.43	1.07	1.79	N	Low		
1243	Mitotichthys meraculus	Western Crested Pipefish	0	N	0	0	1.43	1.07	1.79	N	Low		
1548	Heraldia sp. 1 [in Kuiter, 2000]	Western upsidedown pipefish	0	N	0	0	1.43	1.07	1.79	Y	Low		Override: Availability: inshore species (source unknown)
1584	Choeroichthys cinctus	[a pipefish]	0	N	0	0	1.43	1.07	1.79	N	Low		
1586	Corythoichthys haematopterus	[a pipefish]	0	N	0	0	1.43	1.07	1.79	N	Low		
1589	Cosmocampus maxweberi	[a pipefish]	0	N	0	0	1.43	1.07	1.79	N	Low		
1592	Halicampus macrorhynchus	[a pipefish]	0	N	0	0	1.43	1.07	1.79	N	Low		
1593	Halicampus mataafae	[a pipefish]	0	N	0	0	1.43	1.07	1.79	N	Low		
1595	Hippichthys spicifer	[a pipefish]	0	N	0	0	1.43	1.07	1.79	N	Low		
1596	Hippocampus alatus	[a pipefish]	0	N	0	0	1.43	1.07	1.79	N	Low		

ERA species ID	Scientific name	Common name	Average logbook catch (kg) (2001-04)	Missing > 3 attributes (Y/N)	Missing productivity attributes (out of 7)	Missing susceptibility attributes (out of 4)	Productivity (additive) (1- low, 3-high)	Susceptibility (mult) (1- low, 3-high)	2D vulnerability value (P&S) (low-high range=1.41-4.24)	Susceptibility override used?	2D P&S vulnerability category	High/Med risk category (Refer 2.4.8)	Comments
1597	Hippocampus bargibanti	Pygmy seahorse	0	N	0	0	1.43	1.07	1.79	N	Low		
1598	Hippocampus dahli	[a pipefish]	0	N	0	0	1.43	1.07	1.79	N	Low		
1600	Hippocampus multispinus	[a pipefish]	0	N	0	0	1.43	1.07	1.79	N	Low		
1603	Hippocampus zebra	[a pipefish]	0	N	0	0	1.43	1.07	1.79	N	Low		
1604	Micrognathus pygmaeus	[a pipefish]	0	N	0	0	1.43	1.07	1.79	N	Low		
1605	Micrognathus natans	[a pipefish]	0	N	0	0	1.43	1.07	1.79	N	Low		
1606	Microphis brachyurus	[a pipefish]	0	N	0	0	1.43	1.07	1.79	N	Low		
1607	Nannocampus lindemanensis	[a pipefish]	0	N	0	0	1.43	1.07	1.79	N	Low		
1608	Phoxocampus diacanthus	[a pipefish]	0	N	0	0	1.43	1.07	1.79	N	Low		
1609	Siokunichthys breviceps	[a pipefish]	0	N	0	0	1.43	1.07	1.79	N	Low		
1664	Hippocampus abdominalis	Big-bellied / southern potbellied seahorse	0	N	0	0	1.43	1.07	1.79	N	Low		
1665	Hippocampus histrix	Spiny Seahorse	0	N	0	0	1.43	1.07	1.79	Y	Low		Override: Availability: inshore species (source unknown)
1668	Hippocampus subelongatus	West Australian Seahorse	0	N	0	0	1.43	1.07	1.79	Y	Low		Override: Availability: inshore species (source unknown)
1669	Idiotropiscis larsonae	Helen's Pygmy Pipehorse	0	N	0	0	1.43	1.07	1.79	Y	Low		Override: Availability: inshore species (source unknown)
1675	Hippichthys parvicarinatus	Short-keeled Pipefish	0	N	0	0	1.43	1.07	1.79	N	Low		

ERA species ID	Scientific name	Common name	Average logbook catch (kg) (2001-04)	Missing > 3 attributes (Y/N)	Missing productivity attributes (out of 7)	Missing susceptibility attributes (out of 4)	Productivity (additive) (1- low, 3-high)	Susceptibility (mult) (1- low, 3-high)	2D vulnerability value (P&S) (low-high range=1.41-4.24)	Susceptibility override used?	2D P&S vulnerability category	High/Med risk category (Refer 2.4.8)	Comments
1676	Hippocampus biocellatus	False-eyed seahorse	0	N	0	0	1.43	1.07	1.79	N	Low		
1677	Hippocampus tuberculatus	Knobby Seahorse	0	N	0	0	1.43	1.07	1.79	N	Low		
1678	Hippocampus grandiceps	Bighead Seahorse	0	N	0	0	1.43	1.07	1.79	N	Low		
1699	Idiotropiscis australe	Southern Pygmy Pipehorse	0	N	0	0	1.43	1.07	1.79	Y	Low		Override: Availability: inshore species (source unknown)
1094	Vanacampus phillipi	Port Phillip Pipefish	0	N	0	0	1.29	1.07	1.68	N	Low		

Summary of Habitat PSA results

Habitats was eliminated at Level 1

Summary of Community PSA results

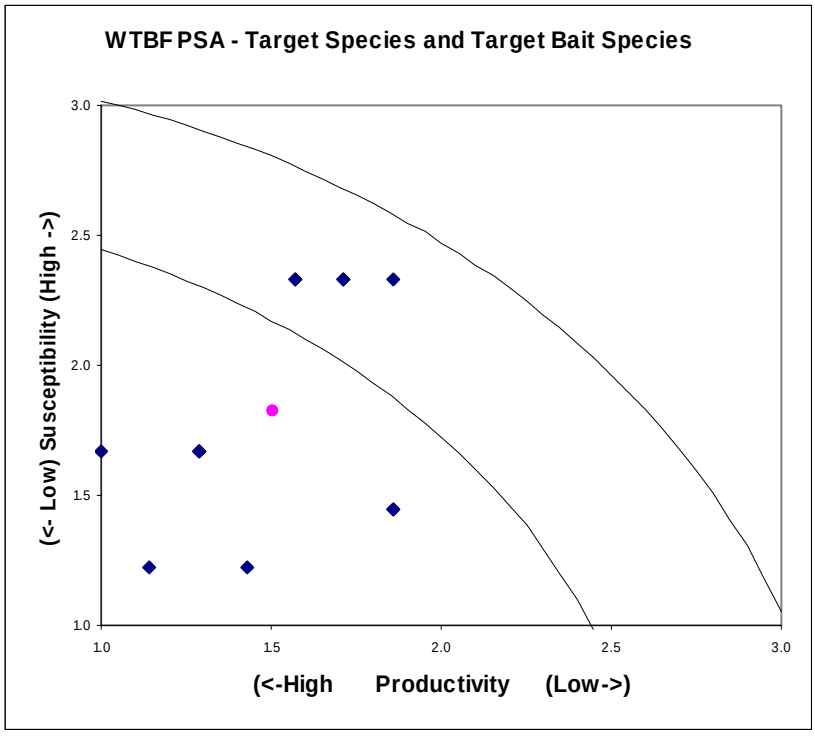
Communities could not yet be examined at Level 2, due to lack of information on the composition of the community assemblages (units of analysis for this component).

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

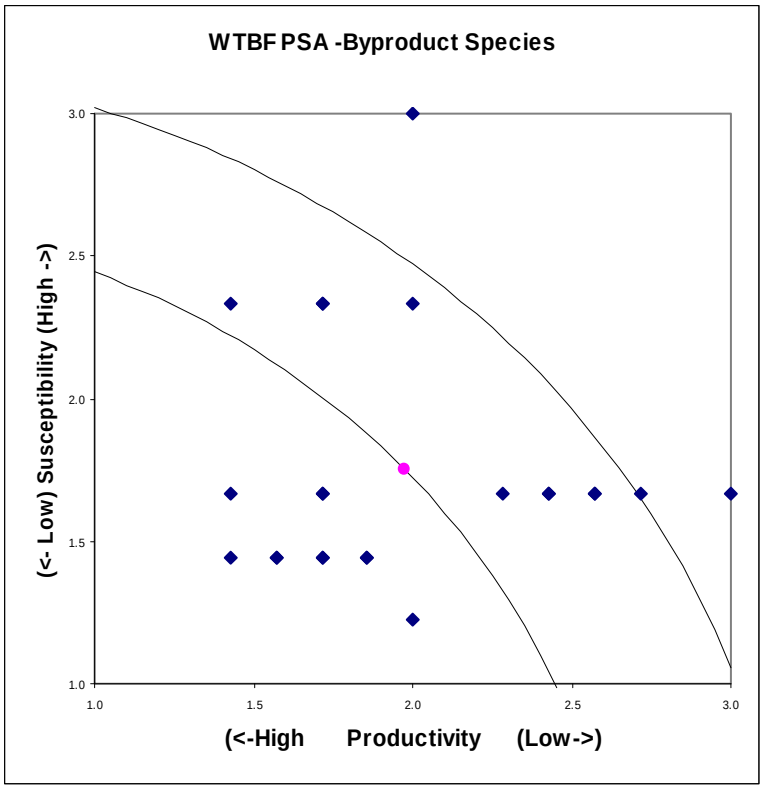
The average productivity and susceptibility scores for each unit of analysis (e.g. for each species) are then used to place the individual units of analysis on 2D plots (as below). The relative position of the units on the plot will determine relative risk at the unit level as per PSA plot below. The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

Results of the PSA plot from PSA workbook ranking worksheet

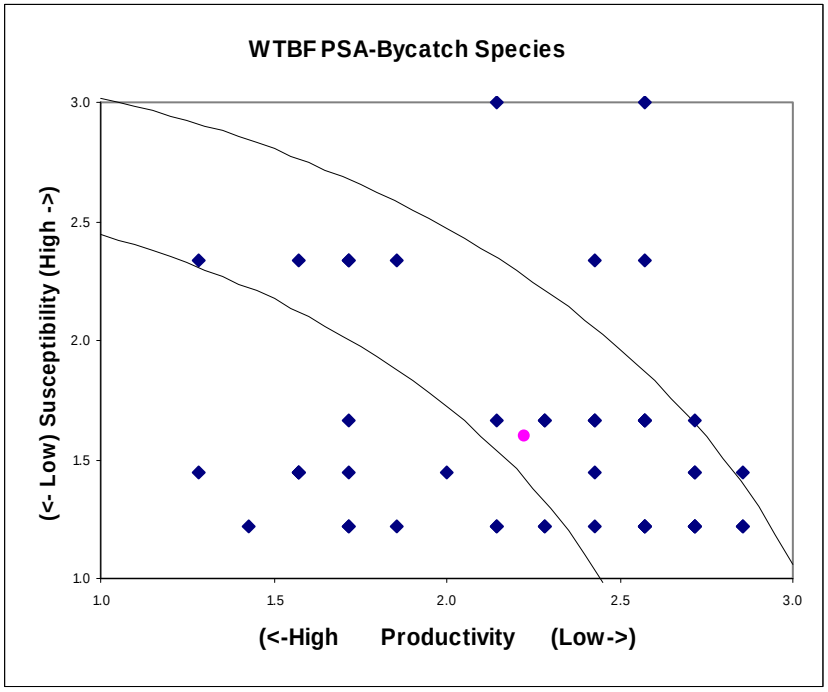
PSA plot for target species and target bait species in the WTBF longline fishery. The magenta dot in the center of the blue diamonds is the average risk for this component.



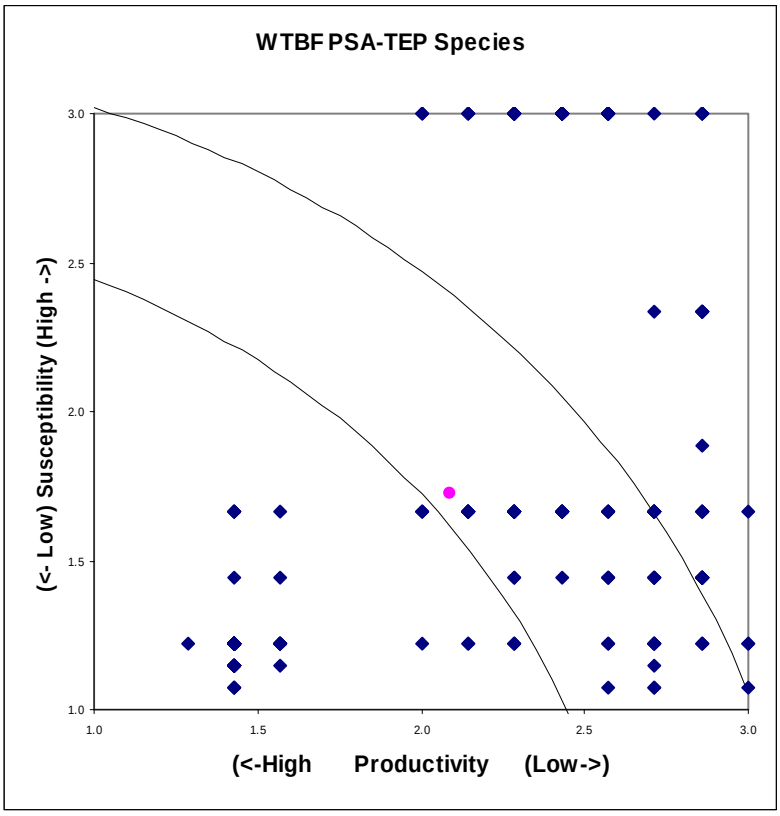
PSA plot for byproduct species in the WTBF longline fishery. The magenta dot in the center of the blue diamonds is the average risk for this component.



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



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



The overall risk value for each unit is the Euclidean distance from the origin to the location of the species on the PSA plot. The units are then divided into three risk categories, high, medium and low, according to the risk values (**Figure 17)**. The cut-offs for each category are thirds of the total distribution of all possible risk values (**Figure 17)**.

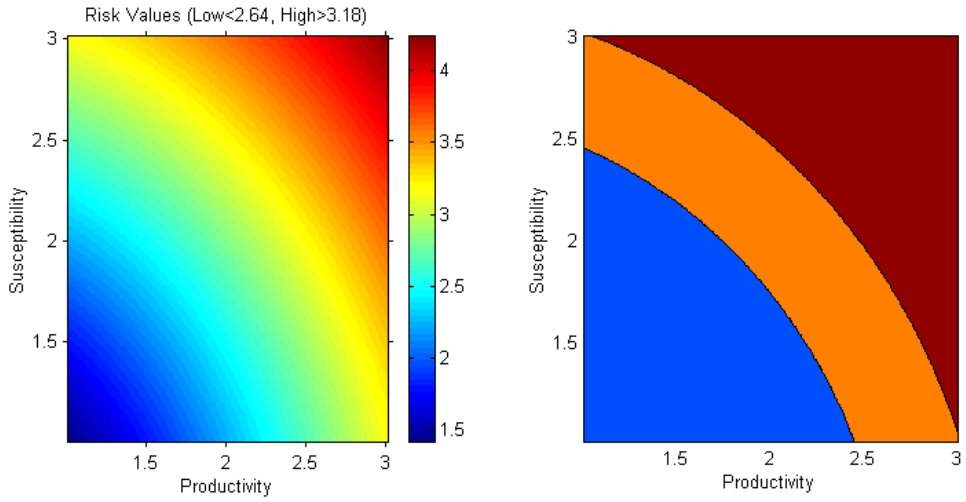


Figure 17. Overall risk values in the PSA plot. Left panel. Colour map of the distribution of the euclidean overall risk values. Right panel. The PSA plot contoured to show the low (blue) risk, medium (orange) risk and high (red) risk values.

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

2.4.5 Uncertainty analysis ranking of overall risk (Step 5)

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

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

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

Availability of information

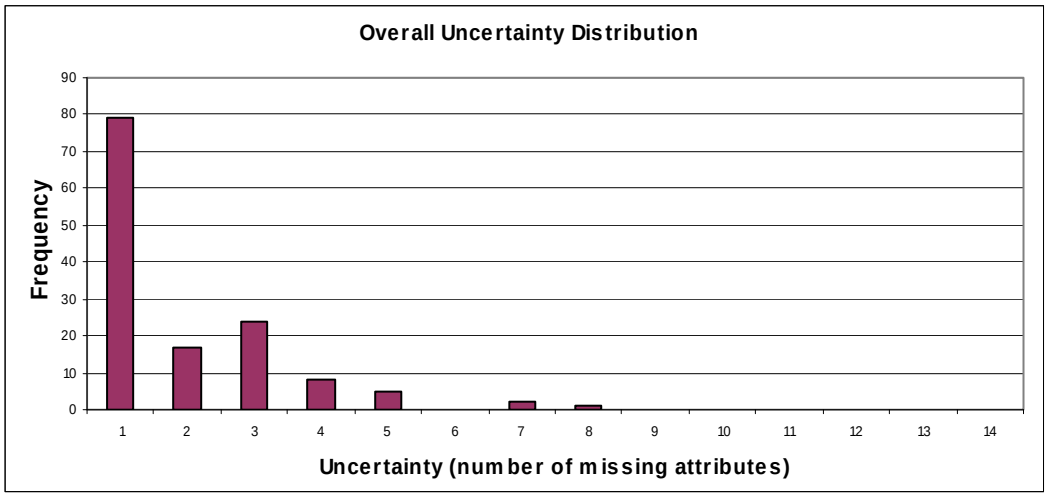
The ability to score each species based on information on each attribute varied between the attributes (as per summary below). With regard to the productivity attributes, trophic level was the least known productivity attribute was missing in 33% of species, and so the most conservative score was used, while information on the best known productivity attributes of average maximum size and average size and maturity was missing for only 1% of species. The current method of scoring the susceptibility attributes provides a value for each attribute for each species – some of these are based on good information, whereas others are merely sensible default values.

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

Productivity Attributes	Average age at maturity	Average max age	Fecundity	Average max size	Average size at Maturity	Reproductive strategy	Trophic level (fishbase)
Total species scores for attribute	309	292	321	346	347	348	232
n species scores with attribute unknown, (conservative score used)	39	56	27	2	1	0	116
% unknown information	11	16	8	1	1	0	33
Susceptibility Attributes	Availability	Encounterability		Selectivity	PCM		
		Bathymetry overlap	Habitat				
Total species scores for attribute	348	348		348	348		
n species scores with attribute unknown, (conservative score used)							
% unknown information	0	0		0	0		

Each species considered in the analysis had information for an average of 6.29 (90%) productivity attributes and 5 (99%) susceptibility attributes. This meant that, on average, conservative scores were used for less than 94% of the attributes for a single species. Species had missing information for between 0 and 8 of the combined 12 productivity and susceptibility attributes.

Species: Overall uncertainty distribution - frequency of missing information for the combined productivity and susceptibility attributes (Overall uncertainty distribution in PSA workbook ranking graphs worksheet)



Correlation between attributes

The attributes selected for productivity were often strongly correlated (as per correlation matrix below for productivity). The strongest productivity attribute correlation was between reproductive strategy and fecundity (0.88). This is why the attributes for productivity are averaged, as they are all 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 (see matrix below).

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

	Age at maturity	Max age	Fecundity	Max size	Min size at maturity	Reproductive strategy	Trophic level
Age at maturity	X						
Max age	0.67	X					
Fecundity	0.51	0.57	X				
Max size	0.30	0.42	0.16	X			
Min size at maturity	0.44	0.64	0.41	0.81	X		
Reproductive strategy	0.44	0.57	0.88	0.15	0.33	X	
Trophic level	0.45	0.73	0.40	0.43	0.58	0.45	X

Correlation matrix for the four species susceptibility attributes. The correlation (r) is based on the scores within each attribute pair. Results from PSA workbook ranking graphs worksheet. Correlations with the post-capture mortality could not be calculated, as this attribute was scored as 3 for all species.

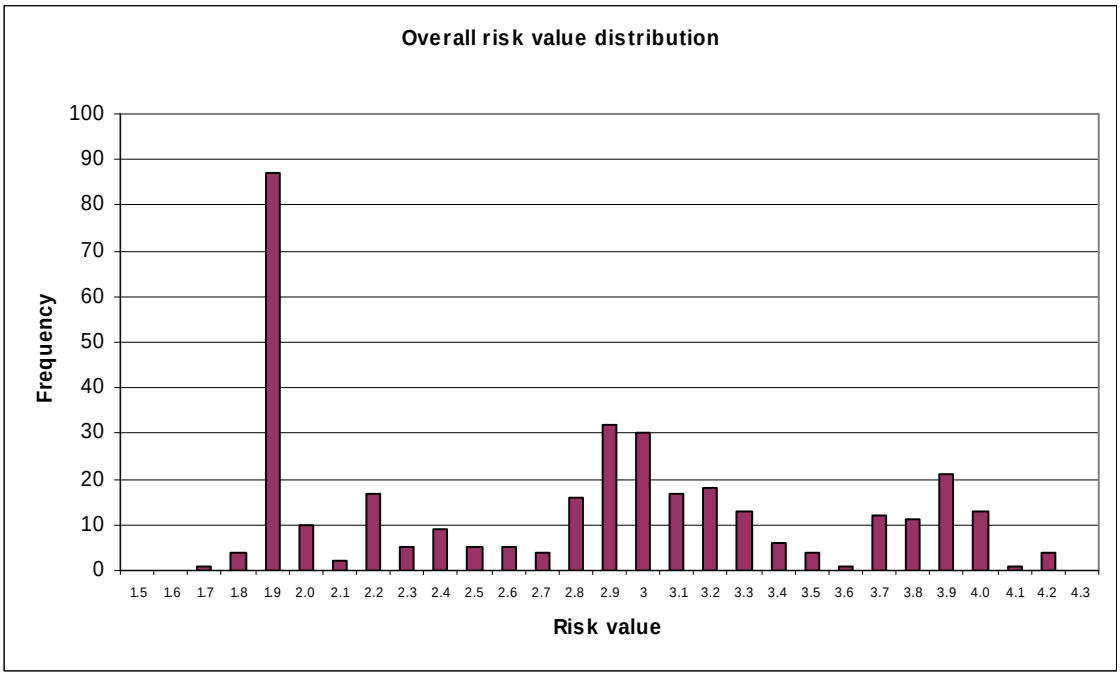
	Availability	Encounterability	Selectivity	Post-capture mortality
Availability	X			
Encounterability	0.63	X		
Selectivity	-0.08	-0.29	X	
Post-capture mortality	- 0.21	- 0.34	- 0.02	X

Productivity and susceptibility risk values for Species

The average productivity score for all species was 2.08 ± 0.11 (mean ± SD of scores calculated using n-1 attributes) and the mean susceptibility score was 1.71 (as per summary of average productivity and susceptibility scores as below). Individual scores are shown in Section 2.4.2 and 2.4.3: Summary of PSA results. The small variation in the average of the boot-strapped values (using n-1 attributes), indicates the productivity and susceptibility scores are robust to elimination of a single attribute. Information for a single attribute does not have a disproportionately large effect on the productivity and susceptibility scores. Information was missing for an average of 0.76 attributes out of 12 possible for each species.

Overall Risk Values for Species

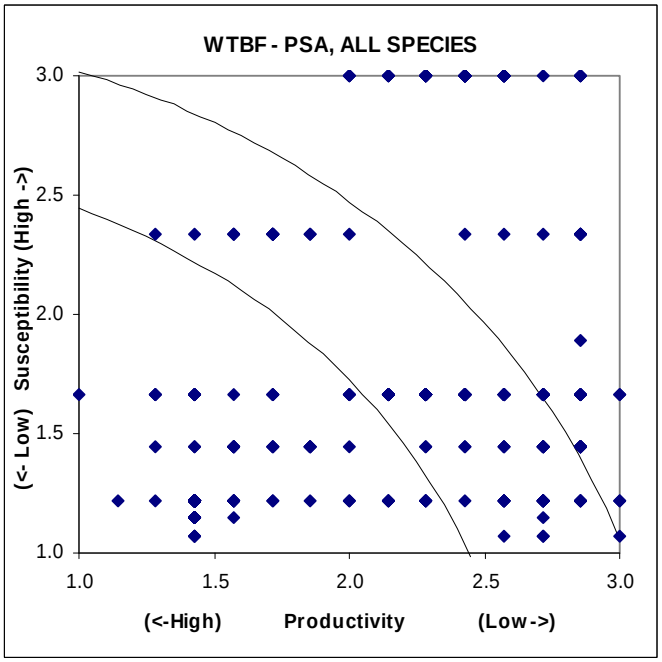
The overall risk values (euclidean distance on the PSA plot) could fall between 1 and 4.24 (scores of 1&1 and 3&3 for both productivity and susceptibility respectively). The mean observed overall risk score was 2.73, with a range of 1.79 -4.14**.** The actual values for each species are shown in Section 2.4.2 and 2.4.3 Summary of PSA results. A total of 99 species (28%) were classed as high risk, 101 (29%) were in the medium risk category, and 148 (43%) as low risk**.**



Frequency distribution of the overall risk values generated for the species in the WTBF longline sub-fishery 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 left and lower right parts of the plot, indicating that there are clusters of low susceptibility, high productivity species (lower left), and low susceptibility, low productivity (lower right) in the sub-fishery. The group of species in the upper right are the high susceptibility, low productivity species of greatest concern in the risk assessment, although a number are likely false positives.

PSA plot for all species in the WTBF longline sub-fishery. Species in the upper right of the plot are at highest risk.



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

2.4.6 Evaluation of the PSA results (Step 6)

Species Components:

The PSA analysis of the Western Tuna and Billfish fishery was presented to a MAC meeting on 9 August 2005. The PSA methodology has since been reviewed and revised (see separate methods document). The following results reflect the revised methodology.

Important note: The PSA method errs on the side of precaution, which tends to result in more false positives (classification of species at high risk that are actually low) than false negatives (classification of species at low risk that are actually high). In particular, species with very low productivity (such as many TEP species) will tend to score at overall high risk even where their susceptibility to fishing is very low. Below we present the nominal results from the PSA analyses, but we also indicate where we believe that false positives may have resulted, leading to a reduced list of priority high risk species or groups.

Overall
A total of 348 species were assessed at Level 2 using the species PSA method. For most species there was little missing data. The average number of missing attributes was 0.76 out of a possible 12. The TEP component had the most missing attributes.

Results: The summary of average productivity and susceptibility scores and overall risk values across all species components is given in the Table below.

Summary of average productivity, susceptibility and overall risk scores

Component	Measure	
All species	Number of species	348
	Average of productivity total	2.08
	Average of susceptibility total	1.71
	Average of overall risk value (2D)	2.73
	Average number of missing attributes	0.76
Target species	Number of species	6
	Average of productivity total	1.71
	Average of susceptibility total	2.19
	Average of overall risk value (2D)	2.79
	Average number of missing attributes	0.0

Target bait species	Number of species	7
	Average of productivity total	1.33
	Average of susceptibility total	1.51
	Average of overall risk value (2D)	2.02
	Average number of missing attributes	0.29
Byproduct species	Number of species	23
	Average of productivity total	1.98
	Average of susceptibility total	1.75
	Average of overall risk value (2D)	2.67
	Average number of missing attributes	0.13
Bycatch species	Number of species	48
	Average of productivity total	2.23
	Average of susceptibility total	1.60
	Average of overall risk value (2D)	2.78
	Average number of missing attributes	0.44
TEP species	Number of species	264
	Average of productivity total	2.09
	Average of susceptibility total	1.73
	Average of overall risk value (2D)	2.74
	Average number of missing attributes	0.90

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

Risk Category	High	Medium	Low	Total
Target species	0	1	5	6
Target bait specie	0	0	7	7
Byproduct species	2	7	14	23
Bycatch species	3	26	19	48
TEP species	27	114	123	264
Total	32	148	168	348

PSA (productivity and susceptibility) risk categories for each taxon

Risk Category	High	Medium	Low	Total
Chondrichthyan	6	26	6	38
Invertebrate	0	0	1	1
Marine bird	21	47	8	76
Marine mammal	5	42	3	50
Marine reptile	0	23	5	28
Teleost	0	10	145	155
Total	32	148	168	348

Discussion

Target species

Of the 6 target species none are classified as high risk, 1 were classified as medium risk, and 5 as low risk. There were no missing data. The seven target bait species in this fishery were all classed as low risk.

The following target species is classified as medium risk the broadbill swordfish. Overall for these species the WTBF Data summary 2003 (1998-2003) in general shows a trend of increasing catches for both the southern and western sector (apart from 2003), with most caught in the western sector. (See also section 2.5).

Byproduct species
Of the 23 byproduct species, 2 are classified as high risk, 7 as medium risk and 14 as low risk. There was very little missing attribute data.

Of the high risk species, 2 are chondrichthyan species (dusky shark and porbeagle shark) which are classified as high risk mainly due to their low productivity. The dusky shark is considered at risk by McAuley and Thomas (2005). As Ward and Curren (BRS, Nov 2004) explain, this species is also caught by State WA fisheries and there is concern over additional pressure. They suggest that more monitoring is required to obtain accurate estimates of shark catches in coastal waters further south. The WTBF Data summaries for 2002 and 2003 are the first for which bycatch has been reported by species. For the dusky shark, in 2002 18 were retained and 154 not retained; in 2003 10 retained and 44 not retained. For the porbeagle shark, in 2002 2 were retained and 330 not retained; in 2003 none were retained and 23 not retained.

The other high risk species is a teleost, the spotted moonfish, which has scored medium for productivity and high for susceptibly. According to information provided by Peter Ward (BRS) adult moonfish are a mid-water predator and feed on squid, jellyfish, small pelagic fish and crustaceans (Palmer, 1984; Anonymous1994). There is little information available on the spawning habits, size at maturity, age, growth, fecundity or migration patterns of moonfish (Hawn et al. 2002). Catches of moonfish have probably increased with deeper longline sets and night-setting. Moonfish has a broad distribution and a highly migratory nature. It is not known to school in large aggregations or display site fidelity. Therefore it is probably less susceptible to fishing pressure than species that do exhibit those behaviours. No commercial fishery exists for this species, and so it has been poorly studied. Little information exists on the biology and ecology of the moonfish, but recent studies have tagged specimens and this should provide more information about the distribution and behaviour of the species. The WTBF Data summaries for 2002 and 2003 list undifferentiated moonfish caught as bycatch. For 2002 there were 82 retained and 42 not retained; in 2003 none were retained and 12 not retained.

Of the 7 medium risk species, 4 are chondrichthyan species (oceanic whitetip, blue shark, shortfinned mako, crocodile shark). Of these the blue shark and crocodile shark require further consideration given the significant numbers caught.

Blue shark: The WTBF Data summaries for 2002 and 2003 report high catches. For 2002 1,613 were retained and 32,210 not retained; 2003 1,859 were retained and 21,517not retained. Results from the scientific monitoring of longline fishing off WA (Ward and Curren 2004) show blue shark as the largest catch of all species, exceeding those of commercially targeted species. For those not retained, 5% were dead, 25% alive and sluggish, 70% alive and vigorous, but survival after release will vary with the animal's condition.

Crocodile shark: The WTBF Data summaries for 2002 and 2003 report high catches. For 2002, 426 were retained and 2,855 not retained; in 2003 none were retained and 10,036 not retained. Results from the scientific monitoring of longline fishing off WA (Ward and Curren 2004) show crocodile sharks as the third largest catch of all species

caught, with none retained. For those discarded, about 50% were released alive and vigorous, 25% alive and sluggish, and the other 25% dead. These species have low productivity and are believed to be extremely slow growing. Whilst these species are found worldwide, Ward and Curren recommend that more information is needed from the Australian fishery and the broader Indian Ocean to determine whether they are vulnerable to current levels of fishing.

Bycatch species

Of the 48 bycatch species, 3 are classified as high risk, 26 as medium risk and 19 as low risk. There was very little missing attribute data.

Of the 3 high risk bycatch species 3 are chondrichthyans (thintail thresher shark, Sherwood's dogfish, and smooth hammerhead shark).

For the thintail thresher shark and the pelagic stingray, low numbers were reported in the WTBF Data summaries for 2002 and 2003 and by Ward and Curren (2004). Smooth and scalloped hammerhead sharks are often not well distinguished by observers. The Smooth hammerhead shark is classified as high risk and the scalloped hammerhead sharks as medium. R Daley (CSIRO) considers that is should probably be the other way around. Scalloped and undifferentiated species were reported as bycatch in the WTBF Data summaries for 2002 and 2003.

Brier shark was initially assessed as high risk, but is likely to be a false positive as it is a deepwater benthic species. Velvet dogfish may be a species misidentification. Sherwood's dogfish is high risk mainly due to missing attribute information.

Summary of priority high risk byproduct and bycatch species:

- Chondrichthyans (dusky shark, portbeagle shark, thin tail thresher shark,). Crocodile shark, although classed as medium, should also be a focus.

TEP species

Of the 264 TEP species, 27 were classified as high risk, 114 as medium risk and 122 as low risk. A number of the high risk species are likely to be false positives, as discussed further below.

Before discussing the TEP species, it is important to review briefly the observer data that are available for the fishery, and their adequacy in assessing risk to bycatch and particularly TEP species. The main period of observer coverage for the fishery was from April 2003 to June 2004, when BRS ran a pilot observer program that covered about 4% of the effort during that period. Observations were primarily in the western part of the fishery (solely off WA). Observers reported on 46 species of target, byproduct and bycatch species caught, as well as on interactions with marine wildlife. Since that pilot observer study finished, there have been only a handful of trips with observers aboard, and data from these trips are not yet available. The annual Data Summaries produced for the fishery contain summarized information on wildlife interactions, but the taxonomic resolution is broad (often just undifferentiated marine birds or mammals), and there has been no (reported) detailed analysis of observer data. Risks for a number of TEP species could almost certainly be lowered with better observer coverage and data.

Notwithstanding these limitations in the data, this report has tried to make the best use of the observer data that are available. This has generally involved reducing the

selectivity scores for species to low on the basis of lack of records for their capture. For example, very few marine mammals have been reported captured, and those were reported released alive. On that basis risk levels for both selectivity and post capture mortality were reduced. However this did not always result in overall risk falling below the high/medium threshold, as most marine mammals have very low productivity. We discuss below whether further reduction of these high risk species is warranted.

The other group where observer data were used to reduce attribute risk scores was for some groups of marine birds. Observers reported interactions with several (broad taxonomic) groups including albatross, petrels and shearwaters, so risk scores have not been altered for species in these groups (even though not all species will be at risk – however species details were not available in the reports used). However selectivity risk has been reduced for all other seabird groups (even though some reports of seabird interactions were for "undifferentiated" seabirds) resulting in a number of species reducing from high to medium risk. Further resolution of seabird risk awaits better observer coverage and data, with better taxonomic resolution.

Seabirds: Of the 76 marine birds in the analysis, 21 were classified as high risk (all albatross, and shearwaters). In the data summaries for the period 1998-2002, marine birds captured included undifferentiated albatross (5 alive, 4 dead, 1 unknown), mutton birds (4 alive, 1 dead) and other seabirds (6 alive, 3 dead, 1 unknown). Ward and Curren (2004) reported that seabirds such as shearwaters, petrels and albatross often followed the vessels as they retrieved longlines. Shearwaters were occasionally snagged in branch lines during hauling. However, reports indicated that most escaped or were released unharmed. No seabirds were reported killed during the period of that study.

A number of mitigation measures are in place for marine bird capture, following development of the Threat Abatement Plan (TAP) released in 1998 and reviewed in 2003. Regulations implemented in Feb 2001 under the Fisheries Management Act 1991 to meet requirements of the TAP require all longliners to:

- Carry tori pole when fishing waters south of latitude 30^{O}S to attach the line where baits enter the water
- Ensure no offal is discharged when longlines are being set and where possible when longlines are being hauled
- Set lines at night when operating in waters south of 30^{O}S
- Use only thawed bait

Regulations allow for testing of alternative mitigation measures under scientific permits. The WTBF has contributed funds for trialing of TAP chute bait setting devices off the east coast, with the intent that results from this trial will be applicable to WTBF (AFMA WTBF Draft assessment July 2003 Pages 100-102).

Research: AFMA and industry have sponsored 3 projects in the ETBF to assess and minimise seabird interactions. These are chute trial, twin tori line/38 gram branch line weighting, twin tori line/60 gram branch line weighting. Results from these projects will be considered for incorporation in future management measures in the WTBF (Pages 100-102). In results to date, the chute did not prove effective as a seabird mitigation measure during the trial but could form part of the solution in combination with other

measures. The twin tori line/38 gram branch line weighting was not successful between 30° S and 33°S although it showed promise at 33°S.

Discussions on seabird bycatch at a MAC meeting on 9th August 2005 suggested that while the potential risk to seabirds was high, the actual risk was probably low.

Marine mammals: Of the 50 species identified to overlap the area of the fishery, 5 were classified as high, 42 as medium, and 3 as low risk. The high risk species included whales. The smaller whales could get caught. As a group, for the period 1998-2002, 1 undifferentiated whale was caught alive, and 4 undifferentiated seals were caught alive. Whales in the Balaenidae and Balaenopteridae families are plankton feeders so are not likely to be attracted to the bait.

Discussions at a MAC meeting on 9th August 2005 suggested that some whales are likely to scavenge bait off hooks, but there have been no reports of entanglements, and most species caught would be likely to break the line. Dolphins were reported as rarely caught.

Marine reptiles: Of the 28 species of marine reptiles in the TEP lists for the area of the fishery, 6 are turtles, and the rest are sea snakes. Of the marine reptiles, 0 were classified as high, 23 as medium, and 5 as low risk. Of the 6 turtles, all were classified at medium risk. Of the 22 sea snakes, 12 were classified as medium risk, but all had missing attribute data. It is very likely that these species are "false positives", and thus also at low or medium risk from the fishery.

As a group, for the period 1998-2002 (Data Summary 2002), 37 undifferentiated turtles were caught alive, and 3 dead; 66 leatherback turtles were caught alive, 1 dead, 1 unknown; 5 loggerhead turtles were caught alive. Ward and Curren (2004) report 5 turtles (2 leatherback, 2 loggerhead and 1 Olive Ridley) caught and all were released alive. There is insufficient information currently available to determine the species composition of turtle bycatch and verify catch levels in the WTBF. Caton (2004) states that expansion of shallow line sets targeting swordfish has increased the potential for interactions with turtles. The survival of turtles released alive is unknown although anecdotal information suggests that if handled correctly they may have high levels of post capture survival. AFMA (2001) *The Australian Tuna Fisheries Bycatch Action Plan* includes action specifically aimed at improving identification, care and release of hooked turtles (page 104).

Research: Robins et al (2002) completed the project "*Bycatch of sea turtles in longline fisheries"* for which AFMA and industry provided data.

Sharks: Two species of sharks were assessed to be at high risk – grey nurse and white sharks. Both are classified as endangered species.

Teleosts: All of the 155 TEP teleost species were syngnathids. All were classified as low risk as they have little or no exposure to the fishery (which is pelagic and offshore).

Habitat Component
The WTBF is a pelagic fishery. The habitat component was not considered in this analysis as no risk scenario scored greater than 2 (minor risk) in the Level 1 SICA analysis.

Community Component
The community component could not be considered at Level 2, even though it was not eliminated in the Level 1 SICA analysis. The data preparation for this analysis has not been completed, and the methods are undergoing development.

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 high risk species need to be the focus of further work, either through implementing a management response to address the risk or be further examined for risk within the particular ecological component at Level 3. Units at low risk, in the lower third (risk value <2.64), are deemed not at risk from the sub-fishery and the assessment is concluded for these units.

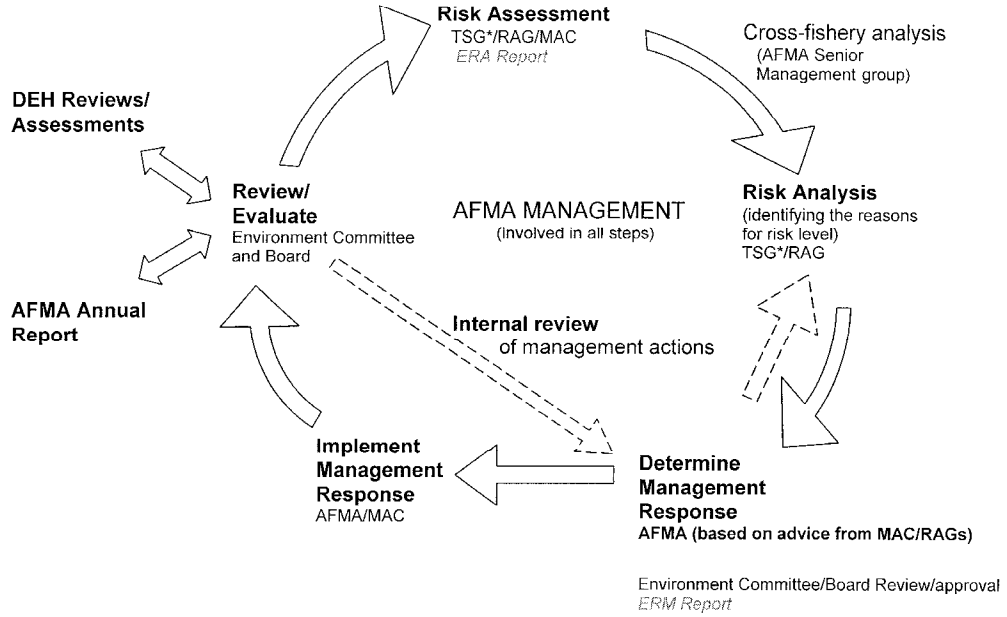
For example, if in a Level 2 analysis of habitat types, two of seven habitat types were determined to be at risk from the sub-fishery, only those two habitat types would be considered at Level 3.

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

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

At level 2 analysis, a fishery can decide to further investigate the risk of fishing to the species via a level 3 assessment or implement a management response to mitigate the risk. To ensure all fisheries follow a consistent process in responding to the results of the risk assessment, AFMA has developed an ecological risk management framework. The framework (see Figure x) 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 risk and what actions the fishery will implement to respond to the risks.

Figure x: Ecological Risk Management Framework



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

2.4.8 High/Medium risk categorisation (Step 8)

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

- **Category 1: Missing data** (*>3 missing attributes in either Productivity or Susceptibility estimation)*. Rationale: A total of more than 3 missing attributes (out of 12 possible) could lead to a change in risk score if the information became known. This is because where information is missing for an attribute, that attribute is automatically scored as high risk. The choice of 3 attributes was identified using sensitivity analysis.
- **Category 2**: **Spatial overlap**
    - **2A. Widely distributed** *(More than 80% of the full range of a species is outside the jurisdictional boundary of the fishery)*. Rationale: These species may have refuge outside the fishery.

- **2B. Low overlap** *(<20% overlap between effort and the species distribution inside the fishery).* Refers to the preferred Availability attribute used to calculate Susceptibility. Rationale: This cutoff (20%) has no strong rationale, other than being a low percentage overlap. Additional work to determine what threshold might be applicable is required. However, the categories are to be used as a guide for management, and additional effort to decide on cutoffs may be misplaced if the categories are just used as a guide. A similar analysis could be undertaken for the encounterability and selectivity attributes, but there is more information available for availability (overlap) for most species and overlap may be more informative about risk. A subtle change in fishing practice could modify encounterability or selectivity, while to change availability requires a major change in fleet location, which will be easier to detect.

- **Category 3**: **Low (susceptibility) attribute score** (*One of the susceptibility attribute scores = 1).* Rationale: These species may be scored high risk based on productivity risk alone, even if their susceptibility is very low.
- **Category 4**: **Spatial uncertainty** (*No detailed distributional data available*) Availability was calculated using less reliable mapping data or distributional categories: Global/Southern Hemisphere/Australia, with stock likelihood overrides where necessary. Rationale: the absence of fine scale catch and species distribution data (e.g. TEP species) means that the substitute attribute (precautionary) was used. Spatial data should be sought.
- **Category 5 Other**: *risk score not affected by 1-4 considered above*

Categorisation results - High risk species

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

Of the 32 species classified as high risk in the WTBF fishery, 3 had missing data (Category 1), 5 had low overlap inside the fishery (Category 2B), 4 had One (susceptibility) attribute scored low (Category 3), and 20 had spatial uncertainty (Category 4).

High risk Category	Description	Total
Category 1	High risk - Missing data for more that 3 attributes	3
Category 2A	High risk - Widely distributed outside fishery	0
Category 2B	High risk - Low overlap inside fishery	5
Category 3	High risk - One (susceptibility) attribute scored low	4
Category 4	High risk - Spatial uncertainty	20
Category 5	High risk -other	0
	Total High	32

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

In general, there are no quantitative stock assessments available for target (or other) species in this fishery. However assessments based on trends in data have been undertaken, and are reported in BRS status reports. These are summarised below for a number of key target species.

Bigeye tuna: According to the BRS status report for 2004, bigeye tuna is not overfished, but over fishing is occurring, particularly in the western Indian ocean. The WTBF Data summary 2003 shows a trend of increasing catches from 1998-2002 with approximately twice as much being caught in the western sector. Catches for both the southern and western sectors decreased by approximately 50% in 2003.

Skipjack tuna: Information on this species is not identified in the BRS assessment report for 2004 or WTBF Data summary 2003. Logbook information suggests that very little is caught.

Yellowfin tuna: According to the BRS status report for 2004, this species is probably only moderately fished in and adjacent to the WTBF, but its status is uncertain in the western Indian Ocean. The WTBF Data summary for 2003 shows that for the period 1998-2003 very little was caught in the southern sector and between 200 and 600 t per annum was caught in the western sector.

Albacore: The WTBF Data summary for 2003 shows that for the period 1998-2003 very little was caught in the southern sector and between 15 and 70 t per annum was caught in the western sector.

Broadbill swordfish: According to the BRS status report for 2004, this species is fully fished in the Indian Ocean and the WTBF, and should be monitored closely in the WTBF for localised depletion associated with intensive fishing. The WTBF Data summary for 2003 shows a trend for 1998-2003 of increased catches in both sectors but two thirds are caught in the western sector.

3. General discussion and research implications

The Western Tuna and Billfish Fishery extends from the tip of Cape York in Qld around Western Australia to the SA/Vic border. However the majority of the effort occurs offshore from the west coast of WA, with small pockets of effort also deployed in the GAB, mainly in SA. The fishing method used is pelagic longline.

3.1 Level 1

The Level 1 SICA analysis eliminated on component from further consideration – the fishery has little or no impact on benthic or pelagic habitats. Direct impact of capture by fishing was assessed to have significant impacts on all other components. Translocation of species was assessed to be only a moderate risk, and only for the community component. External hazards included other fisheries (both international fisheries for tunas in the Indian Ocean and some domestic WA fisheries for species such as dusky shark), coastal development (possibly affecting TEP species, habitats and communities), and other extractive activities (offshore oil and gas affecting benthic habitats).

3.2 Level 2

The 4 components that Level 1 analyses revealed were at moderate or major risk from fishing, were target, byproduct/bycatch, and TEP species as well as communities. The species components were considered in detail at Level 2. Of the 348 species assessed, 32 were found to be at high risk, including 2 byproduct species, 3 bycatch species, and 27 TEP species.

3.2.1 Species at risk

Of the list of species rated as high risk from the PSA analyses, the authors consider that 24 species need further evaluation or management response. Similarly, 2 moderate risk species were considered in need of further evaluation also. This expert judgment is based on taxonomy/identification, distribution, stock structure, movements, conservation status and overlap with this/other fisheries as discussed below (sorted by depth, risk category and taxa).

Species	*Risk category*	*Role*
High risk species		
Chondrichthyans:		
• Dusky Shark	Low overlap	Byproduct
• Porbeagle shark	Low overlap	Byproduct
• Thintail Thresher Shark	Low overlap	Bycatch
• Smooth hammerhead	Low overlap	Bycatch
• White shark	Low overlap	Bycatch
Marine birds		
• Chatham albatross	Missing data	TEP
• Wandering Albatross	Spatial uncertainty	TEP

• Antipodean Albatross	Spatial uncertainty	TEP
• Southern Royal Albatross	Spatial uncertainty	TEP
• Gibson's Albatross	Spatial uncertainty	TEP
• Northern Royal Albatross	Spatial uncertainty	TEP
• Pacific albatross	Spatial uncertainty	TEP
• Salvin's albatross	Spatial uncertainty	TEP
• Sooty Albatross	Spatial uncertainty	TEP
• Light-mantled Albatross	Spatial uncertainty	TEP
• Indian Yellow-nosed Albatross	Spatial uncertainty	TEP
• Buller's Albatross	Spatial uncertainty	TEP
• Shy Albatross	Spatial uncertainty	TEP
• Yellow-nosed Albatross,	Spatial uncertainty	TEP
• Grey-headed Albatross	Spatial uncertainty	TEP
• Campbell Albatross	Spatial uncertainty	TEP
• Black-browed Albatross	Spatial uncertainty	TEP
• Amsterdam Albatross	Spatial uncertainty	TEP
• Tristan Albatross	Spatial uncertainty	TEP

Medium risk species
Chondrichthyans:

• Blue shark	Low overlap	Byproduct
• Crocodile shark	Low attribute score	Byproduct

Target species and target bait species: None of the target species or target bait species were assessed to be at high risk, though stock assessment advice for these species has indicated concern about localised depletion, particularly for broadbill swordfish. All target species will soon be the subject of explicit harvest strategies, under the new policy announced by the Minister in December 2005, and to be implemented by 1 January 2007.

Byproduct: The 2 species assessed to be at high risk from the PSA analysis were the dusky shark, and the portbeagle shark. The dusky shark is considered at risk by McAuley and Thomas (2005). As Ward and Curren (2004) explain, this species is also caught by State WA fisheries, and there is concern over additional pressure from the WTBF. The portbeagle shark is caught in considerable numbers in the WTBF.

Even though they were assessed at only medium risk, two other sharks (blue shark and crocodile shark) are caught in large numbers and deserve further consideration. The blue shark is the most common species caught in the fishery (catches exceed those of any of the target species).

Bycatch: Of the 48 bycatch species, 3 are classified as high risk. These 3 are all chondrichthyans (thintail thresher shark, Sherwood’s dogfish, and smooth hammerhead shark). As discussed in section 2.4.6, the hammerhead species likely to be at higher risk is probably the scalloped hammerhead.

Further analysis of spatial and temporal patterns of catch for all the high risk byproduct and bycatch species should be undertaken. For the bycatch species (and possibly for

byproduct as well), increased observer coverage coupled with better taxonomic resolution of species is required.

TEP: PSA analyses identified 27 species of sharks, marine birds, mammals to be potentially at high risk. Each group is discussed briefly below.

Sharks: Both the grey nurse shark and the white shark are classified as endangered and are occasionally caught in the fishery.

Marine mammals: Very few marine mammals have been recorded as caught in the fishery, and most that have been caught are recorded as released alive. The extent and taxonomic resolution of the observer coverage is, however inadequate. It is probable that most marine mammals are at low risk from the WTBF, but only an improved observer program will determine this.

Marine birds: Many species and groups of marine birds have been observed close to fishing boats, particularly during setting and retrieval. Very few groups have been recorded to species level. The main groups of concern are the albatrosses, and the shearwaters. However almost certainly, only a few species in each group would be of real concern. Again, greatly improved observer coverage with taxonomic resolution to species level is essential to narrow the species list, and to improve the assessment of risk.

Reptiles: Even though these were assessed at only medium risk the turtles deserve further consideration. Several species of turtles are captured by the fishery, with most recorded as released alive. The Olive Ridley turtle was assessed to be the one most at risk from capture. Although several species of sea snakes were assessed to be at medium risk, these all had missing attribute data and represent false positives. It is unlikely that any species of sea snakes are at true risk from pelagic longline fishing.

Mitigation measures are in place to reduce seabird bycatch in the fishery, but their effectiveness has yet to be evaluated. For TEP species of concern, two possible approaches to mitigation are possible. These include gear or behavioural modification (as already undertaken for seabird mitigation), and area/time restrictions to reduce bycatch. The latter have not yet been examined, and will probably need to await further data collection from an improved observer program. Another important uncertainty for many TEP species is their population structure, and in particular their exposure to hazards from other methods of fishing. Finally, much of the uncertainty about impacts on all bycatch species (including TEP species) stems from uncertainty about their population abundance and/or mortality rates from fishing. Collection of fishery independent data on these species would be essential to move risk analyses to Level 3.

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

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

3.2.3 Communities at risk

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

3.3 Key Uncertainties / Recommendations for Research and Monitoring

The major source of uncertainty in assessing risk for species in particular is the lack of an adequate observer program. Such a program should be developed and implemented as a matter of urgency, ensuring good spatial and temporal coverage, and good taxonomic resolution (to species level) for all observer data. Improved reporting of discard species in logbook data would also assist future assessments. Effort to obtain biological data from the literature has been pursued: the next step would be to commission an expert to assess the missing characters.

References

Ecological Risk Assessment References (specific for this fishery)

AFMA (2003) Draft assessment report: Western tuna and billfish Fishery

AFMA (2004) Australia's Tuna and Billfish Longline and Minor Line Fisheries Bycatch Action Plan.

AFMA (2001) *The Australian Tuna Fisheries Bycatch Action Plan*

AFMA (2005) Western Tuna and Billfish Fishery Management Plan 2005

AFMA (2004) *Western Tuna and Billfish Fishery Data summary 2003*. Commonwealth Australia, Canberra.

AFMA (2003) *Western Tuna and Billfish Fishery Data summary 2002*. Commonwealth Australia, Canberra.

Australian Commonwealth Government Bureau of Rural Sciences (2005) *Fishery Status Reports 2004.* Edited by Caton, A. and McLouglin, K. Commonwealth Government of Australia, Canberra.

Caton A and McLoughlin K. (2004) Fishery Status Reports. Eastern Tuna and Billfish Fishery. Australian Government Department of Agriculture, Fisheries and Forestry. BRS, Canberra.

Environment Australia. (1998). Threat Abatement Plan for the incidental catch or bycatch of seabirds during oceanic longline fishing operations. National Parks and Wildlife. Canberra.

Environment Australia. (2002). Recovery Plan for the Grey Nurse Shark (Carcharias taurus) in Australia.

Environment Australia. (2003). Recovery plan for marine turtles in Australia. http://www.deh.gov.au/coasts/species/turtles/recovery/index.html

EPBC Act List of Marine Species: http://www.deh.gov.au/epbc/biodiversityconservation/marine.html

EPBC Act List of Threatened Fauna. [http://www.deh.gov.au/cgi-bin/sprat/public/publicthreatenedlist]

Gaughan, D. J. (2002). Disease-translocation across geographic boundaries must be recognized as a risk even in the absence of disease identification: the case with Australian Sardinops. Reviews in Fish Biology and Fisheries **fs**(2): 113-123.

Gommon, M., Glover, J., and Kuiter, R. Editors (1994)*The fishes of Australia's south coast* State Print, Adelaide, Australia

Greer, A.E. 2004. Encyclopedia of Australian Reptiles. Australian Museum Online http://www.amonline.net.au/herpetology/research/encyclopedia.pdf Version date: 9 November 2004.

Palmer, G. (1984) Lampridae. In: Whitehead, P.J.P.; Bauchot, M-L.; Hureau, J-C.; Nielsen, J.; Tortnose, E. (eds.) *Fishes of the North-eastern Atlantic and Mediterranean*pp. UNESCO, Paris, France. pp 725-726.

Jefferson, T., Leatherwood, S. and Webber, M (1994).Marine Mammals of the World FAO speocies identification guide FAO, Rome

Kuiter, R.H. (2000). A comprehensive guide to Sygnathiformes. TMC Publishing. UK

Last, P.R. & Stevens, J.D. (1994) Sharks and Rays of Australia. CSIRO Division of Fisheries.

McAuley, R., Lenaton, J., Chidlow, J., Allison, R. and Heist, E. (2005a) Biology of the thickskin (sandbar) shark, *Carcharhinus plumbeus*, in Western Australian and further refinement of the dusky shark, *Carcharhinus obscurus*, stock assessment. *Final Report to the Fisheries Reasearch and Development Corporation* Project 2000/134. Western Australian Fisheries and Marine Research Laboratories, Western Australia. 132 pp.

McAuley, R., Ho, K. and Thomas, R. (2005b). Development of a DNA database for compliance and management of western Australian Sharks. *Final Report to the Fisheries Reasearch and Development Corporation* Project 2003/067. Western

Marchant, S. and Higgins, P.J. (co-ords) Handbook of Australian, New Zealand and Antarctic Birds

Milestone progress report: FRDC project number: 99/107 Development of an operating model for evaluation of harvest strategies for the Eastern Tuna and Billfish Fishery (CSIRO, R. Campbell)

National Plan of Action for the Conservation and Management of sharks (Shark-plan). 2004. Shark Advisory Group and M. Lack. DAFF. www.daff.gov.au/sharkplan

Palmer, G. (1984) Lampridae. In: Whitehead, P.J.P.; Bauchot, M-L.; Hureau, J-C.; Nielsen, J.; Tortnose, E. (eds.) *Fishes of the North-eastern Atlantic and Mediterranean*pp. UNESCO, Paris, France. pp 725-726.

Robins, C., Bache, S., and Kalish, S. (2002) Bycatch of sea turtles in longline fisheries:Australia, BRS, Canberra, ACT, Australia.

Robertson, C.J.R. and Nunn, G.B. (1997). Toward a new taxonomy for albatrosses. pp. 413-19, In Albatross biology and conservation, ed. by G. Robertson and R. Gales. Surrey Beatty & Sons, Chipping Norton.

Shaughnessy, P. D. (1999). The Action Plan for Australian Seals. Environment Australia. Canberra, ACT. Pp. 62.

Stobutzki, I., Miller, M., Brewer, D., 2001. Sustainability of fishery bycatch: a process for assessing highly diverse and numerous bycatch. Environmental Conservation 28 (2), 167-181.

The fishes of Australia's south coast (1994) edited by Martin F. Gomon, J.C.M. [i.e. C.J.M.] Glover & R.H. Kuiter.State Print, Adelaide.

The status of Australia's seabirds. (1996). Eds. Ross G, Weaver K, Greig J. Proceedings of the National Seabird Workshop, Canberra 1993. Commonwealth of Australia.

Threat Abatement Plan for the incidental catch or bycatch of seabirds during oceanic longline fishing operations (1998). Environment Australia

Tortonese, E. (1986) Molidae. In: Whitehead, P.J.P.; Bauchot, M-L.; Hureau, J-C.; Nielsen, J.; Tortnose, E. (eds.) *Fishes of the North-eastern Atlantic and Mediterranean.* UNESCO, Paris, France. pp. 1348-1350.

Ward, P. and Curran, D. (November 2004) Scientific monitoring of longline fishing off Western Australia. Bureau of Rural Science web page http://www.brs.gov.au/fisheries

Yearsley, G. K., Last, P. R. and Ward, R. D. 1999. Australian Seafood Handbook – Domestic species. CSIRO Marine Research, Hobart. 461 pp.

General Methodology References

Fletcher, W. (2005) The application of qualitative risk assessment methodology to prioritize issues for fisheries management. *ICES Journal of Marine Science* 62:1576-1587.

Fletcher, W. J., Chesson, J., Fisher, M., Sainsbury, K. J., Hundloe, T., Smith, A.D.M. and Whitworth, B. 2002. National ESD reporting framework for Australian Fisheries: The how to guide for wild capture fisheries. FRDC Report 2000/145, Canberra, Australia.

Hobday, A. J., A. Smith and I. Stobutzki (2004). Ecological risk Assessment for Australian Commonwealth Fisheries. Final Report Stage 1. Hazard identification and preliminary risk assessment. Report Number R01/0934, CSIRO Marine Research.

Stobutzki, I., Miller, M., Brewer, D., 2001. Sustainability of fishery bycatch: a process for assessing highly diverse and numerous bycatch. Environmental Conservation 28 (2), 167-181.

Walker, T. (2004). Elasmobranch fisheries management techniques. Chapter 13. Management measures. *Technical manual for the management of elasmobranchs.* J. A. Musick and R. Bonfil, Asia Pacific Economic Cooperation**:** (in press).

Species Methodology References

Bax, N. J. and Knuckey, I. 1996. Evaluation of selectivity in the South-East fishery to determine its sustainable yield. Final Report to the Fisheries Development Corporation. Project 1996/40.

Daley, R. K., last, P. R., Yearsley, G. K. and Ward, R. D. 1997. South East Fishery Quota Species – an Identification Guide. CSIRO Division of Marine Research, Hobart. 91 pp.

Gomon, M. F., Glover, J. C. M. and Kuiter, R. H. (Eds.) 1994. The Fishes of Australia's South Coast. State Print, Adelaide. 992 pp.

Last, P., V. Lyne, G. Yearsley, D. Gledhill, M. Gomon, T. Rees and W. White. (2005). Validation of national demersal fish datasets for the regionalisation of the Australian continental slope and outer shelf (>40 m depth). Final Report to the National Oceans Office. National Oceans Office, Hobart. 99pp.

Milton, D. A. 2000. Assessing the susceptibility to fishing of rare trawl bycatch: sea snakes caught by Australia's Northern Prawn Fishery. Biological Conservation. 101: 281 – 290.

Walker, T. I., Hudson, R. J. and Gason, A. S. 2005. Catch evaluation of target, byproduct and bycatch species taken by gillnets and longlines in the shark fishery of south-eastern Australia. Journal of Northwest Atlantic Fisheries Science. 35: 505 – 530.

Yearsley, G. K., Last, P. R. and Ward, R. D. 1999. Australian Seafood Handbook – Domestic species. CSIRO Marine Research, Hobart. 461 pp.

Habitat Methodology References

Althaus F.A. and Barker B. 2005. Lab Guide to Habitat scoring (unpublished).

Bax N., Kloser R., Williams A., Gowlett-Holmes K., Ryan T. 1999. Seafloor habitat definition for spatial management in fisheries: a case study on the continental shelf of southeast Australia. Oceanologica Acta 22 (6) 705-719

Bax N. and Williams A. 2001. Seabed habitat on the south-eastern Australian continental shelf: context, vulnerability and monitoring. Marine and Freshwater Research 52: 491-512

Bulman C., Sporcic M., Dambacher J. 2005 (in prep). Ecological Risk Assessment for Communities Methodology Report.

Commonwealth of Australia 2005. National Marine Bioregionalisation of Australia. Summary. Department of Environment and Heritage, Canberra, Australia.

Greene H.G., Yoklavich M.M., Starr R.M., O'Connell V.E., Wakefield W.W., Sullivan D.E., McRea J.E. Jr., Cailliet G.M. 1999. A classification scheme for deep seafloor habitats. Oceanologica Acta 22: 663-678

Heap A.D., Harris P.T., Last P., Lyne V., Hinde A., Woods M. 2005. Draft Benthic Marine Bioregionalisation of Australia's Exclusive Economic Zone. Geoscience Australia Report to the National Oceans Office. Geoscience Australia, Canberra.

Harris P., Heap A.D., Passlow V., Sbaffi L., Fellows M., Porter-Smith R., Buchanan C., Daniell J (2003). Geomorphic Features of the Continental Margin of Australia. Geoscience Australia, Canberra.

Kloser R., Williams A., Butler A. 2000. Assessment of Acoustic Mapping of Seabed Habitats: Phase 1 Surveys April-June 2000, Progress Report 1. Marine Biological and Resource Surveys South-East Region.

Kostylev V.E., Todd B.J., Fader G.B.J., Courtney R.C., Cameron G.D.M., Pickrill R.A. 2001. Benthic habitat mapping on the Scotian Shelf based on multibeam bathymetry, surficial geology and sea floor photographs. Marine Ecology Progress Series 219: 121-137

Roff J.C., and Taylor M.E. 2000. National Frameworks for marine conservation – a hierarchical geophysical approach. Aquatic Conservation: Marine and Freshwater Ecosystems 10: 209- 223

Community Methodology References

Condie, S., Ridgway, K., Griffiths, B., Rintoul, S. and Dunn, J. (2003). National Oceanographic Description and Information Review for National Bioregionalisation. Report for National Oceans Office.(CSIRO Marine Research: Hobart, Tasmania, Australia.)

Interim Marine and Coastal Regionalisation for Australia Technical Group (1998). Interim Marine and Coastal Regionalisation for Australia: an ecosystem-based classification for marine and coastal environments. Version 3.3 (Environment Australia, Commonwealth Department of the Environment: Canberra, Australia.)

Last, P., Lyne, V., Yearsley, G., Gledhill, D., Gomon, M., Rees, T., and White, W. (2005). Validation of national demersal fish datasets for the regionalisation of the Australian continental slope and outer shelf (>40m depth). (National Oceans Office, Department of Environment and Heritage and CSIRO Marine Research, Australia.)

Lyne, V. and Hayes, D. (2004). Pelagic Regionalisation. National Marine Bioregionalisation Integration Project. 137 pp. (CSIRO Marine Research and NOO: Hobart, Australia.)

Meyer, L., Constable, A. and Williams, R. (2000). Conservation of marine habitats in the region of Heard Island and McDonald Islands. Final Report to Environment Australia. (Australian Antarctic Division, Kingston, Tasmania.)

Rees, A.J.J., Yearsley, G.K., and Gowlett-Holmes, K. (2005). Codes for Australian Aquatic Biota (on-line version). CSIRO Marine Research, World Wide Web electronic publication, 1999 onwards. Available at: http://www.marine.csiro.au/caab/.

Glossary of Terms

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

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

Appendix A: General summary of stakeholder feedback

Date	Format received	Comment from stakeholder	Action/explanation

Appendix B: PSA results summary of stakeholder discussions

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

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

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

Appendix C: SICA descriptions of consequences for each component

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

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

Sub-component	Score/level					
	1 Negligible	2 Minor	3 Moderate	4 Major	5 Severe	6 Intolerable
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.