R04/1072 | 29/06/2007

Australian Government
Australian Fisheries Management Authority

Ecological Risk Assessment for Effects of Fishing

REPORT FOR THE BASS STRAIT CENTRAL ZONE SCALLOP SUB-FISHERY

Authors
Alistair Hobday
Jo Dowdney
Cathy Bulman
Miriana Sprocic
Mike Fuller
Mandy Goodspeed (AFMA)
Emma Hutchinson (AFMA)

CSIRO

Natural Heritage Trust
Helping Communities Helping Australia
An Australian Government Initiative

This fishery Ecological Risk Assessment (ERA) report should be cited as

Hobday, A. J., J. Dowdney, C. Bulman, M. Sporcic, M. Fuller, M. Goodspeed, & E. Hutchinson (2007) Ecological Risk Assessment for the Effects of Fishing: Bass Strait Central Zone Scallop Sub-Fishery. Report for the Australian Fisheries Management Authority, Canberra

This work is copyright. Except as permitted under the *Copyright Act 1968 (Commonwealth)*, no part of this publication may be reproduced by any process, electronic or otherwise, without prior written permission from either CSIRO Marine and Atmospheric Research or AFMA. Neither may information be stored electronically in any form whatsoever without such permission.

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 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 Australian Government managed Bass Strait Central Zone Scallop Fishery (BSS) was undertaken using the ERAEF method version 9.2. ERAEF stands for "Ecological Risk Assessment for Effect of Fishing", and was developed jointly by CSIRO Marine and Atmospheric Research, and the Australian Fisheries Management Authority. ERAEF provides a hierarchical framework for a comprehensive assessment of the ecological risks arising from fishing, with impacts assessed against five ecological components – target species; by-product and by-catch species; threatened, endangered and protected (TEP) species; habitats; and (ecological) communities.

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

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

This assessment of the BSS includes the following:

- Scoping
- Level 1 results for all components
- Level 2 results for two species components, and for habitats. At this time the community component was not assessed. This should occur in future iterations.

NOTE THIS FISHERY IS CURRENTLY CLOSED (AUGUST 2006)

Fishery Description

Gear:	Dredge
Area:	Central Bass Strait
Depth range:	20 to 100 m
Fleet size:	103 SFR (although fishery now closed)
Effort:	hours or shots unknown
Landings:	1419 t in 2004, 2005 data pending, closed for 2006
Discard rate:	low when scallops fished at high density
Main target species:	scallop
Management:	Quota management system for the target species
Observer program:	No direct program, occasional scientific involvement on fishing vessels.

Ecological Units Assessed

Target species:	1
By-product and bycatch species:	1 & 140 respectively
TEP species:	137
Habitats:	28 benthic & 4 pelagic
Ecological Communities:	1 demersal & 1 pelagic

Level 1 Results

One ecological component was eliminated at Level 1 (TEP species). There was at least one risk score of 3 – moderate – or above for the remaining four components; target species, bycatch and byproduct, habitats and communities.

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

- Fishing (direct and indirect impacts on the four identified ecological components)
- Translocation of species (impact on habitats)

Significant external hazards included other fisheries in the region, coastal development, and other extractive activities. Risks rated as major or above (risk scores 4 or 5) were all related to direct or indirect impacts from primary fishing operations. Impacts from fishing on target and bycatch/byproduct species components and on habitats were assessed in more detail at Level 2.

Level 2 Results

<u>Species</u>

A total of 142 species were assessed at Level 2 using the PSA analysis. Of these, 26 were assessed to be at high risk, including the single target species and 25 by-catch species. Of the 142 species assessed, expert over rides were used on 85 species. Of the 26 species assessed to be at high risk, 24 species had more than 3 missing attributes.

Most of these high risk species were invertebrates lacking attribute data, meaning they are potential false positives. Effort to gather data for these species is suggested.

Habitats

Twenty eight habitats were assessed at Level 2 using the habitat PSA analysis. Habitat types were classified based on substratum, geomorphology, and dominant fauna, using photographic data. Of the 28 habitat types, none were assessed to be at high risk, 8 were at medium risk, and 20 at low risk. All habitats were from the inner shelf (0-100m), where fishing occurs.

Medium risk inner shelf habitats include several categories of soft sediment seabed types characterised by large sponges or mixed erect fauna. High relief, hard, outcropping rock is relatively abundant on the inner shelf however, hard grounds exhibit a low accessibility to trawling and dredging gears therefore emerged as low risk (dredging gear used in this fishery).

Communities

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

Summary

The assessment showed that the ecological impacts of the BSS were confined to the target species. The TEP component was eliminated at Level 1, while the byproduct and bycatch, and the Habitat component were eliminated at Level 2. Note that this fishery is currently closed (Aug 2006).

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 **7**
2.2.1 General Fishery Characteristics (Step 1). 7
2.2.2 Unit of Analysis Lists (Step 2) 23
2.2.3 Identification of Objectives for Components and Sub-components (Step 3) 46
2.2.4 Hazard Identification (Step 4) 54
2.2.5 Bibliography (Step 5) 60
2.2.6 Decision rules to move to Level 1(Step 6) 60
2.3 Level 1 Scale, Intensity and Consequence Analysis (SICA) **61**
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) 61
2.3.2 Score spatial scale of activity (Step 2) 62
2.3.3 Score temporal scale of activity (Step 3) 62
2.3.4 Choose the sub-component most likely to be affected by activity (Step 4) .. 63
2.3.5 Choose the unit of analysis most likely to be affected by activity and to have highest consequence score (Step 5) 63
2.3.6 Select the most appropriate operational objective (Step 6) 63
2.3.7 Score the intensity of the activity for the component (Step 7) 63
2.3.8 Score the consequence of intensity for that component (Step 8) 64
2.3.9 Record confidence/uncertainty for the consequence scores (Step 9) 64
2.3.10 Document rationale for each of the above steps (Step 10) 65
2.3.11 Summary of SICA results 87
2.3.12 Evaluation/discussion of Level 1 90
2.3.13 Components to be examined at Level 2 90
2.4 Level 2 Productivity and Susceptibility Analysis (PSA) **91**
2.4.1 Units excluded from analysis and document the reason for exclusion (Step 1) 95
2.4.2 and 2.4.3 Level 2 PSA (steps 2 and 3) 96
2.4.4 PSA Plot for individual units of analysis (Step 4) 116
2.4.5 Uncertainty analysis ranking of overall risk (Step 5) 119
2.4.6 Evaluation of the PSA results (Step 6) 125
2.4.7 Decision rules to move from Level 2 to Level 3 (Step 7) 129
2.4.8 High/Medium risk categorisation (Step 8) 130

2.5 Level 3 132
3. General discussion and research implications 133
3.1 Level 1 133
3.2 Level 2 133
3.2.1 Species at risk 133
3.2.2 Habitats at risk 134
3.2.3 Community assemblages at risk 135
3.3. Key Uncertainties / Recommendations for Research and Monitoring 135
References 136
Glossary of Terms 140
Appendix A: General summary of stakeholder feedback 142
Appendix B: PSA results summary of stakeholder discussions 143
Appendix C: SICA consequence scores for ecological components 144

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 7
Scoping Document S2A Species 23
Scoping Document S2B1. Benthic Habitats 37
Scoping Document S2B2. Pelagic Habitats 43
Scoping Document S2C1. Demersal Communities 43
Scoping Document S2C2. Pelagic Communities 45
Scoping Document S3 Components and Sub-components Identification of Objectives 47
Scoping Document S4. Hazard Identification Scoring Sheet 54

List of Level 1 (SICA) Documents

2.3.1 Level 1 (SICA) Documents L1.1 - Target Species Component; 66
2.3.1 Level 1 (SICA) Document L1.2 - Byproduct and Bycatch Component; 70
2.3.1 Level 1 (SICA) Document L1.3 - TEP Species Component; 74
2.3.1 Level 1 (SICA) Document L1.4 - Habitat Component 77
2.3.1 Level 1 (SICA) Document L1.5 - Community Component 82
Level 1 (SICA) Document L1.6. Summary table of consequence scores for all activity/component combinations. 87

List of Level 2 (PSA) documents

Level 2 (PSA) Document L2.1. Summary table of stakeholder discussion regarding PSA results.. 142

List of Figures

Figure 1. Overview of ERAEF showing focus of analysis for each level 1
Figure 2. Generic conceptual model used in ERAEF. 2
Figure 13. The axes on which risk of the ecological units is plotted. 94
Figure 17. Overall risk values in the PSA plot. 118

List of Tables

Table 4. Examples of fishing activities (Modified from Fletcher *et al*. 2002).....57
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 144
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 147
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 150
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 153
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 156

1. Overview

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

The Hierarchical Approach

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

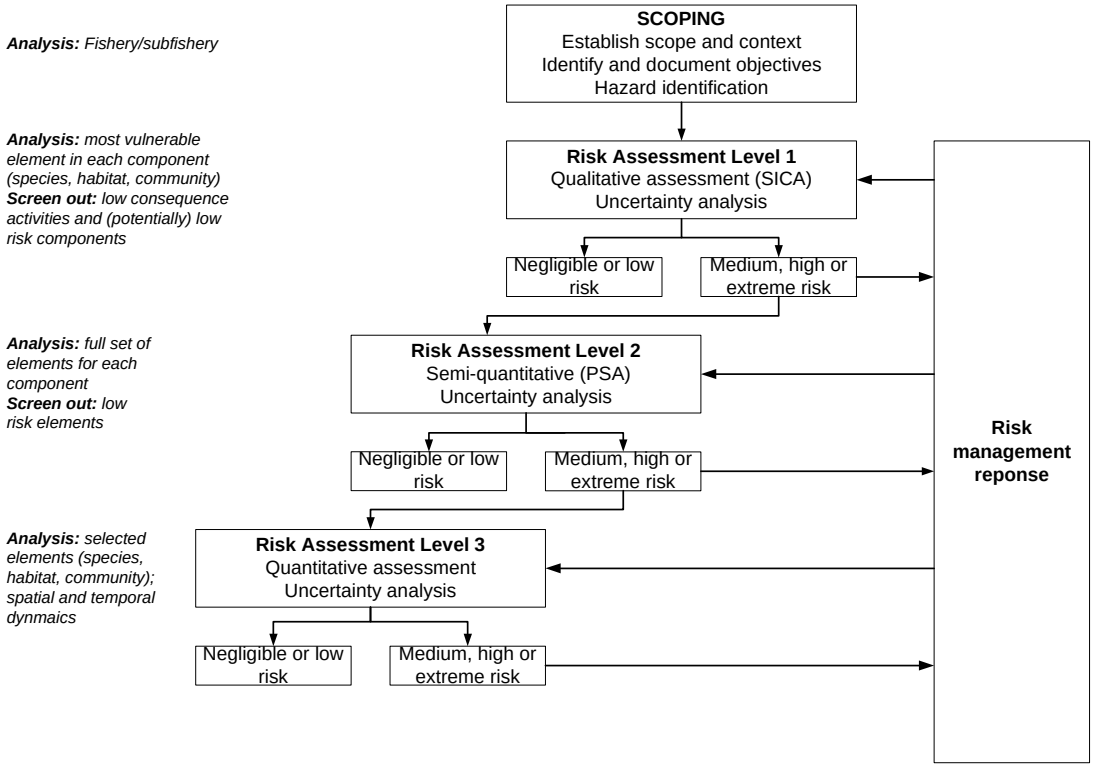


Figure 1. Overview of ERAEF showing focus of analysis for each level at the left in italics.

Conceptual Model

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

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

- Target species
- By-product and by-catch species
- Threatened, endangered and protected species (TEP species)
- Habitats
- Ecological communities

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

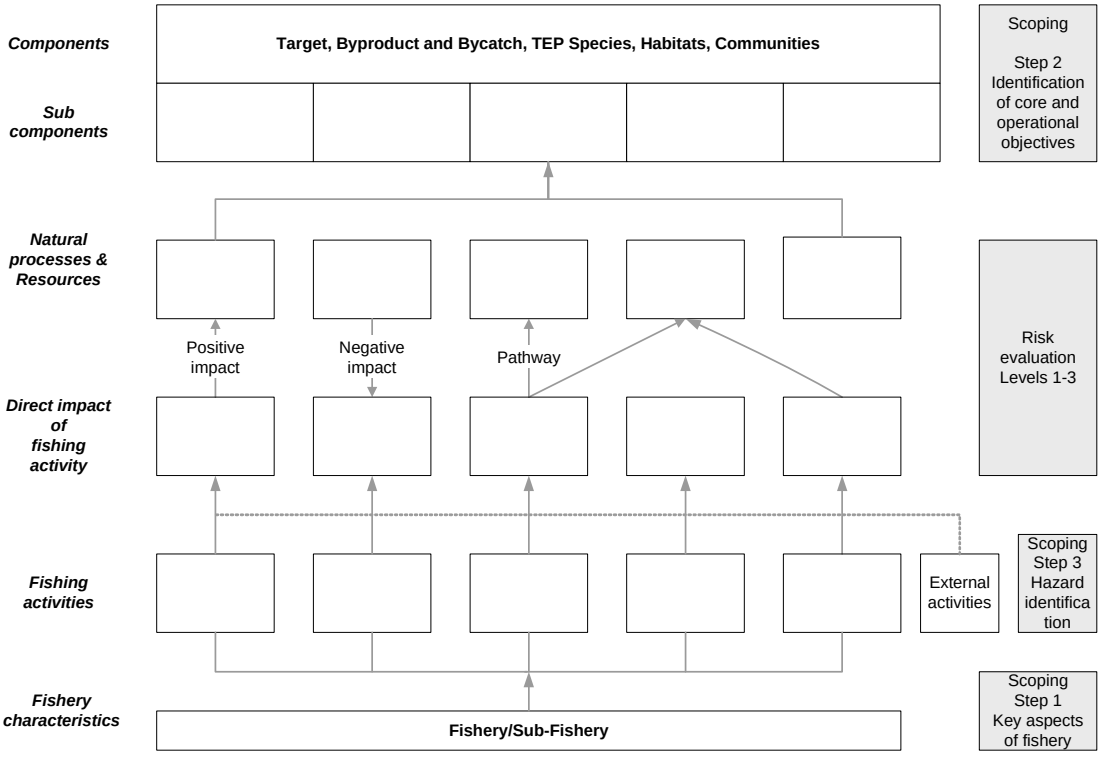


Figure 2. Generic conceptual model used in ERAEF.

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

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

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

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

ERAEF stakeholder engagement process

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

Scoping

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

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

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

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

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

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

Level 2. PSA (Productivity Susceptibility Analysis)

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

Susceptibility attribute estimates, such as “fraction alive when landed”, can also be made based on input from experts such as scientific observers. The final PSA is completed by scientists because access to computing resources, databases, and programming skills is required. Feedback to stakeholders regarding comments received during the preliminary PSA consultations is considered crucial. The final results are then presented to the stakeholder group before decisions regarding Level 3 are made. The stakeholder group may also decide on priorities for analysis at Level 3.

Level 3

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

Conclusion and final risk assessment report

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

Subsequent risk assessment iterations for a fishery

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

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

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

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

2. Results

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

The results presented below are for the BSS dredge fishery.

2.1 Stakeholder Engagement

2.1 Summary Document SD1. Summary of stakeholder involvement for the BSS fishery

ERA report stage	Type of stakeholder interaction	Date of stakeholder interaction	Composition of stakeholder group (names or roles)	Summary of outcome
Scoping	Review by fishers at meeting	27 & 28 November 2003	Scallop MAC meeting	Understand process, provided some information.
	Face to face	January 19, 2004	Malcolm Haddon	Overview of information available to the ERA process. Offer of assistance
	Additional information from experts via email for Hazard ID section.	February 2004	Mandy Goodspeed sought advice from Peter Stegmann (Industry member on ScallopMAC) and Noel Coleman, PIRVIC.	Hazard ID table completed with this feedback.
	Email and phone calls	May 18, 2004	Liz Cotterell (EO)	Supplied a variety of up-to-date information and clarification for the scoping stages. Added to draft.
Level 1 (SICA)	Workshop	February 19, 2004, Melbourne	Dave Johnson (AFMA), Liz Cotterell (EO), Alistair Hobday (ERA), Noel Coleman (PIRVIC) and Geoff Richey (Industry)	Went over scoping and draft Level 1, considered the species lists; identified gaps in understanding, agreement to provide additional information.
	Presentation and discussion of scoping, Level 1 and draft Level 2	April 20, 2004, Canberra	Alistair Hobday (ERA), MAC and FAG members	Presented draft and discussion on it. Additional sources of bycatch data identified and offered. To progress out of session.
Level 2 (PSA)	Presentation	April 20, 2004, Canberra	(ERA), MAC and FAG members	Draft Level 2 also discussed.
	Presentation	August 17, 2005 Melbourne	ERA (MAC FAG members)	Draft Level2 with updated Stage 2 methods discussed.
Final report	Email and circulation by AFMA	July-August 2006	Various, coordinated by AFMA	General and specific comments on the draft (delivered May 30) considered and incorporated where appropriate. (sheet of comments received and updated)

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

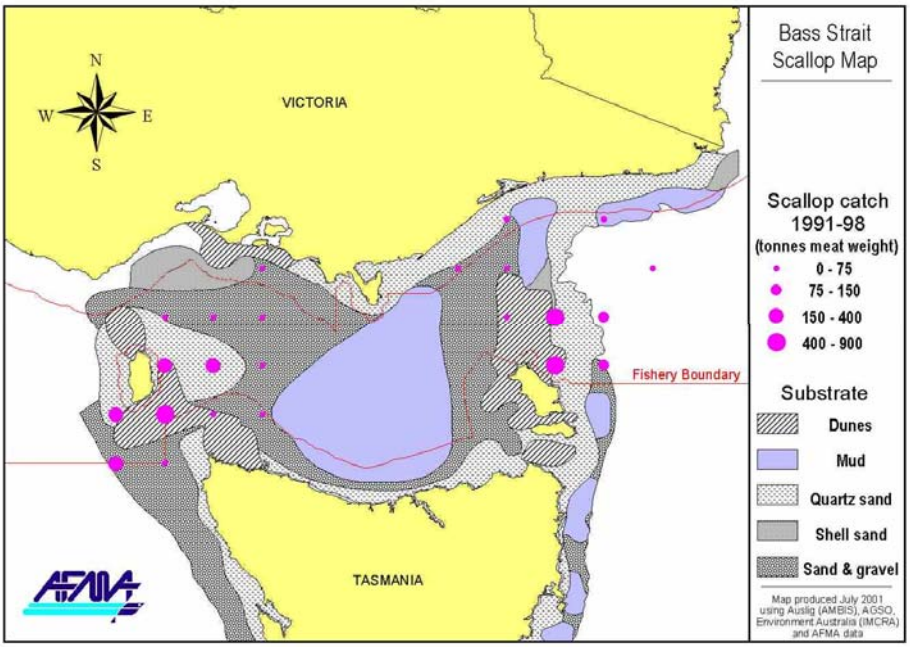
2.2.1 General Fishery Characteristics (Step 1).

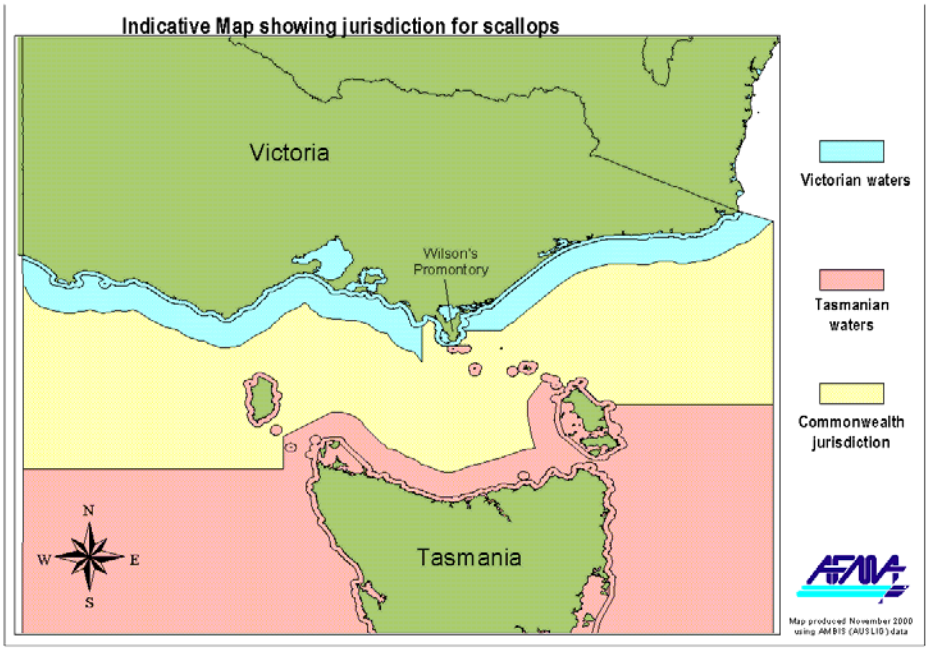
The information used to complete this step may come from a range of documents such as the Fishery's Management Plan, Assessment Reports, Bycatch Action Plans, and any other relevant background documents. The level and range of information available will vary. Some fisheries/sub-fisheries will have a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

Scoping Document S1 General Fishery Characteristics

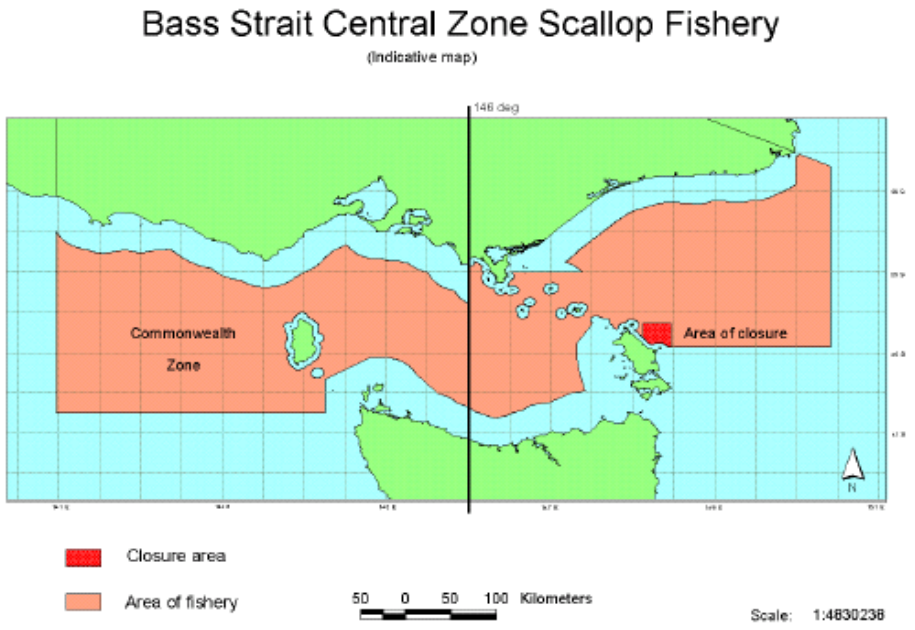
Fishery Name: Bass Strait Central Zone Scallop Fishery
Date of assessment: 28-1-04, 18-5-04, 29-8-05
Assessor: Goodspeed, Hutchinson, Dowdney

General Fishery Characteristics	
Fishery Name	Bass Strait Central Zone Scallop Fishery
Sub-fisheries	*Identify sub-fisheries on the basis of fishing method/area.* There are three scallop fishing zones in Bass Strait. The Commonwealth (AFMA) manages the Central Zone, and Victoria and Tasmania have jurisdiction over the scallop resources generally within 20 nautical miles of their respective coastlines. All use a dredge.
Sub-fisheries assessed	*The sub-fisheries to be assessed on the basis of fishing method/area in this report.* This ERA will only cover the Bass Strait Central Zone Scallop Fishery (AFMA 2001a).
Start date/history	*Provide an indication of the length of time the fishery has been operating.* 1970 (AFMA 2001a) Management Plan for Central Zone determined on 3 September 2002. Granting process for statutory fishing rights was in progress when fishery closed by AFMA in 2006.
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.* Offshore Constitutional Settlement Arrangements finalised in June 1986 rationalised the jurisdiction for Bass Strait scallops. AFMA manages the Commonwealth Central Zone of Bass Strait, between the zones managed by Victoria and Tasmania that lie within 20nm of their respective coasts.

	S1.Figure  **1** **S1.1 Figure 2**. Map of catches and substrate types (AFMA 2001a) The fishery encompasses an area from the Victorian/South Australian border, through the centre of Bass Strait to the Victorian/New South Wales border. Scallop fishing is largely restricted to western Bass Strait around King Island, and eastern Bass Strait, around Flinders Island (AFMA 2002a). Fishing has been entirely restricted to this Flinders Island area since 2002.
Regions or Zones within the fishery	*Any regions or zones used within the fishery for management purposes and the reason for these zones if known* The Victorian and Tasmanian zones of the Bass Strait Scallop Fishery are adjacent to the Bass Strait Central Zone Scallop Fishery. Scallop beds may straddle the jurisdictional lines between State and Commonwealth managed areas. Management arrangements for the Victorian and Tasmanian scallop fisheries are administered independently by the respective State authorities, but the entire south eastern Australian scallop population probably comprises a single stock (Woodburn, 1989).



S1.Figure 1.2 Jurisdiction of waters of Bass Strait Scallop fishing zones (AFMA 2001a)



S1. Figure 3: Area of Fishery showing Zones within the Fishery and the area of the 2003 fishery closure.

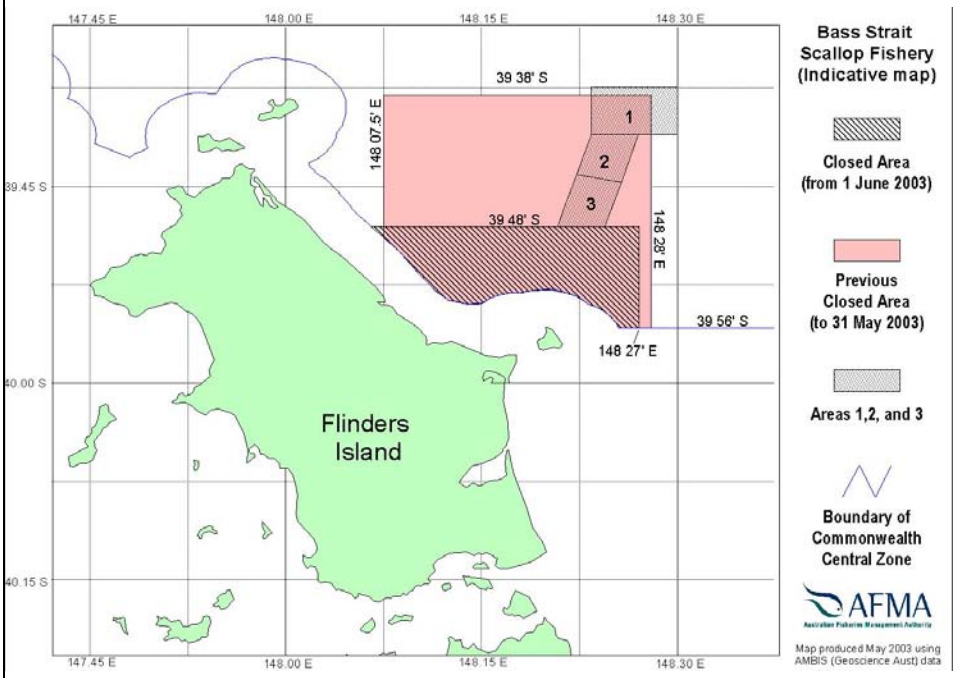
In May 2001 the AFMA Board approved Decision Rules developed by ScallopMAC. These required that a bed in the east of the fishery and a bed in the west of the fishery be closed to fishing each season to increase the probability of recovery of the broader population to support a sustainable fishery (2002a).

Closed area - the decision rules state that an area must be closed and that it must have an equivalent spawning biomass to that in Area X in 2000 (500-800 tonnes). The boundaries of the closed area are flexible every year depending on the MAC decision. In essence the management is spatial but it is a dynamic process to select the area closed because of the nature of scallops. Other fisheries are still allowed to fish in scallop closed areas, they are not completely closed to fishing (Liz Cotterell, May 18, 2004).

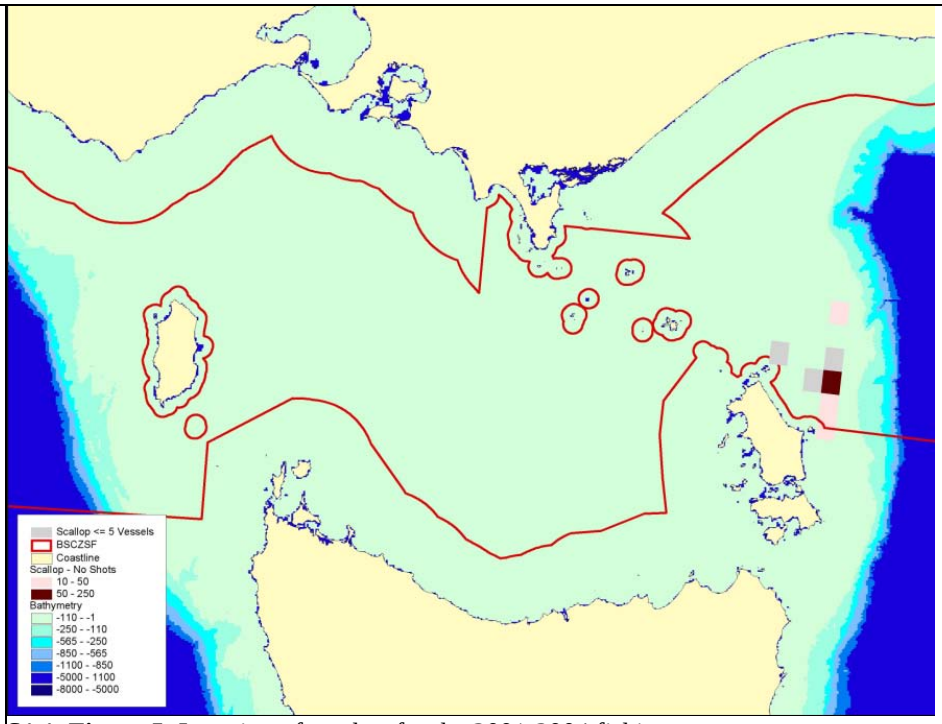
In order to manage annual area closures the fishery is split into east and west zones at 146°00'00". In 2003, scallop fishing is only occurring in the eastern zone, and so only a single fishery closed area is shown on **Figure 3** and in detail on **Figure 4**.

Two other types of closed areas are also of relevance to the BSS.

- Permanent closed areas have been agreed to as part of the conditions of approval as a Wildlife Trade Operation (see **Habitat Issues**, below) to protect habitats within the area of the scallop fishery.
- A number of marine protected areas within the general fishing area also exist, and exclude dredge fishing (see **Other Issues**, below).



S1.1 Figure 4. Fine scale map of the eastern fishing grounds. Closed areas for the 2003 season, the pre-2003 season, and the zones 1, 2, 3 (zones refer to scientific sampling regions; see **Technical Measures**).



S1.1. Figure 5: Location of catches for the 2001-2004 fishing season.

Fishing season	*What time of year does fishing in each sub-fishery occur?* The fishery is open in winter and spring. The summer closure is intended to protect juvenile scallops from incidental fishing mortality and minimise the potential for operators to land scallops in poor condition (AFMA 2002a). The season dates are set under Regulation as 1 May to 20 December, each year. Due to overfishing, known scallop beds in the fishery have been closed several times to allow stocks to rebuild. Parts of the closed beds in the fishery have been opened briefly at different times to allow for industry or research surveys of stocks to take place. Some key dates are: • Fishery closed from June 1990 until July 1991; • Fishery closed for the winter season in 1999 through winter 2000 • Fishery was opened on 28 August 2000 for a three-month industry (experimental) survey. No catch was reported and the fishery was closed; • September 2001 – industry survey in the east of the fishery found areas of undersized scallops but no adult beds. The fishery remained closed. • June 2003 – fishery opened on 1 June (AFMA 2002a; AFMA 2001a)
Target species and stock status	*Species targeted and where known stock status.* Commercial scallops (*Pecten fumatus*) Overfished – the abundance of commercial-sized scallops remains low. The only known aggregation of scallops in the fishery is east of Flinders Island, and was closed to fishing in 2001 and 2002. Surveys of the closed area in 2000-2003 showed an increase in both the number and distribution of scallops. Because there has been some recruitment to the closed bed, AFMA allowed fishing to resume in part of the area in 2003 and 2004. However, there has been little fishing elsewhere in the fishery. The fishery was closed in 2006. *www.afma.gov.au (June 19, 2006)*
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.* None

Current entitlements

The number of current entitlements in the fishery. Note latent entitlements. Licences/permits/boats and number active.

From 1 January 2005, there were 103 Statutory Fishing Right (SFR) holders in the fishery. Each SFR holder was allocated one boat SFR and 3,500 quota SFRs for every permit held on the snapshot date. There are a total of 152 Boat SFRs (which cease to exist on 1/7/2007, after which a quota SFR will be introduced), 532,000 commercial scallop quota SFRs and 532,000 doughboy scallop quota SFRs. (www.afma.gov.au, accessed June 19, 2006).

In 1998, the last year the fishery was open, there were a total of 155 permits, of which 116 were active, 39 were inactive and 47 boats were reported to have fished. (For an explanation of why the number of boats is less than the number of active fishing permits see pp 22 para 2 of AFMA 2002a, but in general it is because some boats hold multiple permits).

S1.1 Table 2: Numbers of active and inactive permits and numbers of boats reported to have fished in the Bass Strait Central Zone Scallop Fishery, 1993-1998.

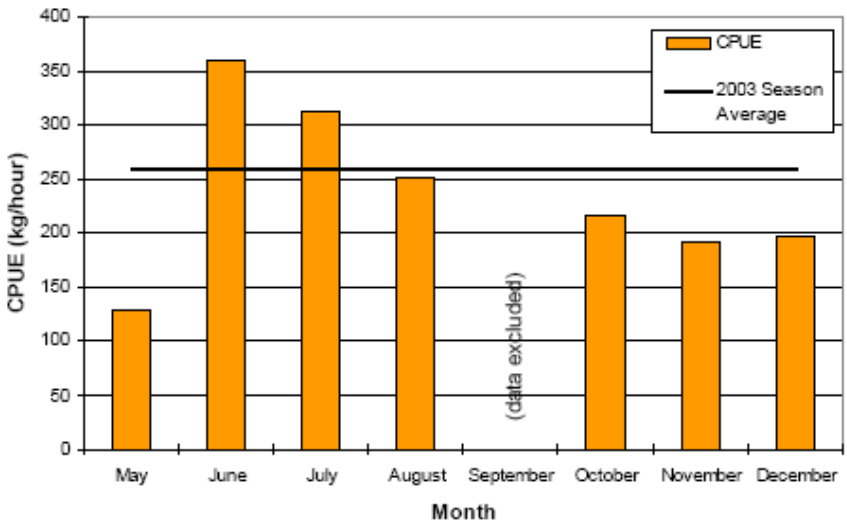
Season	Active permits	Inactive permits	Boats fishing
1993	39	116	67
1994	73	82	99
1995	103	52	114
1996	86	69	92
1997	128	27	79
1998	116	39	47

Eligibility for statutory fishing rights under the management plan is based on the operator

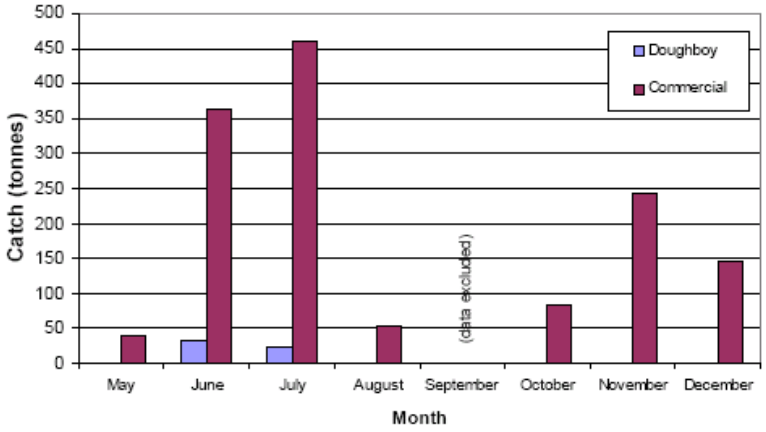
Current and recent TACs, quota trends by method

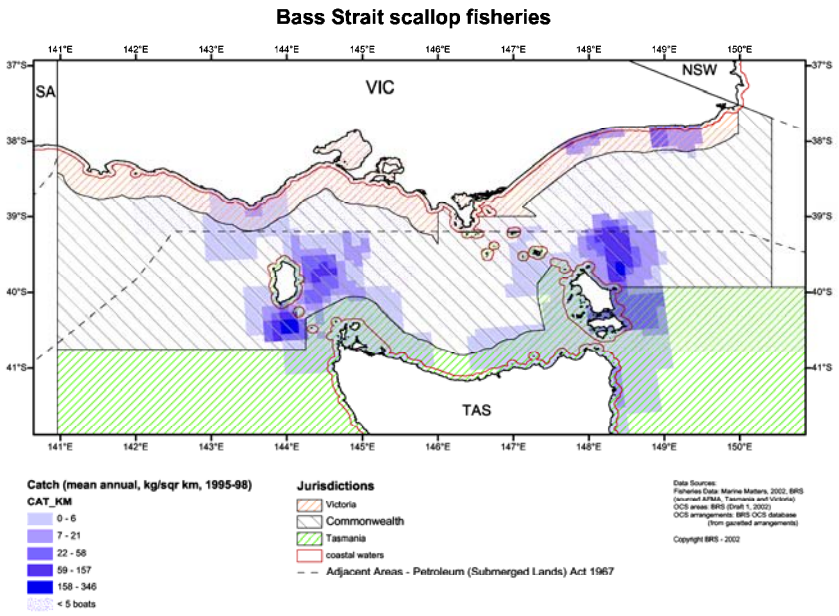
The most recent catch quota levels in the fishery by fishing method (sub-fishery). Summary of the recent quota levels in the fishery by fishing method (sub-fishery).In table form

AFMA provides an end of season wrap up of catch and effort. See also figures in section Current Catches by Method (**S1.1. Figure 5a, b)**.

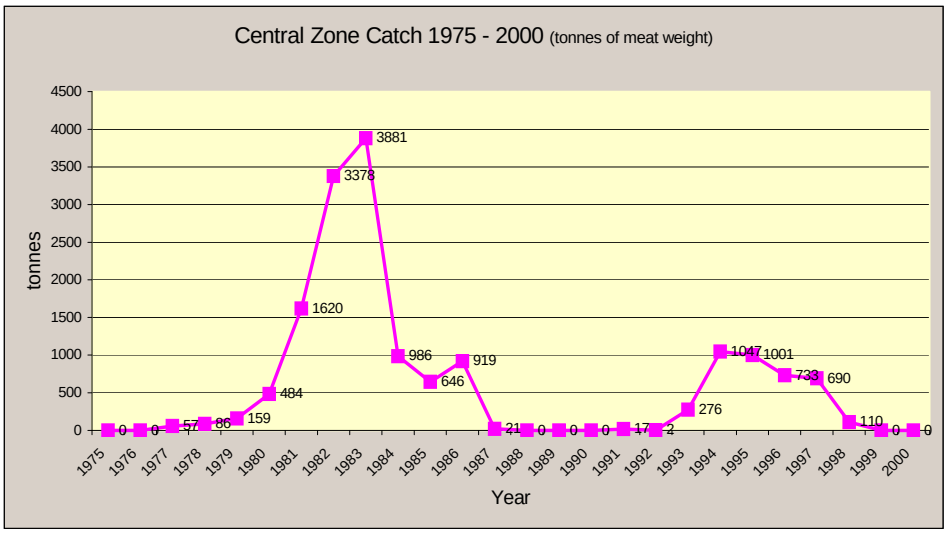


Bass Strait Central Zone CPUE data for 2003 (Liz Cotterell, May 24, 2004).

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* The fishery is currently closed (2006). Historically, other than listing the active and inactive concessions in the fishery there seem to be no estimates of effort in the fishery. The strategic assessment report mentions the number of different ways that data has been collected over the years making it difficult to detect any trends.
Current and recent fishery catch trends by method	*The most recent estimate of catch levels in the fishery by fishing method (sub-fishery) (total and/or by target species). Summary of the recent catch trends in the fishery by fishing method (sub-fishery). In table form* All catch is using a single method, the scallop dredge. See also comments in "Current Effort" section above for why catch data not available at this time. Total catch for 2003 was 1,419,473kg. (Liz Cotterell, May 18, 2004).  **Bass Strait Central Zone catch data for 2003 (Liz Cotterell, May 24, 2004).** Over the period 1995-1998, the combined State and Commonwealth catch was taken from a small fraction of the total fishery ground (**Figure S1.15a**). The Commonwealth catch is concentrated in a small region; for the 2003/04 season effort was concentrated around the eastern side of Flinders Island (**Figure S1.15b**).



S1.1. Figure 5a. Fishing effort for the state and commonwealth scallop fisheries for the period 1995-1998.



S1.1 Figure 6: Bass Strait Central Zone Scallop Fishery catches 1975 to 2000 (AFMA 2001a).

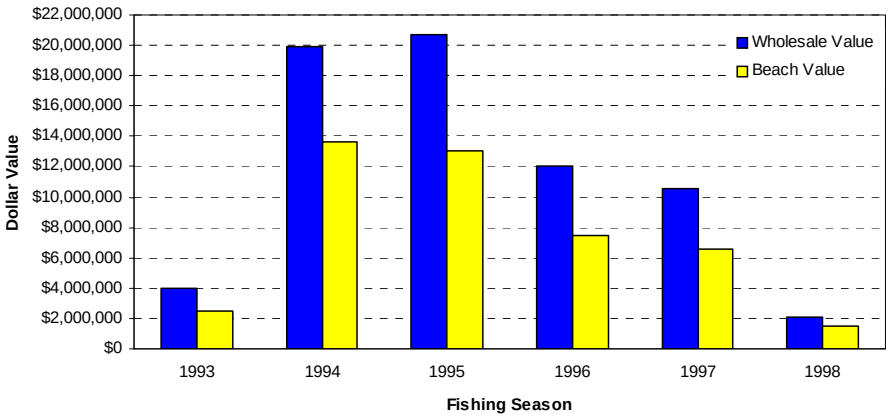
Major new scallop grounds were discovered in eastern Bass Strait in the late 1970s leading to high catch rates (and a rapid increase in the number of boats) culminating in a peak catch of 3,881 tonnes meat weight (approximately 24,400 tonnes shell weight) in 1983. This led to large investment in the industry with a rapid increase in the number of boats. As can be seen from **S1.1 Figure 6** catches fell sharply and all major scallop beds were fished out by 1987. The fishery was closed in 1990 after surveys indicated the stock was severely depleted. Little fishing took place when the fishery reopened in 1991. New beds that matured in the mid-1990s were rapidly fished out due to the large number of vessels authorised to operate in the fishery. Catches peaked in 1994 with a catch of only 1,047 tonnes meat weight (approximately 9,700 tonnes shell weight).

Current and recent value of fishery ($)	*Note current and recent value trends by sub-fishery. In table form* 2003-04 1,112.9 tonnes caught; valued at $1.475 million

Bass Strait Central Zone Scallop Data Summary 2003

The GVP for the 2002/03 scallop fishery was $694,300 (DAFF determined values October 2003). Values and catches in the fishery are often biased by the timing of the fishing season and the end of the financial year. This can be an issue for the most recent data, showing apparent poor catches and/or value.

The value of the fishery has ranged from $2 million to $21 million wholesale value between 1993 and 1998. **S1.1 Figure 7** displays both wholesale value (price received by processors when selling to the market) and beach value (price received by fishers from the processors when the catch is landed).



S1.1 Figure 7: Value of the Fishery from 1993 to 1998 (AFMA 2001a).

The scallop fishery has contributed substantially to the total Commonwealth fisheries production in the past. For example, in the financial years 1995/96 and 1996/97 the gross value of production was estimated by ABARE to be $14 million. This equates to 4.5% of the total value of Commonwealth fisheries production in these years. (AFMA 2001a, AFMA 2002a).

Relationship with other fisheries

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

Commonwealth fisheries that occur in the same region as the Bass Strait Central Zone Scallop Fishery include the South East Trawl Fishery, South East Non-Trawl Fishery, Southern Shark Fishery, Southern Squid Jig Fishery and to a lesser extent the Eastern Tuna and Billfish Fishery (S1.Table 1)

S1.Table 1. Characteristics of Commonwealth fisheries in the region of the BSCZSF.

Fishery	Main target species	Are scallops taken in this fishery?	Fishing methods
South East Trawl Fishery	More than 100 commercial species are taken but 17 species are the major catch Blue warehou, flathead, jackass morwong, ocean perch, john dory etc.	ISMP scientists report a very low bycatch of scallops in observed demersal trawls.	Danish seines, demersal trawling.
Gillnet, Hook and Trap Fishery	Blue eye, blue warehou, ling	Likely small amounts in nets	Dropline, gillnet, demersal longline,

	(formerly Southern Shark and South East Non-trawl Fisheries)	School shark and gummy shark	which touch the seabed such as gillnets and seines	automatic longline, traps
	Southern Squid Jig Fishery	Arrow squid	No	Squid jigs
	Eastern Tuna and Billfish Fishery	Broadbill swordfish, yellowfin tuna, bigeye tuna, skipjack tuna.	No	Longline, other line, purse seine nets
	Neighboring scallop fisheries	Commercial scallop	Yes	Dredge

State managed commercial fisheries that may operate in the Bass Strait region include the Tasmanian Rock Lobster Fishery and the Tasmanian Octopus Fishery. There is no interaction between Bass Strait Central Zone Scallop fishers and Tasmanian Rock Lobster fishers as the two target species live in different habitats. The Tasmanian Octopus Fishery may operate in the same regions as the scallop fishers, however, there are currently only two commercial operators fishing for octopus (using octopus pots) in Bass Strait. (AFMA 2001a). Again, interaction between the two fisheries is unlikely because of the differences in habitat requirements of the target species.

When the scallop grounds are closed to scallop dredging, other fisheries can still use the area, and deploy bottom gear for other fisheries. The extent of coverage by other fisheries on the scallop grounds is unknown.

Gear

Fishing gear and methods

Description of the methods and gear in the fishery, average number days at sea per trip.

The only fishing method used in the fishery is a single towed scallop harvester (dredge) that is towed along the benthos. The runners supporting the box are approximately 100 mm wide. This rigid box-shaped device is covered in 70-45mm weldmesh and has a mouth approximately 45cm in height and is typically 3 – 4 metres wide. Set in front of the mouth is the primary catching mechanism, a toothbar or scraper bar that is about 65mm wide (AFMA 2002a; AFMA 2001a). This bar penetrates up to 50 mm into the sediments, and the teeth are 60-70 mm apart (pers. comm.., Geoff Richey, scallop fisher).

Dredge weight
McLoughlin R. J. *et al*. (1991). *The Australian scallop dredge: estimates of catching efficiency and associated indirect fishing mortality. Fisheries Research 11, 1-24* gives the weight of the scallop dredge they used as approx. 500kg out of water.
Young, P.C. and Martin, R.B. (1989). *The scallop fisheries of Australia and their management. Reviews in aquatic sciences 1, 615:638* write: 'Mud dredges are now used in all Pecten fisheries in south-eastern Australia. Present regulations limit the maximum dredge width to 3.36 m. A mud dredge of this size weighs around 270 kg '. They support this statement with a reference to Hughes, W.D. (1972) Scallop Dredging Gear and Methods. Aust Fish 31(7), 12.

The dredge rests on a metal frame at the stern of the vessel with its mouth facing downwards towards a sorting tray. A cable runs from two towing points at the front of the dredge to a winch. Shooting, hauling and tipping the contents of the dredge on to the sorting tray are all controlled by one person operating the winch. (AFMA 2002a). Although the length and speed of tow varies considerably, most operators tow the harvester for approximately 10 minutes at a speed of 3 – 4 knots (AFMA 2001a). Longer tows result in dredge loads which can crush some of the scallops; for this reason the tows are kept short.

Fishing gear restrictions

Any restrictions on gear

	Depth of teeth may be limited, as described above.
Selectivity of gear and fishing methods	*Description of the selectivity of the sub-fishery methods* Scallops congregate in discrete beds in or on sediments ranging from mud to coarse sand (Yearsley *et al* 1999). As scallop harvesting is targeted at these discrete beds the proportion of non-target species in the catch is likely to be low when the density of scallops is high. Operators prefer to target high-density beds because catch rates are high and less effort is required to sort scallops from non-target species. The proportion of non-target species in the catch is likely to increase when areas of low scallop density are being fished (2002a).
Spatial gear zone set	*Description where gear set i.e. continental shelf, shelf break, continental slope (range nautical miles from shore)* The gear is deployed in zoned commercial beds which occur on the inner shelf (25-100m). Scallops occurring in waters shallower than 25 m are considered to be in state waters. Theoretically, the dredge could be deployed in shallower water; however, scallop beds are not common in shallower waters and the Commonwealth zone is outside the state zone, further limiting the minimum depth.
Depth range gear set	*Depth range gear set at in metres* The gear is typically deployed in a depth range of 30-100m, where the best scallop beds occur.
How gear set	*Description how set, pelagic in water column, benthic set (weighted) on seabed*
Area of gear impact per set or shot	*Description of area impacted by gear per set (square metres)* The width of the dredge is 100 mm runners, supporting a wire box approximately 3-4 meters wide. A scraper bar and teeth penetrate up to 50 mm into the sediment as the dredge is towed.
Capacity of gear	*Description number hooks per set, net size weight per trawl shot* Described above
Effort per annum all boats	*Description effort per annum of all boats in fishery by shots or sets and hooks, d for all boats* Not available from AFMA
Lost gear and ghost fishing	*Description of how gear is lost, whether lost gear is retrieved, and what happens to gear that is not retrieved, and impacts of ghost fishing* Dredge loss is rare, and can be recovered by fishers. Gear that is not recovered will not ghost fish, as the mouth of the dredge is open.
Issues	
Target species issues	*List any issues, including biological information such as spawning season and spawning location, major uncertainties about biology* Commercial scallops are found along the southern and eastern coastline of Australia. *P. fumatus* is a functional hermaphrodite which normally reaches sexual maturity in two years. In Victorian, Tasmanian and Bass Strait waters it normally spawns from June to December with spat settling up to one month later in spring and early summer. Although there is considerable variability in growth *P. fumatus* typically reaches 30-40mm in length in its first year and 70-80mm in length in 2 years (AFMA 2002a). Damaged scallops – scallops may be damaged during harvesting or by interacting with the dredge on the sea floor. As boats continue to fish the same grounds the percentage of damaged and dead shells increases during the season (AFMA 2001b). There is evidence that scallops that suffer incidental damage and are not retained by fishing gear, or are returned to the water, suffer significant mortalities (McLoughlin *et al*, 1991). Although this ERA applies only to the Commonwealth portion (central zone) of the

	scallop fishery, the complexity of managing a single biological stock that straddles three jurisdictions is a major issue. For example the advice of the Scallop Fishery Advisory Group on the status of the stock is compromised because the central zone of the fishery is treated as a separate entity for stock assessment and management purposes. Key issues for the fishery are: • Clarification of the relationship between the spawner population levels and subsequent recruitment; • Spatial dispersal of recruits; and • Natural mortality rates.
Byproduct and bycatch issues and interactions	*List any issues, as for the target species above* Prior to 2000 logbooks for the fishery did not require bycatch to be recorded. Consequently, 2003 will be the first fishing year for which there will be logbook records for bycatch. Logbook records and anecdotal evidence from operators as well as observer data indicates that bycatch levels in the fishery are very low. The only species that could be considered by-product are doughboy scallops. These will be managed under the plan using a TAC. The majority of information regarding bycatch comes from fishery independent surveys conducted by the Tasmanian Aquaculture and Fisheries Institute in 2001 and 2002. The list of bycatch species listed in **Scoping Document S1.2** was compiled from catch compositions undertaken during those surveys. These surveys were conducted in a stratified random design, and covered a greater range of habitats that is likely in the fishery. The dredge was also lined with a fine mesh to retain sampled organisms. As a result, the list of captured species here may contain more species than are encountered in commercial fishing operations.
TEP issues and interactions	*List any issues. This section should consider all TEP species groups: marine mammals, chondrichthyans (sharks, rays etc.), marine reptiles, seabirds, teleosts (bony fishes), include any key spawning/breeding/aggregation locations that might overlap with the fishery/sub-fishery.* There are no recorded interactions with any threatened, endangered or protected species. Note again that some logbook data has only been collected beginning 2003 season. TEP interactions on logbooks – At this stage, no interactions are recorded on logbooks, although it would be easy enough to add a line to the logbooks about TEP interactions, however there will not be another logbook reprint needed until about 2006 (Liz Cotterell, 18 May 2004). **Recording of TEP interactions should be addressed if the fishery is reopened.** Comparison with the state fishery data may also yield insight into TEP interactions, if any. Recent scientific surveys have captured sygnathids, but have not been on the fishing grounds. A list of species was extracted from the Environment Australia (DEH) based on the geographic coverage of the fishery (east and western Bass Strait, as in **Figure 3**), and appropriate species selected from this list for inclusion.
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* Discussion with stakeholders identified that agreements for the protection of habitat have been reached as part of the Wildlife Trade Operation conditions. http://www.deh.gov.au/coasts/fisheries/assessment/commonwealth/bass-strait/wto.html The wording of WTO Condition #5 is: A structured approach, including stakeholder consultation, will be implemented to identify areas to be closed within the fishery to ensure benthic impacts of the fishery on the environment are managed in a precautionary manner. The areas will be identified and closed by 30 June 2005 and will include:

	• 'Unfishable' areas will be broadly identified and closed; • Sufficient areas of representative habitats and ecological communities in areas of the fishery where fishing can occur using existing technology, but where fishing does not occur because there are no commercial scallop beds in those areas will be broadly identified and protected from present and future fishing pressure; and Sufficient areas of representative habitats and ecological communities in areas of the fishery that are currently fished for scallops will be broadly identified and protected from present and future fishing pressure.
Community issues and interactions	*List any issues for any of the community units identified in **Scoping Document S1.2**.* No threatened communities identified by Environment Australia as occurring within the fishery area. The same Wildlife Trade Operation measures outlined for the Habitat issues section also apply to the protection of benthic communities. http://www.deh.gov.au/coasts/fisheries/assessment/commonwealth/bass-strait/wto.html
Discarding	*Summary of discarding practices by sub-fishery, including bycatch, juveniles of target species, high-grading, processing at sea.* Any non-target species caught are likely to be discarded. Some fish, such as flathead, may occasionally be retained by the crew for their use. Undersized target species should be discarded at sea. Management arrangements required if the catch composition contains more that 20% undersized target species, the bed is avoided. Market forces determine the size of scallops caught. The 20% undersize rule is not assessed during the season: only prior to the start of the season to determine which beds are open (Liz Cotterell May 18, 2004). Dispersed discarding occurs- vessels travel at about 4kts in waters of about 30m depth. Most of the bycatch goes over the side immediately (alive), and over the same area it came from (Liz Cotterell May 18, 2004). Processing at sea does not occur.
Management: planned and those implemented	
Management Objectives	*The management objectives from the most recent management plan* AFMA has produced a guide to the 2005 management arrangements (PDF 584kb) for the fishery, which was distributed to all SFR holders in December 2004. The objectives of this Management 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 non-quota species and the long-term sustainability of the marine environment; (c) to maximise economic efficiency in the exploitation of resources within the fishery; (d) to ensure AFMA's accountability to the fishing industry and to the Australian community in the management of 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, through proper conservation and management, that the living resources of the AFZ are not endangered by over-exploitation; (g) To achieve the best use of the living resources of the AFZ.
Fishery management	*Is there a fisheries management plan is it in the planning stage or implemented what are the key features*

plan	There is a draft management plan
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.* Input controls: summer closure to allow spat fall and growth, area closures, and minimum size limits to allow two major spawnings before landing. 1. Limited entry. Entry to the fishery is limited to the number of permits held on 1 March 2001. Under the management plan each permit is being replaced by one boat statutory fishing right (allowing access to the fishery) and 3500 quota statutory fishing rights (allowing access to the stock). Prior to 1 February 2007, limited entry will be enforced using the boat SFRs. It is expected that a market will develop for the tradable rights in this fishery, adjusting the number of rights holders in the fishery. Consequently, after 1 February 2007, access to the fishery and fishable stock will be based solely on the holdings of quota SFRs (AFMA 2002a). *2.* Scallops may be taken by trawling or dredging. (Trawling is a historical concession, and is being removed from current management plans).
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.* Output controls: a total allowable catch and a system of individual transferable quota (ITQ) Statutory Fishing Rights under the Management Plan. Under the management plan, and in the absence of fishery-independent stock assessments, AFMA will determine a TAC of 1000 tonnes (maximum) for commercial scallops and 100 tonnes (maximum) for doughboy scallops. These low TACs have been pre-set to provide an incentive to operators to search and fish for scallops while ensuring that any beds that are found are not over-exploited before they can be assessed as suitable for fishing. Once the beds have been assessed and found to be suitable AFMA will increase the TAC by 1350 tonnes on the first day of each month in July, August and September. The regulations set out these dates for TAC increases so that operators can plan for their businesses accordingly. AFMA will monitor the catches of scallops against the TAC, and if, 2 weeks before the TAC is increased, if over 70% of the TAC has been taken, then AFMA may increase the TAC by more than 1350 tonnes. (AFMA 2002a).
Technical measures	*Summary of any technical measures in the fishery, e.g. size limits, bans on females, closed areas or seasons. Gear mesh size, mitigation measures such as TEDs. Primarily focused on target species as other species are addressed below.* 1. Size limit. Currently (2006) 90 mm shell length (widest diameter of the shell) for commercial scallops (there is no limit for doughboy scallops). In order to improve the probability of recruitment to the fishery AFMA set a “two spawning” objective in 1990. This objective recognises that scallop fecundity increases with age and that scallops allowed to undertake two major spawnings will contribute significantly to egg production. The current minimum size is 90 mm shell length. Major spawnings are generally defined as reproductive output from the upper part of the exponential relationship between spawner size and reproductive output. 2. Area closures – general rule. Each fishing season AFMA will close a bed of scallops to fishing in the east and the west of the fishery before allowing other beds in those areas to be fished. This measure is intended to maintain a minimum mature spawning stock. 3. Example of an area closure in 2003. The 2002 and 2003 Central Bass Strait Scallop

	Surveys had five sampling strata located just north of Flinders and Babel Islands. The strata stretch in a line from north (Strata 1) to south (Strata 5a & 5b) abutting the state boundary at 3nm. In the 2003 fishing season strata 1, 2 & 3 will be open for fishing which will enable the comparison of commercial catches with biomass estimates from the scientific survey (**Figure 4)**. Strata 4, 5a & 5b remain closed. An additional data sheet (SCA03) will be completed by operators recording catches in the opened survey strata areas. 4. Discarding. If more than 20% of the scallops in the catch (as determined at the start of the season from surveys) are below 90 mm (minimum size limit) then the area will be closed to fishing. This is to protect small size scallops and ensure they are able to spawn as well as contribute to the future yield of the bed. 5. Limited fishing season. The fishery is closed from the 21 December to 30 April. The purpose of the closure is to minimise the disturbance of newly settled spat as well as protect the stock at a time when condition is likely to be poor.
Regulations	*Regulations regarding species (bycatch and byproduct, TEP), habitat, and communities; Marpol and pollution; rules regarding activities at sea such as discarding offal and/or processing at sea.* Paragraph 22(2) (c) of the management plan requires that concession holders must "take reasonable precautions to ensure that the incidental catch of a species that the holder is not entitled to take is kept to a minimum." This obligation is intended to ensure concession holders implement actions outlined in the bycatch action plan (required by Section 9). Scallop fishers who are licensed to fish for scallops in Tasmania and/or Victoria as well as the Commonwealth Central Zone may only fish in one jurisdiction on a single trip. For example, a boat must return to port and offload the scallops taken in the Central Zone before fishing under a state entitlement. This is to maintain the integrity of the Commonwealth quota system. AFMA confirms that vessels are fishing in a single zone via VMS -compliance is shared with Tasmanian police, Victorian compliance is contracted to AFMA (Liz Cotterell, May 18, 2004). Relevant information about commercial and doughboy scallops must be entered into a Bass Strait, Tasmanian and Victorian Scallop Fishery Confidential Daily Log (SCA01) and the Bass Strait Scallop Catch Disposal Record (SCA02).
Initiatives and strategies	*BAPs; TEDs; industry codes of conduct, MPAs, Reserves* Industry-sponsored closures, as specified in previous sections
Enabling processes	*Monitoring (logbooks, observer data, scientific surveys); assessment (stock assessments); performance indicators (decision rules, processes, compliance; education; consultation process* Pre-season surveys to determine size distributions and areas of beds.
Other initiatives or agreements	*State, national or international conventions or agreements that impact on the management of the fishery/sub-fishery being evaluated.* There are currently no Commonwealth Marine Protected areas, however, the following Nature Reserves occur within the area of the fishery (some of these are on land that is included within the search area). Babel Island Muttonbird Reserve, TAS Christmas Island Nature Reserve, TAS Inner Sister Island Muttonbird Reserve, TAS Kentford Forest State Reserve, TAS Lavinia Nature Reserve, TAS New Year Island Game Reserve, TAS North East River Game Reserve, TAS Reekara Wildlife Sanctuary, TAS Seal Rocks State Reserve, TAS

	Sealers Creek Reference Area (Outside PA), VIC Sealers Creek Reference Area, VIC Unnamed (Lake Martha, Lavinia) Nature Reserve, TAS Unnamed Natural Features Reserve, VIC Wilsons Promontory Marine Park Schedule 4 Park Or Reserve, VIC Wilsons Promontory Marine Reserve Schedule 4 Park Or Reserve, VIC Wilsons Promontory National Park, VIC Wingaroo Nature Reserve, TAS <u>Closed Areas and spatial overlap with other fisheries</u> Closed areas are designed to protect scallop beds. Other fisheries, including other trawl fisheries, are not excluded from the closed area. There is anecdotal evidence of trawling practices targeting fish may "run-over" a scallop bed, wait to allow fish in to feed on damaged scallops and then trawl it again to catch the fish attracted over the damaged bed. It should be a priority to allow the protection agreed to by scallop fishers, to be observed by other fishers with gear that damages scallop beds.
Data	
Logbook data	*Verified logbook data; data summaries describe programme*
Observer data	*Observer programme describe parameters as below* Purpose: None Data collection: Experimental design Scope Coverage Experience Education Training Resources Data collation: Data communication: Data checking:
Other data	*Studies, surveys* Pre-season bed surveys contracted to TAFI have been undertaken since 2002. Malcolm Haddon and Jayson Semmens are contacts for data.

2.2.2 Unit of Analysis Lists (Step 2)

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

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

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

Target	By-product	By-catch	TEP	Habitats	Communities
1	1	140	137	28 benthic 4 pelagic	1 demersal 1 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: BSS

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

ERA species ID	Taxa name	Scientific name	CAAB code	Family name	Common name
1272	Invertebrate	Pecten fumatus	23270007	Pectinidae	scallop

Byproduct species: BSS

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

ERA species ID	Taxa name	Scientific name	CAAB code	Family name	Common name
1271	Invertebrate	Mimachlamys asperrima	23270006	Pectinidae	Doughboy Scallop

Bycatch species: BSS

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

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

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

Bycatch

ERA species ID	Taxa name	Scientific name	CAAB code	Family name	Common name	Source
1444	Algae	Carpoglossum confluens	54103002	Cystoseiraceae	Carpoglossum	Haddon and Semmens 2001, 2002
1442	Algae	Ecklonia radiata	54080001	Alariaceae	Common kelp	Haddon and Semmens 2001, 2002
1443	Algae	Phyllospora comosa	54102001	Seirococcaceae	[a brown alga]	Haddon and Semmens 2001, 2002
493	Chondrichthyan	Cephaloscyllium laticeps	37015001	Scyliorhinidae	Draughtboard Shark	Haddon and Semmens 2001, 2002: New list from Noel Coleman: 20050804
764	Chondrichthyan	Dasyatis brevicaudata	37035001	Dasyatidae	smooth stingray	New list from Noel Coleman: 20050804
760	Chondrichthyan	Dipturus lemprieri	37031007	Rajidae	thornback skate	Haddon and Semmens 2001, 2002
1065	Chondrichthyan	Dipturus whitleyi	37031006	Rajidae	whitley's (melbourne) skate	Haddon and Semmens 2001, 2002

ERA species ID	Taxa name	Scientific name	CAAB code	Family name	Common name	Source
260	Chondrichthyan	Heterodontus portusjacksoni	37007001	Heterodontidae	Port Jackson Shark	Species added from GENLOG species list 2001-2004
744	Chondrichthyan	Narcine tasmaniensis	37028002	Narcinidae	little numbfish	Haddon and Semmens 2001, 2002
1805	Chondrichthyan	Shark Egg case			Shark Egg case	New list from Noel Coleman: 20050804
1765	Chondrichthyan	Sharks - other	37990003	Multi-family group	Sharks (other)	Species added from GENLOG species list 2001-2004
775	Chondrichthyan	Trygonoptera testacea	37038006	Urolophidae	common stingaree	Haddon and Semmens 2001, 2002
687	Chondrichthyan	Trygonorrhina fasciata	37027002	Rhinobatidae	fiddler ray	Haddon and Semmens 2001, 2002
772	Chondrichthyan	Urolophus cruciatus	37038002	Urolophidae	banded stingaree	Haddon and Semmens 2001, 2002: New list from Noel Coleman: 20050804
774	Chondrichthyan	Urolophus paucimaculatus	37038004	Urolophidae	sparsely-spotted stingaree	Haddon and Semmens 2001, 2002: New list from Noel Coleman: 20050804
1351	Invertebrate	Actaea peronii peronii	28920001	Xanthidae	Stone crab	Haddon and Semmens 2001, 2002
1810	Invertebrate	Acuminia brazieri			Brazier's auger	New list from Noel Coleman: 20050804
2259	Invertebrate	Adeana cellulosa			lace coral : bryozoan	Species added from BSS Update worksheet provided by Jo Dowdney.
1329	Invertebrate	Alpheus spp.	28765901	Alpheidae	Snapping shrimp	Haddon and Semmens 2001, 2002
1307	Invertebrate	Amblypneustes ovum	25241005	Temnopleuridae	Temnopleurid urchin	Haddon and Semmens 2001, 2002
1297	Invertebrate	Amoria undulata	24207007	Volutidae	Wavy volute	Haddon and Semmens 2001, 2002: New list from Noel Coleman: 20050804
2007	Invertebrate	Aplysiidae - undifferentiated	24388000	Aplysiidae	sea hares	Haddon and Semmens 2001, 2002,Undifferentiated taxa, 20050831
1812	Invertebrate	Argobuccinum bassi			Bass Triton	New list from Noel Coleman: 20050804
1813	Invertebrate	Astele (Astele) subcarinatum	24047003		Umbilicated top shell	New list from Noel Coleman: 20050804
1807	Invertebrate	Astropecten pectinatus			Seastar	New list from Noel Coleman: 20050804
1269	Invertebrate	Atrina (Atrina) tasmanica	23245007	Pinnidae	Razor clam	Haddon and Semmens 2001, 2002: New list from Noel Coleman: 20050804
1814	Invertebrate	Austrosipho maxima			Large whelk	New list from Noel Coleman: 20050804
1823	Invertebrate	Balanus trigonus	27560004		Barnacle	New list from Noel Coleman: 20050804
1515	Invertebrate	Bassina (Callanaitis) disjecta	23380040	Veneridae	wedding-cake cockle	Haddon and Semmens 2001, 2002
1344	Invertebrate	Bellidilia undecimspinosa	28876003	Leucosiidae	Pebble Crab	Haddon and Semmens 2001, 2002
1299	Invertebrate	Bollonaster pectinatus	25111017	Astropectinidae	Astropectinid	Haddon and Semmens 2001, 2002
2026	Invertebrate	Brachyura - undifferentiated	28850000	infraorder Brachyura	crabs	Species added from GENLOG species list 2001-2004
1292	Invertebrate	Cabestana spengleri	24176003	Ranellidae	Triton	Haddon and Semmens 2001, 2002: New list from Noel Coleman: 20050804
1298	Invertebrate	Ceratosoma brevicaudatum	24432001	Chromodorididae	Nudibranch	Haddon and Semmens 2001, 2002
1294	Invertebrate	Charonia lampas rubicunda	24176014	Ranellidae	Triton	Haddon and Semmens 2001, 2002
1288	Invertebrate	Clanculus undatus	24046137	Trochidae	Top shell	Haddon and Semmens 2001, 2002

ERA species ID	Taxa name	Scientific name	CAAB code	Family name	Common name	Source
1518	Invertebrate	Conus anemone	24222010	Conidae	[a cone shell]	Haddon and Semmens 2001, 2002
1799	Invertebrate	Corbula stolata	23387001		Little basket shell (a cockle)	New list from Noel Coleman: 20050804
1302	Invertebrate	Coscinasterias muricata	25154011	Asteriidae	11-armed starfish	Haddon and Semmens 2001, 2002: New list from Noel Coleman: 20050804
1293	Invertebrate	Cymatium (Monoplex) parthenopeum	24176006	Ranellidae	Triton	Haddon and Semmens 2001, 2002
1290	Invertebrate	Cypraea (Notocypraea) comptoni	24155005	Cypraeidae	Cowrie	Haddon and Semmens 2001, 2002
1816	Invertebrate	Cypraea (Umbilia) hesitata	24155023		Umbilicated cowry	New list from Noel Coleman: 20050804
1275	Invertebrate	Dosinia caerulea	23380001	Veneridae	Venus shell	Haddon and Semmens 2001, 2002
1343	Invertebrate	Dromia wilsoni	28852004	Dromiidae	Sponge crab	Haddon and Semmens 2001, 2002
1516	Invertebrate	Ericusa sowerbyi	24207010	Volutidae	[a volute]	Haddon and Semmens 2001, 2002: New list from Noel Coleman: 20050804
1274	Invertebrate	Eucrassatella kingicola	23330004	Crassatellidae	Crassatella	Haddon and Semmens 2001, 2002: New list from Noel Coleman: 20050804
1296	Invertebrate	Fusinus (Fusinus) novaehollandiae	24202031	Buccinidae	New Holland spindle shell	Haddon and Semmens 2001, 2002: New list from Noel Coleman: 20050804
1815	Invertebrate	Gazameda gunni	24079004		Gunn's screw shell	New list from Noel Coleman: 20050804
1267	Invertebrate	Glycymeris (Glycymeris) striatularis	23231001	Glycymerididae	Dog cockle	Haddon and Semmens 2001, 2002: New list from Noel Coleman: 20050804
1268	Invertebrate	Glycymeris (Veletuceta) grayana	23231007	Glycymerididae	Dog cockle	Haddon and Semmens 2001, 2002
762	Invertebrate	Hapalochlaena maculosa	23659013	Octopodidae	southern blue ringed octopus	Haddon and Semmens 2001, 2002
1308	Invertebrate	Heliocidaris erythrogramma	25247001	Echinometridae	Common urchin	Haddon and Semmens 2001, 2002
1357	Invertebrate	Herdmania momus	35032008	Pyuridae	Sea squirt	Haddon and Semmens 2001, 2002: New list from Noel Coleman: 20050804
1520	Invertebrate	Holopneustes inflatus	25241010	Temnopleuridae	[a sea urchin]	Haddon and Semmens 2001, 2002
1339	Invertebrate	Ibacus alticrenatus	28821001	Scyllaridae	Deepwater bug; Wollongong bug	Haddon and Semmens 2001, 2002
1806	Invertebrate	Ibacus peronii	28821004	Scyllaridae	Balmain bug	New list from Noel Coleman: 20050804
1342	Invertebrate	Lamarckdromia globosa	28852002	Dromiidae	Sponge crab	Haddon and Semmens 2001, 2002
1523	Invertebrate	Leptomithrax gaimardii	28880010	Majidae	great spider crab	Haddon and Semmens 2001, 2002: New list from Noel Coleman: 20050804
1350	Invertebrate	Liocarcinus corrugatus	28911016	Portunidae	Swimming crab	Haddon and Semmens 2001, 2002
1808	Invertebrate	Luidia australiae	25105001		Black and white seastar	New list from Noel Coleman: 20050804
1265	Invertebrate	Magellania flavacens	19170001	Terebratellidae	Lamp shell	Haddon and Semmens 2001, 2002
1289	Invertebrate	Maoricolpus roseus	24079001	Turritellidae	Screw shell	Haddon and Semmens 2001, 2002

ERA species ID	Taxa name	Scientific name	CAAB code	Family name	Common name	Source
7	Invertebrate	Melicertus plebejus	28711052	Penaeidae	eastern king prawn	New list from Noel Coleman: 20050804
1801	Invertebrate	Myochama anomoides	23422002		False jingle shell	New list from Noel Coleman: 20050804
1266	Invertebrate	Myxicola infundibulum	22083025	Sabellidae	Fan worm	Haddon and Semmens 2001, 2002
1349	Invertebrate	Nectocarcinus tuberculosus	28911004	Portunidae	Red swimmer crab	Haddon and Semmens 2001, 2002
1300	Invertebrate	Nectria ocellata	25127039	Oreasteridae	Oreasterid	Haddon and Semmens 2001, 2002: New list from Noel Coleman: 20050804
1273	Invertebrate	Neotrigonia margaritacea	23280002	Trigoniidae	Brooch shell	Haddon and Semmens 2001, 2002: New list from Noel Coleman: 20050804
1345	Invertebrate	Notomithrax ursus	28880008	Majidae	Decorator crab	Haddon and Semmens 2001, 2002
11	Invertebrate	Nototodarus gouldi	23636004	Ommastrephidae	Arrow Squid	Species added from GENLOG species list 2001-2004
1285	Invertebrate	Octopus berrima	23659002	Octopodidae	Sand octopus	Haddon and Semmens 2001, 2002: New list from Noel Coleman: 20050804
1286	Invertebrate	Octopus pallidus	23659004	Octopodidae	Pale octopus	Haddon and Semmens 2001, 2002: New list from Noel Coleman: 20050804
1305	Invertebrate	Ophiarachnella ramsayi	25180013	Ophiodermatidae	Ophiodermatid	Haddon and Semmens 2001, 2002
1803	Invertebrate	Ophiocrossota multispina	25176016		Brittle star	New list from Noel Coleman: 20050804
1303	Invertebrate	Ophiomyxa australis	25166001	Ophiomyxidae	Ophiomyxid	Haddon and Semmens 2001, 2002: New list from Noel Coleman: 20050804
1304	Invertebrate	Ophionereis schayeri	25179009	Ophionereididae	Ophionereid	Haddon and Semmens 2001, 2002
1519	Invertebrate	Ophioplocus bispinosus	25176030	Ophiuridae	[a brittlestar]	Haddon and Semmens 2001, 2002
1306	Invertebrate	Ophiothrix (Ophiothrix) caespitosa	25192002	Ophiotrichidae	Ophiotrichid	Haddon and Semmens 2001, 2002
1804	Invertebrate	Ophiothrix sp.			Brittle star : ophiuroid brittlestar	New list from Noel Coleman: 20050804
2003	Invertebrate	Order Octopoda - undifferentiated	23650000	Order Octopoda	octopods	Species added from GENLOG species list 2001-2004
1270	Invertebrate	Ostrea (Eostrea) angasi	23257002	Ostreidae	Mud oyster	Haddon and Semmens 2001, 2002
1348	Invertebrate	Ovalipes australiensis	28911003	Portunidae	Sand crab	Haddon and Semmens 2001, 2002
1809	Invertebrate	Peronella peronii	25266009		Hat urchin	New list from Noel Coleman: 20050804
1353	Invertebrate	Pilumnus etheridgei	28926057	Pilumnidae	Hairy shore crab	Haddon and Semmens 2001, 2002: New list from Noel Coleman: 20050804
1276	Invertebrate	Placamen placidum	23380041	Veneridae	Venus shell	Haddon and Semmens 2001, 2002: New list from Noel Coleman: 20050804
1301	Invertebrate	Plectaster decanus	25143015	Echinasteridae	Echinasterid	Haddon and Semmens 2001, 2002
1295	Invertebrate	Pleuroploca australasia	24202005	Buccinidae	Tulip shell	Haddon and Semmens 2001, 2002: New list from Noel Coleman: 20050804
1819	Invertebrate	Polycitor giganteus	35018041		Colonial ascidian	New list from Noel Coleman: 20050804
1981	Invertebrate	Porifera - undifferentiated	10000000		sponges	Species added from GENLOG species list 2001-2004
1263	Invertebrate	Primnoella australasiae	11197001	Primnoidae	Sea whip	Haddon and Semmens 2001, 2002

ERA species ID	Taxa name	Scientific name	CAAB code	Family name	Common name	Source
1820	Invertebrate	Pyura sp.		Pyuridae	Stalked sea squirt : Pyura sp.	New list from Noel Coleman: 20050804
1358	Invertebrate	Pyura stolonifera	35032041	Pyuridae	Cunjevoi	Haddon and Semmens 2001, 2002: New list from Noel Coleman: 20050804
1264	Invertebrate	Sarcoptilus grandis	11219001	Pteroeididae	Sea pen	Haddon and Semmens 2001, 2002: New list from Noel Coleman: 20050804
2023	Invertebrate	Scyllaridae - undifferentiated	28821000	Scyllaridae	shovel-nosed/slipper lobsters	Species added from GENLOG species list 2001-2004
1817	Invertebrate	Semicassis pyrum			Pear helmet	New list from Noel Coleman: 20050804
1811	Invertebrate	Semicassis (Antephalium) semigranosum	24171027		Half-grained helmet	New list from Noel Coleman: 20050804
1291	Invertebrate	Semicassis (Semicassis) pyrum	24171004	Cassidae	Helmut shell	Haddon and Semmens 2001, 2002
1280	Invertebrate	Sepioteuthis australis	23617005	Loliginidae	Southern calamari	Haddon and Semmens 2001, 2002
1825	Invertebrate	Sponges various unidentified			Sponges various unidentified	New list from Noel Coleman: 20050804
1320	Invertebrate	Stichopus mollis	25417009	Stichopodidae	Stichopodid	Haddon and Semmens 2001, 2002
1522	Invertebrate	Stimdromia lateralis	28852010	Dromiidae	ridged sponge crab	Haddon and Semmens 2001, 2002
1818	Invertebrate	Stony coral			Stony coral	New list from Noel Coleman: 20050804
1341	Invertebrate	Strigopagurus strigimanus	28827002	Diogenidae	Hermit crab	Haddon and Semmens 2001, 2002: New list from Noel Coleman: 20050804
1277	Invertebrate	Tawera gallinula	23380042	Veneridae	Venus shell	Haddon and Semmens 2001, 2002
1278	Invertebrate	Tawera lagopus	23380062	Veneridae	Venus shell	Haddon and Semmens 2001, 2002
1800	Invertebrate	Tucetona flabellata	23231010		Fan-like dog cockle	New list from Noel Coleman: 20050804
1802	Invertebrate	Venericardia amabilis	23325015		False cockle	New list from Noel Coleman: 20050804
2263	Not Allocated	Membranipora perfragilis			bryozoan	New list from Noel Coleman: 20050808
2148	Not Allocated	Ostreidae & Pteriidae spp	23255901		oyster	Species added from GENLOG species list 2001-2004
2265	Not Allocated	Paguristes tuberculatus	28827087	Diogenidae	friendly hermit crab	ERA Stage 1
2266	Not Allocated	Penion maximus	24202026	Buccinidae	[a whelk]	ERA Stage 1
2267	Not Allocated	Pinnoctopus cordiformis (syn Octopus maorum)	23659003	Octopodidae	Maori octopus	ERA Stage 1
310	Teleost	Acanthaluteres spilomelanurus	37465043	Monacanthidae	Bridled leatherjacket	Haddon and Semmens 2001, 2002
311	Teleost	Acanthaluteres vittiger	37465002	Monacanthidae	Toothbrush leatherjacket	Haddon and Semmens 2001, 2002
122	Teleost	Acanthopegasus lancifer/Pegasus lancifer	37309003	Pegasidae	sea moth	Haddon and Semmens 2001, 2002: New list from Noel Coleman: 20050804
225	Teleost	Ammotretis lituratus	37461004	Pleuronectidae	spotted flounder	Haddon and Semmens 2001, 2002

ERA species ID	Taxa name	Scientific name	CAAB code	Family name	Common name	Source
241	Teleost	Aracana aurita	37466003	Ostraciidae	shaw's cowfish	Haddon and Semmens 2001, 2002
239	Teleost	Aracana ornata	37466001	Ostraciidae	ornate cowfish	Haddon and Semmens 2001, 2002
1821	Teleost	Arnoglossus muelleri	37460030	Bothidae	Mueller's flounder	New list from Noel Coleman: 20050804
2143	Teleost	Bothidae, Psettodidae & Pleuronectidae (all spp)	37990009	Multi-family group	flounder	Species added from GENLOG species list 2001-2004
124	Teleost	Caesioperca lepidoptera	37311002	Serranidae	butterfly perch	Haddon and Semmens 2001, 2002
125	Teleost	Caesioperca rasor	37311003	Serranidae	barber perch	Haddon and Semmens 2001, 2002
214	Teleost	Cyttus australis	37264002	Zeidae	Silver dory	Haddon and Semmens 2001, 2002
249	Teleost	Diodon nicthemerus	37469001	Diodontidae	globe fish	Haddon and Semmens 2001, 2002: New list from Noel Coleman: 20050804
309	Teleost	Dotalabrus aurantiacus	37384018	Labridae	Castlenau's wrasse	Haddon and Semmens 2001, 2002
1824	Teleost	Enigmapercis reducta	37393008	Percophidae	Broad sandfish	New list from Noel Coleman: 20050804
931	Teleost	Eocallionymus papilio	37427014	Callionymidae	painted stinkfish	Haddon and Semmens 2001, 2002
236	Teleost	Eubalichthys gunnii	37465034	Monacanthidae	velvet leatherjacket	Haddon and Semmens 2001, 2002
231	Teleost	Eubalichthys mosaicus	37465003	Monacanthidae	mosaic leatherjacket	Haddon and Semmens 2001, 2002
201	Teleost	Foetorepus calauropomus	37427001	Callionymidae	common stinkfish	Haddon and Semmens 2001, 2002: New list from Noel Coleman: 20050804
874	Teleost	Gonorynchus greyi	37141001	Gonorynchidae	sandfish	Haddon and Semmens 2001, 2002
99	Teleost	Gymnapistes marmoratus	37287018	Tetrarogidae	cobbler	New list from Noel Coleman: 20050807
941	Teleost	Helicolenus percoides	37287001	Sebastidae	Ocean Perch - inshore	Haddon and Semmens 2001, 2002
930	Teleost	Hypoplectrodes maccullochi	37311036	Serranidae	Half-banded sea perch	Haddon and Semmens 2001, 2002
194	Teleost	Kathetostoma laeve	37400003	Uranoscopidae	common stargazer	Haddon and Semmens 2001, 2002
110	Teleost	Lepidotrigla modesta	37288007	Triglidae	grooved gurnard	New list from Noel Coleman: 20050804
104	Teleost	Lepidotrigla papilio	37288002	Triglidae	spiny gurnard	Haddon and Semmens 2001, 2002: New list from Noel Coleman: 20050804
106	Teleost	Lepidotrigla vanessa	37288003	Triglidae	butterfly gurnard	Haddon and Semmens 2001, 2002: New list from Noel Coleman: 20050804
307	Teleost	Lophonectes gallus	37460001	Bothidae	Crested flounder	Haddon and Semmens 2001, 2002: New list from Noel Coleman: 20050804
235	Teleost	Meuschenia australis	37465008	Monacanthidae	brown-striped leatherjacket	Haddon and Semmens 2001, 2002
232	Teleost	Meuschenia scaber	37465005	Monacanthidae	velvet leatherjacket	Haddon and Semmens 2001, 2002
1012	Teleost	Nemadactylus macropterus	37377003	Cheilodactylidae	Jackass Morwong	Haddon and Semmens 2001, 2002
1037	Teleost	Neoplatycephalus richardsoni	37296001	Platycephalidae	Flathead	Species added from GENLOG species list 2001-2004
95	Teleost	Neosebastes scorpaenoides	37287005	Neosebastidae	ruddy gurnard perch	New list from Noel Coleman: 20050809

ERA species ID	Taxa name	Scientific name	CAAB code	Family name	Common name	Source
928	Teleost	Ophisurus serpens	37068001	Ophichthidae	Serpent eel	Haddon and Semmens 2001, 2002
156	Teleost	Parequula melbournensis	37349001	Gerreidae	silverbelly	Haddon and Semmens 2001, 2002: New list from Noel Coleman: 20050804
188	Teleost	Pseudolabrus mortonii	37384023	Labridae	rosy wrasse	ERA Stage 1
906	Teleost	Pseudophycis barbata	37224003	Moridae	bearded rock cod	Haddon and Semmens 2001, 2002
109	Teleost	Pterygotrigla polyommata	37288006	Triglidae	Latchet	Haddon and Semmens 2001, 2002
224	Teleost	Rhombosolea tapirina	37461003	Pleuronectidae	greenback flounder	Haddon and Semmens 2001, 2002
929	Teleost	Scolecenchelys australis	37068003	Ophichthidae	Short-finned worm eel	Haddon and Semmens 2001, 2002: New list from Noel Coleman: 20050804
97	Teleost	Scorpaena papillosa	37287008	Scorpaenidae	Red Rock Cod	Haddon and Semmens 2001, 2002
1822	Teleost	Sillago bassensis	37330002	Sillaginidae	School whiting	New list from Noel Coleman: 20050804
18	Teleost	Thamnaconus degeni	37465037	Monacanthidae	degen's leatherjacket	Haddon and Semmens 2001, 2002
26	Teleost	Zebrias fasciatus	37462010	Soleidae	many-banded sole	Haddon and Semmens 2001, 2002

TEP species: BSS

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.

TEP

ERA species ID	Taxa name	Scientific name	CAAB code	Family name	Common name	SOURCE
313	Chondrichthyan	Carcharias taurus	37008001	Odontaspididae	grey nurse shark	DEH website;TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
315	Chondrichthyan	Carcharodon carcharias	37010003	Lamnidae	white shark	DEH website;TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
1067	Chondrichthyan	Rhincodon typus	37014001	Rhincodontidae	whale shark	DEH website;TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
203	Marine bird	Anous stolidus	40128002	Laridae	Common noddy	TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
325	Marine bird	Catharacta skua	40128005	Laridae	Great Skua	DEH website;TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
595	Marine bird	Daption capense	40041003	Procellariidae	Cape Petrel	TEP Species added ERA Stage 2, Lists provided by Jo Dowdney. TEP database has detailed referencing
1428	Marine bird	Diomedea amsterdamensis	40040018	Diomedeidae	Amsterdam Albatross	DEH website;TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
628	Marine bird	Diomedea antipodensis	40040011	Diomedeidae	Antipodean Albatross	DEH website;TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
1429	Marine bird	Diomedea dabbenena	40040019	Diomedeidae	Tristan Albatross	DEH website;TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
753	Marine bird	Diomedea epomophora	40040005	Diomedeidae	Southern Royal Albatross	DEH website;TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
451	Marine bird	Diomedea exulans	40040006	Diomedeidae	Wandering Albatross	DEH website;TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
755	Marine bird	Diomedea gibsoni	40040010	Diomedeidae	Gibson's Albatross	DEH website;TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
799	Marine bird	Diomedea sanfordi	40040012	Diomedeidae	Northern Royal Albatross	DEH website;TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
898	Marine bird	Eudyptula minor	40001008	Spheniscidae	Little Penguin	DEH website;TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
917	Marine bird	Fregetta tropica	40042002	Hydrobatidae	Black-bellied Storm-Petrel	TEP Species added ERA Stage 2, Lists provided by Jo Dowdney. TEP database has detailed referencing
314	Marine bird	Fulmarus glacialoides	40041004	Procellariidae	Southern fulmar	TEP Species added ERA Stage 2, Lists provided by Jo Dowdney. TEP database has detailed referencing
555	Marine bird	Garrodia nereis	40042003	Hydrobatidae	Grey-backed storm petrel	TEP Species added ERA Stage 2, Lists provided by Jo Dowdney. TEP database has detailed referencing
1436	Marine bird	Haliaeetus leucogaster	40077001	Accipitridae	White-bellied Sea-Eagle	DEH website;TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
939	Marine bird	Halobaena caerulea	40041005	Procellariidae	Blue Petrel	DEH website;TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
974	Marine bird	Larus novaehollandiae	40128013	Laridae	Silver Gull	DEH website;TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
975	Marine bird	Larus pacificus	40128014	Laridae	Pacific Gull	DEH website;TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
73	Marine bird	Macronectes giganteus	40041007	Procellariidae	Southern Giant-Petrel	DEH website;TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
981	Marine bird	Macronectes halli	40041008	Procellariidae	Northern Giant-Petrel	DEH website;TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
1549	Marine bird	Morus capensis	40047001	Sulidae	Cape gannet	TEP Species added ERA Stage 2, Lists provided by Jo Dowdney. TEP database has detailed referencing
998	Marine bird	Morus serrator	40047002	Sulidae	Australasian Gannet	DEH website;TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.

ERA species ID	Taxa name	Scientific name	CAAB code	Family name	Common name	SOURCE
556	Marine bird	Oceanites oceanicus	40042004	Hydrobatidae	Wilson's storm petrel (subantarctic)	TEP Species added ERA Stage 2, Lists provided by Jo Dowdney. TEP database has detailed referencing
1003	Marine bird	Pachyptila turtur	40041013	Procellariidae	Fairy Prion	TEP Species added ERA Stage 2, Lists provided by Jo Dowdney. TEP database has detailed referencing
1006	Marine bird	Pelecanoides urinatrix	40041017	Procellariidae	Common Diving-Petrel	DEH website;TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
912	Marine bird	Phalacrocorax fuscescens	40048003	Phalacrocoracidae	Black faced cormorant	DEH website;TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
1008	Marine bird	Phoebetria fusca	40040008	Diomedeidae	Sooty Albatross	DEH website;TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
1009	Marine bird	Phoebetria palpebrata	40040009	Diomedeidae	Light-mantled Albatross	TEP Species added ERA Stage 2, Lists provided by Jo Dowdney. TEP database has detailed referencing
1041	Marine bird	Procellaria aequinoctialis	40041018	Procellariidae	White-chinned Petrel	TEP Species added ERA Stage 2, Lists provided by Jo Dowdney. TEP database has detailed referencing
504	Marine bird	Pterodroma lessoni	40041029	Procellariidae	White-headed petrel	TEP Species added ERA Stage 2, Lists provided by Jo Dowdney. TEP database has detailed referencing
1046	Marine bird	Pterodroma leucoptera	40041030	Procellariidae	Gould's Petrel	TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
1047	Marine bird	Pterodroma macroptera	40041031	Procellariidae	Great-winged Petrel	TEP Species added ERA Stage 2, Lists provided by Jo Dowdney. TEP database has detailed referencing
1048	Marine bird	Pterodroma mollis	40041032	Procellariidae	Soft-plumaged Petrel	DEH website;TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
1051	Marine bird	Pterodroma solandri	40041035	Procellariidae	Providence Petrel	TEP Species added ERA Stage 2, Lists provided by Jo Dowdney. TEP database has detailed referencing
1055	Marine bird	Puffinus carneipes	40041038	Procellariidae	Flesh-footed Shearwater	TEP Species added ERA Stage 2, Lists provided by Jo Dowdney. TEP database has detailed referencing
1056	Marine bird	Puffinus gavia	40041040	Procellariidae	Fluttering Shearwater	TEP Species added ERA Stage 2, Lists provided by Jo Dowdney. TEP database has detailed referencing
1057	Marine bird	Puffinus griseus	40041042	Procellariidae	Sooty Shearwater	TEP Species added ERA Stage 2, Lists provided by Jo Dowdney. TEP database has detailed referencing
1058	Marine bird	Puffinus huttoni	40041043	Procellariidae	Hutton's Shearwater	TEP Species added ERA Stage 2, Lists provided by Jo Dowdney. TEP database has detailed referencing
1060	Marine bird	Puffinus tenuirostris	40041047	Procellariidae	Short-tailed Shearwater	DEH website;TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
1014	Marine bird	Sterna albifrons	40128022	Laridae	Little tern	TEP Species added ERA Stage 2, Lists provided by Jo Dowdney. TEP database has detailed referencing
1017	Marine bird	Sterna bergii	40128025	Laridae	Crested Tern	DEH website;TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
1018	Marine bird	Sterna caspia	40128026	Laridae	Caspian Tern	TEP Species added ERA Stage 2, Lists provided by Jo Dowdney. TEP database has detailed referencing
1020	Marine bird	Sterna fuscata	40128028	Laridae	Sooty tern	TEP Species added ERA Stage 2, Lists provided by Jo Dowdney. TEP database has detailed referencing
1021	Marine bird	Sterna hirundo	40128029	Laridae	Common tern	TEP Species added ERA Stage 2, Lists provided by Jo Dowdney. TEP database has detailed referencing
1023	Marine bird	Sterna paradisaea	40128032	Laridae	Arctic tern	TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
1024	Marine bird	Sterna striata	40128033	Laridae	White-fronted Tern	TEP Species added ERA Stage 2, Lists provided by Jo Dowdney. TEP database has detailed referencing
1032	Marine bird	Thalassarche bulleri	40040001	Diomedeidae	Buller's Albatross	DEH website;TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
1031	Marine bird	Thalassarche carteri	40040014	Diomedeidae	Indian Yellow-nosed Albatross	TEP Species added ERA Stage 2, Lists provided by Jo Dowdney. TEP database has detailed referencing
1033	Marine bird	Thalassarche cauta	40040002	Diomedeidae	Shy Albatross	DEH website;TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.

ERA species ID	Taxa name	Scientific name	CAAB code	Family name	Common name	SOURCE
1034	Marine bird	Thalassarche chlororhynchos	40040003	Diomedeidae	Yellow-nosed Albatross, Atlantic Yellow-	DEH website;TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
1035	Marine bird	Thalassarche chrysostoma	40040004	Diomedeidae	Grey-headed Albatross	DEH website;TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
889	Marine bird	Thalassarche eremita	40040017	Diomedeidae	Chatham albatross	TEP Species added ERA Stage 2, Lists provided by Jo Dowdney. TEP database has detailed referencing
1084	Marine bird	Thalassarche impavida	40040013	Diomedeidae	Campbell Albatross	DEH website;TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
1085	Marine bird	Thalassarche melanophrys	40040007	Diomedeidae	Black-browed Albatross	DEH website;TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
1673	Marine bird	Thalassarche nov. sp.		Thalassarche	Pacific Albatross	TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
893	Marine bird	Thalassarche platei	40040015	Diomedeidae	Pacific albatross	TEP Species added ERA Stage 2, Lists provided by Jo Dowdney. TEP database has detailed referencing
894	Marine bird	Thalassarche salvini	40040016	Diomedeidae	Salvin's albatross	DEH website;TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
1086	Marine bird	Thalassarche steadi		Diomedeidae	White-capped Albatross	TEP Species added ERA Stage 2, Lists provided by Jo Dowdney. TEP database has detailed referencing
253	Marine mammal	Arctocephalus pusillus doriferus	41131003	Otariidae	Australian Fur Seal	DEH website;TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
263	Marine mammal	Arctocephalus tropicalis	41131004	Otariidae	Subantarctic fur seal	TEP Species added ERA Stage 2, Lists provided by Jo Dowdney. TEP database has detailed referencing
256	Marine mammal	Balaenoptera acutorostrata	41112001	Balaenopteridae	Minke Whale	DEH website;TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
1439	Marine mammal	Balaenoptera bonaerensis	41112007	Balaenidae	Antarctic Minke Whale	DEH website;TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
261	Marine mammal	Balaenoptera borealis	41112002	Balaenopteridae	Sei Whale	DEH website;TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
262	Marine mammal	Balaenoptera edeni	41112003	Balaenopteridae	Bryde's Whale	DEH website;TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
265	Marine mammal	Balaenoptera musculus	41112004	Balaenopteridae	Blue Whale	DEH website;TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
268	Marine mammal	Balaenoptera physalus	41112005	Balaenopteridae	Fin Whale	DEH website;TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
269	Marine mammal	Berardius arnuxii	41120001	Ziphiidae	Arnoux's Beaked Whale	DEH website;TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
289	Marine mammal	Caperea marginata	41110002	Balaenidae	Pygmy Right Whale	DEH website;TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
612	Marine mammal	Delphinus delphis	41116001	Delphinidae	Common Dolphin	DEH website;TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
896	Marine mammal	Eubalaena australis	41110001	Balaenidae	Southern Right Whale	DEH website;TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
934	Marine mammal	Globicephala macrorhynchus	41116003	Delphinidae	Short-finned Pilot Whale	DEH website;TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
935	Marine mammal	Globicephala melas	41116004	Delphinidae	Long-finned Pilot Whale	DEH website;TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
937	Marine mammal	Grampus griseus	41116005	Delphinidae	Risso's Dolphin	DEH website;TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
295	Marine mammal	Hydrurga leptonyx	41136001	Phocidae	Leopard seal	TEP Species added ERA Stage 2, Lists provided by Jo Dowdney. TEP database has detailed referencing

ERA species ID	Taxa name	Scientific name	CAAB code	Family name	Common name	SOURCE
959	Marine mammal	Hyperoodon planifrons	41120002	Ziphiidae	Southern Bottlenose Whale	DEH website;TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
968	Marine mammal	Kogia breviceps	41119001	Physeteridae	Pygmy Sperm Whale	DEH website;TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
969	Marine mammal	Kogia simus	41119002	Physeteridae	Dwarf Sperm Whale	DEH website;TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
970	Marine mammal	Lagenodelphis hosei	41116006	Delphinidae	Fraser's Dolphin	TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
971	Marine mammal	Lagenorhynchus obscurus	41116008	Delphinidae	Dusky Dolphin	DEH website;TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
61	Marine mammal	Lissodelphis peronii	41116009	Delphinidae	Southern Right Whale Dolphin	DEH website;TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
984	Marine mammal	Megaptera novaeangliae	41112006	Balaenopteridae	Humpback Whale	DEH website;TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
985	Marine mammal	Mesoplodon bowdoini	41120004	Ziphiidae	Andrew's Beaked Whale	DEH website;TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
986	Marine mammal	Mesoplodon densirostris	41120005	Ziphiidae	Blainville's Beaked Whale	DEH website;TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
987	Marine mammal	Mesoplodon gingkodens	41120006	Ziphiidae	Gingko Beaked Whale	TEP Species added ERA Stage 2, Lists provided by Jo Dowdney. TEP database has detailed referencing
988	Marine mammal	Mesoplodon grayi	41120007	Ziphiidae	Gray's Beaked Whale	DEH website;TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
989	Marine mammal	Mesoplodon hectori	41120008	Ziphiidae	Hector's Beaked Whale	DEH website;TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
990	Marine mammal	Mesoplodon layardii	41120009	Ziphiidae	Strap-toothed Beaked Whale	DEH website;TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
991	Marine mammal	Mesoplodon mirus	41120010	Ziphiidae	True's Beaked Whale	DEH website;TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
1002	Marine mammal	Orcinus orca	41116011	Delphinidae	Killer Whale	DEH website;TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
1036	Marine mammal	Physeter catodon	41119003	Physeteridae	Sperm Whale	DEH website;TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
1044	Marine mammal	Pseudorca crassidens	41116013	Delphinidae	False Killer Whale	DEH website;TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
1030	Marine mammal	Tasmacetus shepherdi	41120011	Ziphiidae	Tasman Beaked Whale	DEH website;TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
1494	Marine mammal	Tursiops aduncus	41116020	Delphinidae	Indian Ocean bottlenose dolphin	DEH website;TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
1091	Marine mammal	Tursiops truncatus	41116019	Delphinidae	Bottlenose Dolphin	DEH website;TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
1098	Marine mammal	Ziphius cavirostris	41120012	Ziphiidae	Cuvier's Beaked Whale	DEH website;TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
942	Teleost	Heraldia nocturna	37282071	Syngnathidae	Upside-down Pipefish	DEH website;TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
1548	Teleost	Heraldia sp. 1 [in Kuiter, 2000]	37282130	Syngnathidae	Western upsidedown pipefish	TEP Species added ERA Stage 2, Lists provided by Jo Dowdney. TEP database has detailed referencing
308	Teleost	Heteroclinus perspicillatus	37416013	Clinidae	Common weedfish	Haddon and Semmens 2001, 2002;TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
1664	Teleost	Hippocampus abdominalis	37282120	Syngnathidae	Big-bellied / southern potbellied seahorse	TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.

ERA species ID	Taxa name	Scientific name	CAAB code	Family name	Common name	SOURCE
946	Teleost	Hippocampus bleekeri	37282010	Syngnathidae	pot bellied seahorse	Haddon and Semmens 2001, 2002;TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
947	Teleost	Hippocampus breviceps	37282026	Syngnathidae	Short-head Seahorse, Short-snouted Seaho	DEH website;TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
950	Teleost	Hippocampus minotaur	37282105	Syngnathidae	Bullneck Seahorse	DEH website;TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
952	Teleost	Hippocampus whitei	37282027	Syngnathidae	white's seahorse	DEH website;TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
953	Teleost	Histiogamphelus briggsii	37282011	Syngnathidae	Briggs' Crested Pipefish, Briggs' Pipefish	DEH website;TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
954	Teleost	Histiogamphelus cristatus	37282081	Syngnathidae	Rhino Pipefish, Macleay's Crested Pipefish	DEH website;TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
961	Teleost	Hypselognathus rostratus	37282012	Syngnathidae	Knife-snouted Pipefish	DEH website;TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
966	Teleost	Kaupus costatus	37282014	Syngnathidae	Deep-bodied Pipefish	DEH website;TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
967	Teleost	Kimblaeus bassensis	37282083	Syngnathidae	Trawl Pipefish, Kimbla Pipefish	DEH website;TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
978	Teleost	Leptoichthys fistularius	37282013	Syngnathidae	Brushtail Pipefish	DEH website;TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
979	Teleost	Lissocampus caudalis	37282016	Syngnathidae	Australian Smooth Pipefish, Smooth Pipefish	DEH website;TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
980	Teleost	Lissocampus runa	37282009	Syngnathidae	Javelin Pipefish	DEH website;TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
983	Teleost	Maroubra perserrata	37282085	Syngnathidae	Sawtooth Pipefish	DEH website;TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
994	Teleost	Mitotichthys mollisoni	37282022	Syngnathidae	Mollison's Pipefish	DEH website;TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
995	Teleost	Mitotichthys semistriatus	37282015	Syngnathidae	Half-banded Pipefish	DEH website;TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
996	Teleost	Mitotichthys tuckeri	37282025	Syngnathidae	Tucker's Pipefish	DEH website;TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
1001	Teleost	Notiocampus ruber	37282095	Syngnathidae	Red Pipefish	DEH website;TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
1010	Teleost	Phycodurus eques	37282001	Syngnathidae	Leafy Seadragon	DEH website;TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
1011	Teleost	Phyllopteryx taeniolatus	37282002	Syngnathidae	Weedy Seadragon, Common Seadragon	DEH website;TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
1061	Teleost	Pugnaso curtirostris	37282021	Syngnathidae	Pug-nosed Pipefish	DEH website;TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
1072	Teleost	Solegnathus robustus	37282004	Syngnathidae	Robust Spiny Pipehorse, Robust Pipehorse	DEH website;TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
1073	Teleost	Solegnathus spinosissimus	37282029	Syngnathidae	spiny pipehorse	DEH website;TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
1026	Teleost	Stigmatopora argus	37282017	Syngnathidae	Spotted Pipefish	DEH website;TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.

ERA species ID	Taxa name	Scientific name	CAAB code	Family name	Common name	SOURCE
1027	Teleost	Stigmatopora nigra	37282018	Syngnathidae	Wide-bodied Pipefish, Black Pipefish	DEH website;TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
1028	Teleost	Stipecampus cristatus	37282019	Syngnathidae	Ring-backed Pipefish	DEH website;TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
1029	Teleost	Syngnathoides biaculeatus	37282100	Syngnathidae	Double-ended Pipehorse, Alligator Pipefish	DEH website;TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
1092	Teleost	Urocampus carinirostris	37282008	Syngnathidae	Hairy Pipefish	DEH website;TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
1093	Teleost	Vanacampus margaritifer	37282102	Syngnathidae	Mother-of-pearl Pipefish	DEH website;TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
1094	Teleost	Vanacampus phillipi	37282023	Syngnathidae	Port Phillip Pipefish	DEH website;TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.
1095	Teleost	Vanacampus poecilolaemus	37282024	Syngnathidae	Australian Long-snout Pipefish, Long-snouted Pipefish	DEH website;TEP Species added ERA Stage 2, Lists provided by Jo Dowdney.

Scoping Document S2B1. Benthic Habitats

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

Habitat data used for assessment of the Bass Strait scallop fishery were images taken during CSIRO surveys off Eastern Bass Strait between 1994 and 2005 in depths from ~20 to 100 m.

A list of the benthic habitats for the Bass Strait Central Zone Scallop Fishery. Shading denotes habitats occurring within the jurisdictional boundary of the sub-fishery that are not subject to effort from dredging.

ERAEF record No.	ERAEF Habitat Number	Sub-biome	Feature	Habitat type	SGF Score	Depth (m)	Image available	Reference image location
0122	012	inner shelf	shelf	fine sediments, unrippled, large sponges	101	25- 100	Y	BSS Image Collection
0906	094	inner shelf	shelf	fine sediments, unrippled, small sponges	102	25- 100	N	BSS Image Collection
0158	016	inner shelf	shelf	fine sediments, unrippled, mixed faunal community	103	25- 100	Y	BSS Image Collection
0894	093	inner shelf	shelf	fine sediments, unrippled, bioturbators	109	25- 100	N	BSS Image Collection
0146	014	inner shelf	shelf	fine sediments, wave rippled, large sponges	111	25- 100	Y	BSS Image Collection
0918	095	inner shelf	shelf	fine sediments, wave rippled, no fauna	120	25- 100	N	BSS Image Collection
0930	096	inner shelf	shelf	fine sediments, wave rippled, small sponges	122	25- 100	N	BSS Image Collection
0870	091	inner shelf	shelf	fine sediments, irregular, large sponges	131	25- 100	N	BSS Image Collection
0882	092	inner shelf	shelf	fine sediments, irregular, small sponges	132	25- 100	N	BSS Image Collection
0134	013	inner shelf	shelf	coarse sediments, unrippled, large sponges	201	25- 100	Y	BSS Image Collection
0097	010	inner shelf	shelf	coarse sediments, current rippled, no fauna	210	25- 100	Y	BSS Image Collection
0858	090	inner shelf	shelf	coarse sediments, current rippled, bioturbators	219	25- 100	N	BSS Image Collection
0109	011	inner shelf	shelf	coarse sediments, wave rippled, large sponges	221	25- 100	Y	BSS Image Collection
1991	191	inner shelf	shelf	coarse sediments, wave rippled, small sponges	222	25- 100	N	BSS Image Collection

ERAEF record No.	ERAEF Habitat Number	Sub-biome	Feature	Habitat type	SGF Score	Depth (m)	Image available	Reference image location
2080	200	inner shelf	shelf	coarse sediments, wave rippled, encrustors	226	25- 100	N	BSS Image Collection
0085	009	inner shelf	shelf	coarse sediments, wave rippled, sedentary	227	25- 100	Y	BSS Image Collection
0846	089	inner shelf	shelf	coarse sediments, irregular, encrustors	236	25- 100	N	BSS Image Collection
0061	006	inner shelf	shelf	coarse sediments, subcrop, large sponges	251	25- 100	Y	BSS Image Collection
0001	001	inner shelf	shelf	gravel, current rippled, mixed faunal community	313	25- 100	Y	BSS Image Collection
0955	098	inner shelf	shelf	gravel, wave rippled, no fauna	320	25- 100	Y	BSS Image Collection
0943	097	inner shelf	shelf	gravel, wave rippled, bioturbators	329	25- 100	Y	BSS Image Collection
0073	007	inner shelf	shelf	gravel, debris flow, mixed faunal community	343	25- 100	Y	BSS Image Collection
2067	199	inner shelf	shelf	cobble, wave rippled, low/ encrusting mixed fauna	426	25- 100	N	BSS Image Collection
0049	005	inner shelf	shelf	cobble, debris flow, large sponges	441	25- 100	Y	BSS Image Collection
0967	099	inner shelf	shelf	Igneous rock, high outcrop, large sponges	591	25- 100	N	BSS Image Collection
0037	004	inner shelf	shelf	Sedimentary rock, outcrop, large sponges	671	25- 100	Y	BSS Image Collection
0013	002	inner shelf	shelf	Sedimentary rock, outcrop, large sponges	691	25- 100	Y	BSS Image Collection
0025	003	inner shelf	shelf	Sedimentary rock, outcrop, mixed faunal community	693	25- 100	Y	BSS Image Collection
1835	173	outer shelf	shelf-break	mud, unrippled, no fauna	000	100- 200, 200- 700	N	BSS Image Collection
0979	100	outer shelf	shelf	mud, unrippled, sedentary	007	100- 200	Y	BSS Image Collection
1847	174	outer shelf	shelf-break	mud, unrippled, sedentary	007	100- 200, 200- 700	N	BSS Image Collection
1293	125	outer shelf	shelf	mud, subcrop, small sponges	052	100- 200	Y	BSS Image Collection
1129	112	outer shelf	shelf	fine sediments, unrippled, no fauna	100	100- 200	Y	BSS Image Collection
1799	170	outer shelf	shelf-break	fine sediments, unrippled, no fauna	100	100- 200, 200- 700	N	BSS Image Collection
1117	111	outer shelf	shelf	fine sediments, unrippled, large sponges	101	100- 200	Y	BSS Image Collection
1142	113	outer shelf	shelf	fine sediments, unrippled, small sponges	102	100- 200	Y	BSS Image Collection
1811	171	outer shelf	shelf-break	fine sediments, unrippled, octocorals	105	100- 200, 200- 700	N	BSS Image Collection
1104	110	outer shelf	shelf	fine sediments, unrippled, bioturbators	109	100- 200	Y	BSS Image Collection
1787	169	outer shelf	shelf-break	fine sediments, unrippled, bioturbators	109	100- 200, 200- 700	N	BSS Image Collection
1029	104	outer shelf	shelf	fine sediments, current rippled, bioturbators	119	100- 200	Y	BSS Image Collection
1192	117	outer shelf	shelf	fine sediments, wave rippled, no fauna	120	100- 200	N	BSS Image Collection
1180	116	outer shelf	shelf	fine sediments, wave rippled, large sponges	121	100- 200	N	BSS Image Collection
1217	119	outer shelf	shelf	fine sediments, wave rippled, small sponges	122	100- 200	N	BSS Image Collection
1168	115	outer shelf	shelf	fine sediments, wave rippled, encrustors	126	100- 200	N	BSS Image Collection

ERAEF record No.	ERAEF Habitat Number	Sub-biome	Feature	Habitat type	SGF Score	Depth (m)	Image available	Reference image location
1205	118	outer shelf	shelf	fine sediments, wave rippled, sedentary	127	100- 200	N	BSS Image Collection
1155	114	outer shelf	shelf	fine sediments, wave rippled, bioturbators	129	100- 200	Y	BSS Image Collection
1053	106	outer shelf	shelf	fine sediments, irregular, no fauna	130	100- 200	N	BSS Image Collection
1041	105	outer shelf	shelf	fine sediments, irregular, large sponges	131	100- 200	N	BSS Image Collection
1066	107	outer shelf	shelf	fine sediments, irregular, small sponges	132	100- 200	N	BSS Image Collection
1775	168	outer shelf	shelf-break	fine sediments, irregular, small sponges	132	100- 200, 200- 700	N	BSS Image Collection
1763	167	outer shelf	shelf-break	fine sediments, irregular, bioturbators	139	100- 200, 200- 700	N	BSS Image Collection
0170	017	outer shelf	shelf	fine sediments, subcrop, large sponges	151	100- 200	Y	BSS Image Collection
1091	109	outer shelf	shelf	fine sediments, subcrop, small sponges	152	100- 200	Y	BSS Image Collection
1079	108	outer shelf	shelf	fine sediments, subcrop, mixed faunal community	153	100- 200	N	BSS Image Collection
0318	030	outer shelf	shelf	coarse sediments, unrippled, mixed faunal community	203	100- 200	Y	BSS Image Collection
0269	026	outer shelf	shelf	coarse sediments, unrippled, encrustors	206	100- 200	Y	BSS Image Collection
0281	027	outer shelf	shelf	coarse sediments, current rippled, no fauna	210	100- 200	Y	BSS Image Collection
0256	025	outer shelf	shelf	coarse sediments, wave rippled, no fauna	220	100- 200	Y	BSS Image Collection
1017	103	outer shelf	shelf	coarse sediments, wave rippled, small sponges	222	100- 200	N	BSS Image Collection
1005	102	outer shelf	shelf	coarse sediments, wave rippled, encrustors	226	100- 200	N	BSS Image Collection
0306	029	outer shelf	shelf	coarse sediments, irregular, large sponges	231	100- 200	Y	BSS Image Collection
0195	019	outer shelf	shelf	coarse sediments, subcrop, large sponges	251	100- 200	Y	BSS Image Collection
0991	101	outer shelf	shelf	coarse sediments, subcrop, small sponges	252	100- 200	N	BSS Image Collection
1229	120	outer shelf	shelf	gravel, current rippled, bioturbators	319	100- 200	N	BSS Image Collection
1280	124	outer shelf	shelf	gravel, wave rippled, no fauna	320	100- 200	N	BSS Image Collection
1267	123	outer shelf	shelf	gravel, wave rippled, large sponges	321	100- 200	N	BSS Image Collection
1255	122	outer shelf	shelf	gravel, wave rippled, encrustors	326	100- 200	N	BSS Image Collection
1242	121	outer shelf	shelf	gravel, wave rippled, bioturbators	329	100- 200	Y	BSS Image Collection
0244	024	outer shelf	shelf	gravel, irregular, encrustors	336	100- 200	Y	BSS Image Collection
0294	028	outer shelf	shelf	cobble, unrippled, large sponges	401	100- 200	Y	BSS Image Collection
0330	032	outer shelf	shelf	cobble, subcrop, crinoids	454	100- 200	Y	BSS Image Collection
0208	020	outer shelf	shelf	cobble, outcrop, crinoids	464	100- 200	Y	BSS Image Collection
1823	172	outer shelf	shelf-break	Igneous rock,high outcrop,no fauna	590	100- 200, 200- 700	N	BSS Image Collection
1306	126	outer shelf	shelf	Sedimentary rock, subcrop, large sponges	651	100- 200	Y	BSS Image Collection

ERAEF record No.	ERAEF Habitat Number	Sub-biome	Feature	Habitat type	SGF Score	Depth (m)	Image available	Reference image location
1318	127	outer shelf	shelf	Sedimentary rock, subcrop, small sponges	652	100- 200	Y	BSS Image Collection
1871	176	outer shelf	shelf-break	Sedimentary rock, subcrop, small sponges	652	100- 200, 200- 700	N	BSS Image Collection
0220	022	outer shelf	shelf	Sedimentary rock, subcrop, mixed faunal community	653	100- 200	Y	BSS Image Collection
1859	175	outer shelf	shelf-break	Sedimentary rock, subcrop, crinoids	654	100- 200, 200- 700	N	BSS Image Collection
0232	023	outer shelf	shelf	Sedimentary rock, outcrop, large sponges	671	100- 200	Y	BSS Image Collection
0666	065	outer shelf	canyon	Sedimentary rock, outcrop, small sponges	672	100- 200	Y	BSS Image Collection
0183	018	outer shelf	shelf	Sedimentary rock, outcrop, encrustors	696	100- 200	Y	BSS Image Collection
1751	166	outer shelf	shelf-break	Bryozoan based commmunities	xx6	100- 200, 200- 700	N	BSS Image Collection
1499	143	upper slope	slope	mud, unrippled, large sponges	001	200- 700	N	BSS Image Collection
1487	142	upper slope	slope	mud, unrippled, encrustors	006	200- 700	Y	BSS Image Collection
1511	144	upper slope	slope	mud, unrippled, sedentary	007	200- 700	Y	BSS Image Collection
1475	141	upper slope	slope	mud, unrippled, bioturbators	009	200- 700	Y	BSS Image Collection
1463	140	upper slope	slope	mud, irregular, bioturbators	039	200- 700	Y	BSS Image Collection
0462	046	upper slope	slope	fine sediments, unrippled, no fauna	100	200- 700	Y	BSS Image Collection
1427	137	upper slope	slope	fine sediments, unrippled, small sponges	102	200- 700	N	BSS Image Collection
1415	136	upper slope	slope	fine sediments, unrippled, encrustors	106	200- 700	Y	BSS Image Collection
0786	078	upper slope	canyon	fine sediments, unrippled, sedentary	107	200- 700	Y	BSS Image Collection
0438	044	upper slope	slope, canyon	fine sediments, unrippled, bioturbators	109	200- 700	Y	BSS Image Collection
1391	133	upper slope	slope	fine sediments, current rippled, no fauna	110	200- 700	N	BSS Image Collection
0750	073	upper slope	canyon	fine sediments, irregular, encrustors	136	200- 700	Y	BSS Image Collection
0414	041	upper slope	slope	fine sediments, irregular, bioturbators	139	200- 700	Y	BSS Image Collection
1403	134	upper slope	slope	fine sediments, subcrop, large sponges	151	200- 700	N	BSS Image Collection
0774	077	upper slope	canyon, slope	fine sediments, subcrop, small sponges	152	200- 700	Y	BSS Image Collection
0402	040	upper slope	slope	fine sediments, subcrop, sedentary	157	200- 700	Y	BSS Image Collection
0426	043	upper slope	slope	coarse sediments, unrippled, low mixed encrustors	206	200- 700	Y	BSS Image Collection
0450	045	upper slope	slope	coarse sediments, unrippled, sedentary	207	200- 700	Y	BSS Image Collection
0762	076	upper slope	canyon, slope	coarse sediments, irregular, low mixed encrustors	236	200- 700	Y	BSS Image Collection
0738	072	upper slope	canyon	coarse sediments, irregular, bioturbators	239	200- 700	Y	BSS Image Collection
1451	139	upper slope	slope	gravel, debris flow, no fauna	340	200- 700	N	BSS Image Collection
1439	138	upper slope	slope	gravel, debris flow, encrustors	346	200- 700	Y	BSS Image Collection

ERAEF record No.	ERAEF Habitat Number	Sub-biome	Feature	Habitat type	SGF Score	Depth (m)	Image available	Reference image location
1355	130	upper slope	slope	cobble, debris flow, no fauna	440	200- 700	Y	BSS Image Collection
1379	132	upper slope	slope	cobble, debris flow, small sponges	442	200- 700	Y	BSS Image Collection
1367	131	upper slope	slope	cobble, debris flow, octocorals	445	200- 700	N	BSS Image Collection
1343	129	upper slope	slope	cobble, debris flow, encrustors	446	200- 700	Y	BSS Image Collection
0702	069	upper slope	canyon	cobble, outcrop, crinoids	464	200- 700	Y	BSS Image Collection
0810	081	upper slope	seamount	Sedimentary rock, unrippled, no fauna	600	200- 700	Y	BSS Image Collection
0834	085	upper slope	seamount	Sedimentary rock, unrippled, encrustors	606	200- 700	Y	BSS Image Collection
0690	067	upper slope	canyon, slope	Sedimentary rock, subcrop, large sponges	651	200- 700	Y	BSS Image Collection
0714	070	upper slope	canyon	Sedimentary rock, subcrop, small sponges	652	200- 700	Y	BSS Image Collection
0342	033	upper slope	slope	Sedimentary rock, subcrop, mixed faunal community	653	200- 700	Y	BSS Image Collection
1547	148	upper slope	slope	Sedimentary rock, subcrop, octocorals	655	200- 700	N	BSS Image Collection
0378	036	upper slope	slope	Sedimentary rock, subcrop, encrustors	656	200- 700	Y	BSS Image Collection
0366	035	upper slope	slope	Sedimentary rock, outcrop, encrustors	666	200- 700	Y	BSS Image Collection
1523	145	upper slope	slope	Sedimentary rock, low outcrop, large sponges	671	200- 700	N	BSS Image Collection
1535	146	upper slope	slope	Sedimentary rock, low outcrop, small sponges	672	200- 700	Y	BSS Image Collection
0726	071	upper slope	canyon	Sedimentary rock, outcrop, encrustors	676	200- 700	Y	BSS Image Collection
0798	080	upper slope	seamount	Sedimentary rock, outcrop, encrustors	676	200- 700	Y	BSS Image Collection
0390	039	upper slope	slope	Sedimentary rock, outcrop, crinoids	684	200- 700	Y	BSS Image Collection
0678	066	upper slope	canyon	Sedimentary rock, outcrop, crinoids	694	200- 700	Y	BSS Image Collection
0354	034	upper slope	slope	Sedimentary rock, outcrop, encrustors	696	200- 700	Y	BSS Image Collection
1331	128	upper slope	slope	Bryozoan based communities	xx6	200- 700	N	BSS Image Collection
1691	161	mid-slope	slope	mud, unrippled, small sponges	002	700- 1500	N	BSS Image Collection
1655	158	mid-slope	slope	mud, current rippled, bioturbators	019	700- 1500	N	BSS Image Collection
1679	160	mid-slope	slope	mud, irregular, sedentary	037	700- 1500	N	BSS Image Collection
1667	159	mid-slope	slope	mud, irregular, bioturbators	039	700- 1500	N	BSS Image Collection
1631	156	mid-slope	slope	fine sediments, unrippled, no fauna	100	700- 1500	N	BSS Image Collection
0642	063	mid-slope	slope	fine sediments, unrippled, octocorals	105	700- 1500	Y	BSS Image Collection
0618	061	mid-slope	slope	fine sediments, irregular, bioturbators	139	700- 1500	Y	BSS Image Collection
0570	057	mid-slope	slope	fine sediments, subcrop, bioturbators	150	700- 1500	Y	BSS Image Collection
1595	153	mid-slope	slope	coarse sediments, unrippled, no fauna	200	700- 1500	N	BSS Image Collection

ERAEF record No.	ERAEF Habitat Number	Sub-biome	Feature	Habitat type	SGF Score	Depth (m)	Image available	Reference image location
0630	062	mid-slope	slope	coarse sediments, unrippled, octocorals	205	700- 1500	Y	BSS Image Collection
1559	150	mid-slope	slope	coarse sediments, current rippled, no fauna	210	700- 1500	N	BSS Image Collection
1571	151	mid-slope	slope	coarse sediments, current rippled, octocorals	215	700- 1500	N	BSS Image Collection
1583	152	mid-slope	slope	coarse sediments, current rippled, sedentary	217	700- 1500	N	BSS Image Collection
0594	059	mid-slope	slope	coarse sediments, irregular,low encrusting	236	700- 1500	Y	BSS Image Collection
0582	058	mid-slope	slope	cobble, unrippled, small sponges	402	700- 1500	Y	BSS Image Collection
1607	154	mid-slope	slope	cobble, debris flow, crinoids	444	700- 1500	N	BSS Image Collection
1619	155	mid-slope	slope	slabs/ boulders, debris flow, octocorals	445	700- 1500	Y	BSS Image Collection
0486	050	mid-slope	slope	cobble, debris flow, encrustors	446	700- 1500	Y	BSS Image Collection
0498	051	mid-slope	slope	cobble, outcrop, no fauna	460	700- 1500	Y	BSS Image Collection
0606	060	mid-slope	slope	cobble, outcrop, crinoids	464	700- 1500	Y	BSS Image Collection
0654	064	mid-slope	slope	Sedimentary slab and mud boulders, outcrop, crinoids	464	700- 1500	Y	BSS Image Collection
0522	053	mid-slope	slope	Igneous rock, low outcrop, sedentary	567	700- 1500	Y	BSS Image Collection
0474	049	mid-slope	slope	Igneous rock, high outcrop, bioturbators	594	700- 1500	Y	BSS Image Collection
1643	157	mid-slope	slope	Igneous rock, high outcrop, octocorals	595	700- 1500	N	BSS Image Collection
0546	055	mid-slope	slope	Sedimentary rock, unrippled, sedentary	607	700- 1500	Y	BSS Image Collection
1703	162	mid-slope	slope	Sedimentary rock, debris flow, crinoids	644	700- 1500	N	BSS Image Collection
1727	164	mid-slope	slope	Sedimentary rock, subcrop, crinoids	654	700- 1500	Y	BSS Image Collection
1739	165	mid-slope	slope	Sedimentary rock, subcrop, octocorals	655	700- 1500	Y	BSS Image Collection
0558	056	mid-slope	slope, canyons, seamounts	Sedimentary rock, outcrop, mixed faunal community	673	700- 1500	Y	BSS Image Collection
0510	052	mid-slope	slope	Sedimentary rock, outcrop, octocorals	675	700- 1500	Y	BSS Image Collection
0822	084	mid-slope	seamount	Sedimentary rock, outcrop, sedentary	677	700- 1500	Y	BSS Image Collection
0534	054	mid-slope	slope	Sedimentary rock, outcrop, crinoids	694	700- 1500	Y	BSS Image Collection
1715	163	mid-slope	slope	Sedimentary rock, high outcrop, octocorals	695	700- 1500	Y	BSS Image Collection

Scoping Document S2B2. Pelagic Habitats

A list of the pelagic habitats for the Bass Strait Central Zone Scallop Fishery. Shading denotes habitats occurring within the jurisdictional boundary of the sub-fishery that are not subject to effort from dredging.

ERAEF Habitat Number	Pelagic Habitat type	Depth (m)	Comments	Reference
P1	Eastern Pelagic Province - Coastal	0 – 200		dow167A1, A2, A4
P2	Eastern Pelagic Province - Oceanic	0 – > 600	this is a compilation of the range covered by Oceanic Community (1) and (2)	dow167A1, A2, A4
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

Scoping Document S2C1. Demersal Communities

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

Demersal communities that occur within the jurisdictional area of the BSS (indicated by x) although fishing activity does not necessarily occur in all. Shaded cells indicate all communities within the province.

Demersal community	Cape	North Eastern	North Eastern Transition	Central Eastern	Central Eastern Transition	South Eastern Transition	Central Bass	Tasmanian	Western Tas Transition	Southern	South Western Transition	Central Western	Central Western Transition	North Western	North Western Transition	Timor	Timor Transition	Heard & McDonald Is	Macquarie Is
Inner Shelf 0 – 110m [1,2]							X												
Outer Shelf 110 – 250m [1,2,4]																			

Demersal community	Cape	North Eastern	North Eastern Transition	Central Eastern	Central Eastern Transition	South Eastern Transition	Central Bass	Tasmanian	Western Tas Transition	Southern	South Western Transition	Central Western	Central Western Transition	North Western	North Western Transition	Timor	Timor Transition	Heard & McDonald Is	Macquarie Is
Upper Slope 250 – 565m [3,4]																			
Mid–Upper Slope 565 – 820m[3,5]																			
Mid Slope 820 – 1100m[3,5]																			
Lower slope/ Abyssal > 1100m[6]																			
Reef 0 -110m[7, 8]																			
Reef 110-250m[8]																			
Seamount 0 – 110m																			
Seamount 110- 250m																			
Seamount 250 – 565m																			
Seamount 565 – 820m																			
Seamount 820 – 1100m																			
Seamount 1100 – 3000m																			
Plateau 0 – 110m																			
Plateau 110- 250m[9]																			
Plateau 250 – 565m[9]																			
Plateau 565 – 820m																			
Plateau 820 – 1100m																			

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

Scoping Document S2C2. Pelagic Communities

Pelagic communities that occur within the jurisdictional area of BSS (indicated by x) although fishing activity may not necessarily occur in all. Shaded cells indicate all communities that exist in the province.

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

[1] Northern Province has five coastal pelagic zones (NWS, Bonaparte, Arafura, Gulf and East Cape York). [2] Coastal pelagic zone at Heard and McDonald Is broadened to cover entire plateau to maximum of 1000m

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

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

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

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

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

Scoping Document S3 Components and Sub-components Identification of Objectives

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

Component	Core Objective	Sub-component	Example Operational Objectives	Example Indicators	Rationale
	"What is the general goal?"	*As shown in sub-component model diagrams at the beginning of this section.*	*"What you are specifically trying to achieve"*	*"What you are going to use to measure performance"*	*Rationale flagged as 'EMO' where Existing Management Objective in place, or 'AMO' where there is an existing AFMA Management Objective in place for other Commonwealth fisheries (assumed that squid fishery will fall into line).*
Target Species	Avoid recruitment failure of the target species Avoid negative consequences for species or population sub-components	1. Population size	1.1 No trend in biomass 1.2 Maintain biomass above a specified level 1.3 Maintain catch at specified level 1.4 Species do not approach extinction or become extinct.	Biomass, numbers, density, CPUE, yield	1.1 Fishing down thru the season is accepted. 1.2. Biomass management is carried out via surveys. 1.3. EMO; catch levels are desirable above certain levels for economic efficiency. 1.4. GMO, the fishery seeks to have animals available every season.
		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 fishing area	2.1. Changes in the distribution may change availability of the fish to harvest. Capacity of the populations to recover may change if range contracts or becomes patchier.
		3. Genetic structure	3.1 Genetic diversity does not change outside acceptable bounds	Frequency of genotypes in the population, effective population size (N_e), number of spawning units	3.1. Not currently applicable to this fishery

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 GMO: Changes in these characters important if they impact on population processes. In general, these are difficult to understand for the target species at this time.
		5. Reproductive Capacity	5.1 Fecundity of the population does not change outside acceptable bounds (e.g. more than X% of reference population fecundity) 2 Recruitment to the population does not change outside acceptable bounds	Egg production of population Abundance of recruits	5.1. EMO. Closed areas are implemented each season to protect the reproductive capacity. GMO: Fecundity of the population should not change such that ability to recover from harvest is not compromised. 5.2. GMO: if recruitment declines, due to changes in habitat quality for example, then sustainability impacted.
		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 No existing objective, but if animals change behavior and move into unfishable grounds, or disperse such that beds are not able to be fished economically, then a bad thing.

Component	Core Objective	Sub-component	Example Operational Objectives	Example Indicators	Rationale
Byproduct and Bycatch	Avoid recruitment failure of the byproduct and bycatch species Avoid negative consequences for species or population sub-components	1. Population size	1.1 No trend in biomass 1.2 Species do not approach extinction or become extinct 1.3 Maintain biomass above a specified level 1.4 Maintain catch at specified level	Biomass, numbers, density, CPUE, yield	1.1 1.2 1.3 1.4
		2. Geographic range	2.1 Geographic range of the population, in terms of size and continuity does not change outside acceptable bounds	Presence of population across space	2.1
		3. Genetic structure	3.1 Genetic diversity does not change outside acceptable bounds	Frequency of genotypes in the population, effective population size (N_e), number of spawning units	3.1
		4. Age/size/sex structure	4.1 Age/size/sex structure does not change outside acceptable bounds (e.g. more than X% from reference structure)	Biomass, numbers or relative proportion in age/size/sex classes Biomass of spawners Mean size, sex ratio	4.1
		5 Reproductive Capacity	5.1 Fecundity of the population does not change outside acceptable bounds (e.g. more than X% of reference population fecundity) Recruitment to the population does not change outside acceptable bounds	Egg production of population Abundance of recruits	5.1

Component	Core Objective	Sub-component	Example Operational Objectives	Example Indicators	Rationale
		6. Behaviour /Movement	6.1 Behaviour and movement patterns of the population do not change outside acceptable bounds	Presence of population across space, movement patterns within the population (e.g. attraction to bait, lights)	6.1
TEP species	Avoid recruitment failure of TEP species Avoid negative consequences for TEP species or population sub-components Avoid negative impacts on the population from fishing	1. Population size	1.1 Species do not further approach extinction or become extinct 1.2 No trend in biomass 1.3 Maintain biomass above a specified level 1.4 Maintain catch at specified level	Biomass, numbers, density, CPUE, yield	1.1 1.2 1.3 1.4
		2. Geographic range	2.1 Geographic range of the population, in terms of size and continuity does not change outside acceptable bounds	Presence of population across space, i.e. the GAB	2.1
		3. Genetic structure	3.1 Genetic diversity does not change outside acceptable bounds	Frequency of genotypes in the population, effective population size (N_e), number of spawning units	3.1
		4. Age/size/sex structure	4.1 Age/size/sex structure does not change outside acceptable bounds (e.g. more than X% from reference structure)	Biomass, numbers or relative proportion in age/size/sex classes Biomass of spawners Mean size, sex ratio	4.1

Component	Core Objective	Sub-component	Example Operational Objectives	Example Indicators	Rationale
		5. Reproductive Capacity	5.1 Fecundity of the population does not change outside acceptable bounds (e.g. more than X% of reference population fecundity) Recruitment to the population does not change outside acceptable bounds	Egg production of population Abundance of recruits	5.1
		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
		7. Interactions with fishery	7.1 Survival after interactions is maximised 7.2 Interactions do not affect the viability of the population or its ability to recover	Survival rate of species after interactions Number of interactions, biomass or numbers in population	7.1 7.2
Habitats	Avoid negative impacts on the quality of the environment Avoid reduction in the amount and quality of habitat	1. Water quality	1.1 Water quality does not change outside acceptable bounds	Water chemistry, noise levels, debris levels, turbidity levels, pollutant concentrations, light pollution from artificial light	1.1
		2. Air quality	2.1 Air quality does not change outside acceptable bounds	Air chemistry, noise levels, visual pollution, pollutant concentrations, light pollution from artificial light	2.1

Component	Core Objective	Sub-component	Example Operational Objectives	Example Indicators	Rationale
		3. Substrate quality	3.1 Sediment quality does not change outside acceptable bounds	Sediment chemistry, stability, particle size, debris, pollutant concentrations	3.1
		4. Habitat types	4.1 Relative abundance of habitat types does not vary outside acceptable bounds	Extent and area of habitat types, % cover, spatial pattern, landscape scale	4.1
		5. Habitat structure and function	5.1 Size, shape and condition of habitat types does not vary outside acceptable bounds	Size structure, species composition and morphology of biotic habitats	5.1
Communities	Avoid negative impacts on the composition/function/distribution/structure of the community	1. Species composition	1.1 Species composition of communities does not vary outside acceptable bounds	Species presence/absence, species numbers or biomass (relative or absolute) Richness Diversity indices Evenness indices	1.1
		2. Functional group composition	2.1 Functional group composition does not change outside acceptable bounds	Number of functional groups, species per functional group (e.g. autotrophs, filter feeders, herbivores, omnivores, carnivores)	2.1
		3. Distribution of the community	3.1 Community range does not vary outside acceptable bounds	Geographic range of the community, continuity of range, patchiness	3.1

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
		5. Bio- and geo-chemical cycles	5.1 Cycles do not vary outside acceptable bounds	Indicators of cycles, salinity, carbon, nitrogen, phosphorus flux	5.1

2.2.4 Hazard Identification (Step 4)

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

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

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

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

Scoping Document S4. Hazard Identification Scoring Sheet

This table is completed once for each sub-fishery. **Table 4** provides a set of examples of fishing activities for the effects of fishing to be used as a guide to assist in scoring the hazards.

Fishery Name: Bass Strait Central Zone Scallop Fishery
Sub-fishery Name: Dredge
Date: January 29, 2004 (updated March 2, 2004, reviewed July 2006).

Direct impact of Fishing	Fishing Activity	Score (0/1)	Documentation of Rationale
Capture	Bait collection	0	Does not occur in fishery
	Fishing	1	Occurs in this fishery.
	Incidental behaviour	1	Assume that fishing using “recreational” gear can occur during the down time of the vessel, and that animals are captured. Peter Stegmann (MAC member) advised that crew may occasionally troll on the way out or back from grounds. Does happen but low incidence.
Direct impact without capture	Bait collection	0	Does not occur in fishery
	Fishing	1	Animals may be damaged by the fishing gear and not captured. These animals may later die.
	Incidental behaviour	1	Assume that fishing using “recreational” gear can occur during the down time of the vessel, and that animals are sometimes hooked but not captured. Peter Stegmann advised that crew may occasionally troll on the way out or back from grounds. Does happen but low incidence. Crew may go ashore in sensitive bird breeding areas.

Direct impact of Fishing	Fishing Activity	Score (0/1)	Documentation of Rationale
	Gear loss	1	Expect very low rates of gear loss. Dredges are lost on occasion. Peter Stegmann advised it there is a very low chance of this happening - most operators attach a surface buoy from the dredge, such that if the dredge wires break, the position of the dredge is marked which allows recovery of gear.
	Anchoring/ mooring	1	Assume that vessels anchor up at night or in bad weather.
	Navigation/steaming	1	Occurs as a part of general fishing activities.
Addition/ movement of biological material	Translocation of species (boat launching, reballasting)	1	Fishers are permit holders in several fisheries, and so will use different ports, which has a potential to translocate hull fouling animals, or through brine tanks used for ballast on the way to fishing grounds (Noted that the brine tanks are not used for holding the catch in this fishery).
	On board processing	0	No processing occurs at sea – (because of Health Regulations and compliance/quota issues – quota is managed by shell weight).
	Discarding catch	1	Occurs, undersize target species and bycatch species are discarded.
	Stock enhancement	0	Does not occur in this fishery. It is noted that some scallop fisheries elsewhere in the world are considering reseeding and stock enhancement.
	Provisioning	0	No bait is used to attract the target species.
	Organic waste disposal	1	Occurs during normal crew activities (food scraps, sewage etc)
Addition of non-biological material	Debris	1	Assume debris enters the water, e.g. plastics, line. Fish bins are used to transport the catch, and not easily blown or washed overboard.
	Chemical pollution	1	As part of cleaning and/or processing, upkeep of vessel, paints, oils, etc. No TBT-based paints are permitted, but existing paints may contain TBT. Oil is managed as per MARPOL regulations.
	Exhaust	1	As part of steaming and vessel activities.
	Gear loss	1	Might lose the odd fish bin or similar, dredges are recoverable.
	Navigation/ steaming	1	Introduce noise and light
	Activity/ presence on water	1	Vessel itself can be an attractant for some non-target species, such as scavenging birds and fish, mammals, sharks.
Disturb physical processes	Bait collection	0	No bait collection in this fishery
	Fishing	1	Yes, dredge contacts sediments.
	Boat launching	0	Boats launched from established ports, not local beaches.
	Anchoring/ mooring	1	Anchors will also disrupt the sediments if they are used.
	Navigation/ steaming	1	Mixing of the water column occurs; particulates enter the air and surface waters.
External Hazards (specify the particular example within each activity area)	Other capture fishery methods	1	Yes, at least four other commercial Commonwealth fisheries in similar region, see the list in the Scoping document. Scallops are taken by recreational fishers in both state managed, adjacent fisheries – by dive (Vic & Tas) and dredge (Tas).

Direct impact of Fishing	Fishing Activity	Score (0/1)	Documentation of Rationale
	Aquaculture	1	Not in Commonwealth waters, abalone at nearby Flinders Island. Some potential interactions but not in same waters. Some stakeholders thought this should not be included at all.
	Coastal development	1	Not in Commonwealth waters, but some agricultural runoff close to Flinders Island a possibility.
	Other extractive activities	1	Oil and gas prospecting and extraction in the region occur. Seismic profiling also occurs.
	Other non-extractive activities	1	BassLink cable across Bass Strait.
	Other anthropogenic activities	1	Tourism and dive charters around the Bass Strait Islands. Visits to the islands for tourism.

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

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

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

2.2.5 Bibliography (Step 5)

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

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

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

Other publications that may provided information include

- BRS Fishery Status Reports
- Strategic Plans

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

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

In this case, 19 out of 26 possible internal activities were identified as occurring in this fishery. All 6 external activities were identified as present in some form. Thus, a total of 26 activity-component scenarios will be considered at Level 1. This results in 130 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)) identified at step 3 at the scoping level (Scoping Document S3) onto the SICA table
Step 2: Score spatial scale of the activity
Step 3: Score temporal scale of the activity
Step 4: Choose the sub-component most likely to be affected by activity
Step 5: Choose the most vulnerable unit of analysis for the component e.g. species, habitat type or community assemblage
Step 6: Select the most appropriate operational objective
Step 7: Score the intensity of the activity for that sub-component
Step 8: Score the consequence resulting from the intensity for that sub-component
Step 9: Record confidence/uncertainty for the consequence scores
Step 10. Document rationale for each of the above steps
Step 11. Summary of SICA results
Step 12. Evaluation/discussion of Level 1
Step 13. Components to be examined at Level 2

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

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

2.3.2 Score spatial scale of activity (Step 2)

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

Spatial scale score of activity

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

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

2.3.3 Score temporal scale of activity (Step 3)

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

Temporal scale score of activity

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

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

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

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

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

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

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

2.3.6 Select the most appropriate operational objective (Step 6)

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

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

The score for intensity of an activity considers the direct impacts in line with the categories shown in the conceptual model (**Figure 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 temporal scale
Minor	2	occurs rarely or in few restricted locations and detectability even at these scales is rare
Moderate	3	moderate at broader spatial scale, or severe but local
Major	4	severe and occurs reasonably often at broad spatial scale
Severe	5	occasional but very severe and localized or less severe but widespread and frequent
Catastrophic	6	local to regional severity or continual and widespread

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Direct impact of Fishing	Fishing Activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (from S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence score (1-2)	Rationale
Capture	Bait collection	0									
	Fishing	1	3	4	Population size	Commercial scallop, Pecten fumatus	1.3	3	4	1	Fishing does result in the elimination of beds of scallops, it is local mining. Recovery of beds is uncertain; fishery is a boom-bust fishery, with closed years common in the history of the fishery. Note that this fishery harvests a straddling stock, with overlap with the state fisheries. Confidence in long term effects is low, even though existing data shows that beds are eliminated/reduced during the season.
	Incidental behaviour	1	4	4	Population size	Commercial scallop, Pecten fumatus	1.3	2	1	1	Collection of the target species, by crew in their downtime probably very rare, as can use harvested animals. Capture with other methods, such as fishing lines, will not capture target sp. Uncertainty about other fishing methods in this activity is high, but consequence is negligible as volumes of animals would not be captured.
Direct impact without capture	Bait collection	0									
	Fishing	1	3	4	Population size	Commercial scallop, Pecten fumatus	1.3	3	3	1	Fishing also results in damage to animals that are not captured. Possibility that damaged animals attracts scavenging species to the area, which increase predation on damaged and intact animals. Confidence low, as unsure of effect of dredge on beds, with regard to damaged and non-captured animals.
	Incidental behaviour	1	4	4	Population size	Commercial scallop, Pecten fumatus	1.3	2	1	1	Collection of the target species, by crew in their downtime probably very rare, as can use harvested animals. Capture with other methods, such as fishing lines, will not capture target sp. Failure to capture animals that are damaged by the incidental capture methods is likely to have no impact on any sub-component. Uncertainty about this activity is high, but consequence is negligible.
	Gear loss	1	3	4	Population size	Commercial scallop, Pecten fumatus	1.3	1	1	1	Lost gear, such as a dredge, may have a full load of catch, yet will not continue to fish, will also likely be recovered. Other types of lost gear will not fish, or impact the target species.
	Anchoring/ mooring	1	3	3	Population size	Commercial scallop, Pecten fumatus	1.3	1	1	2	Anchoring on the scallop beds is not considered to occur. The consequence is the minimum score. Confidence is high, based on consensus and expert opinion, also logic.

Direct impact of Fishing	Fishing Activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (from S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence score (1-2)	Rationale
	Navigation/ steaming	1	4	4	Population size	Commercial scallop, Pecten fumatus	1.3	2	1	2	This activity is widespread, but consequence for the target species is negligible. Confidence constrained by logic, consensus.
Addition/ movement of biological material	Translocation of species	1	4	4	Population size	Commercial scallop, Pecten fumatus	1.3	3	4	1	fishers do hold permits in state and commonwealth fisheries, boats may use harbors in Tasmania and Victoria, even further afield, thus the chance for introduced pests (such as Asterias amurensis, North Pacific sea star, Mariocolpis) being translocated on vessels, ballast, brine tanks, might occur. Introduction of this type of pest to the scallop beds could be disastrous. Not known if any animals have been observed. Consequence considered major. uncertainty high
	On board processing	0									
	Discarding catch	1	3	4	Age-size structure	Commercial scallop, Pecten fumatus	4.1	3	2	1	Discarding of undersize target species occurs. This may change the size structure on the beds; juveniles will be proportionately more common. However, adult beds are targeted. Are the beds commonly single-size class?
	Stock enhancement	0									
	Provisioning	0									
	Organic waste disposal	1	4	4	Reproductive output	Commercial scallop, Pecten fumatus	5.1	1	1	2	Food scraps etc are discarded, but impact on the target species, might be on reproductive output if the extra food makes it up the food chain, likely as scavenging solid material more likely. Confidence is high due to logical constraints
Addition of non-biological material	Debris	1	4	4	Population size	Commercial scallop, Pecten fumatus	1.3	2	1	2	Debris might include packing material for the catch, anything that can be washed off a fishing boat. This may occur, however, the consequence for the target species, which are mobile and filter feeders (thus can move and don't ingest materials) is considered to be negligible. consequence high, logic
	Chemical pollution	1	4	4	Reproductive output	Commercial scallop, Pecten fumatus	5.1	1	2	1	Chemical pollution may impact the quantity or quality of gametes, direct evidence is lacking, but scenarios judged to have negligible consequence at this stage and intensity of the fishery. Materials used to paint the dredges might be abraded and enter the sediments in the beds, confidence about the consequence considered low.
	Exhaust	1	4	4	Reproductive output	Commercial scallop, Pecten fumatus	5.1	2	1	1	Most exhaust enters the atmosphere, or immediately below the water from engines, dissolved gases and particulates not believed to be of consequence to benthic target species. Confidence high to logical consideration

Direct impact of Fishing	Fishing Activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (from S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence score (1-2)	Rationale
	Gear loss	1	3	4	Population size	Commercial scallop, Pecten fumatus	1.3	1	1	2	Lost gear does become a structure, but not expected to have any impact on mobile target species. Confidence high by logic and consensus
	Navigation/ steaming	1	4	4	Age-size structure	Commercial scallop, Pecten fumatus	4.1	2	1	2	Introduction of noise and light not considered to be a threat at all for benthic target species, like scallops. Might scare some of the size classes such that size structure changes on the fishing ground through different movements
	Activity/ presence on water	1	4	4	Behavior and Movement	Commercial scallop, Pecten fumatus	6.1	3	1	2	Simple presence of vessels on water might change the behavior, but hard to envisage for the target species. High confidence by consensus and lack of scenarios.
Disturb physical processes	Bait collection	0									
	Fishing	1	4	4	Reproductive output	Commercial scallop, Pecten fumatus	5.1	3	3	1	Same species are exploited by adjacent fisheries in Tasmanian and Victorian scallop fisheries. Major impacts documented, such as depletion, for some of these stocks. Linkage between the stocks is expected but unknown. Confidence low.
	Boat launching	0									
	Anchoring/ mooring	1	3	4	Population size	Commercial scallop, Pecten fumatus	1.3	1	1	2	Effects on any subcomponent hard to envisage for the target species. Confidence high through logical constraints
	Navigation/steaming	1	4	4	Population size	Commercial scallop, Pecten fumatus	1.3	1	1	2	Effects on any subcomponent hard to envisage for the target species. Confidence high through logical constraints
External hazards (specify the particular example within each activity area)	Other fisheries	1	5	6	Population size	Commercial scallop, Pecten fumatus	1.3	3	4	1	State and recreational fisheries do impact the target species, similar effects to the directed commonwealth fishery. Confidence low, due to lack of data and conflicting opinions.
	Aquaculture	1	3	6	Population size	Commercial scallop, Pecten fumatus	1.3	3	2	1	Some operations in the region, may remove some of the coastal production if filter feeders like mussel cultures, oyster beds. There is spatial segregation between fishing and aquaculture at this time.

Direct impact of Fishing	Fishing Activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (from S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence score (1-2)	Rationale
	Coastal development	1	4	6	Population size	Commercial scallop, Pecten fumatus	1.3	3	2	1	if target species beds are close to the coast, runoff from developed lands may lead to greater inputs of freshwater, nutrients, fertilizers, impacts on target species considered minor, confidence low due to lack of data
	Other extractive activities	1	5	6	Population size	Commercial scallop, Pecten fumatus	1.3	3	2	1	Dredging activities for harbors, seawalls etc, may dump materials, (e.g. Port of Burnie) in Bass Strait areas. Effect on target species is unknown. Confidence low, due to lack of data.
	Other non extractive activities	1	6	6	Reproductive output	Commercial scallop, Pecten fumatus	5.1	3	2	1	Effect of things like Basslink hard to understand. Confidence low, conservative score with regard to consequence used.
	Other anthropogenic activities	1	5	5	Population size	Commercial scallop, Pecten fumatus	1.3	2	1	1	The nearby tourism activities may occasionally interact with the region, perhaps through anchoring, collecting, pollution etc. Hard to come up with a scenario for this example. Low confidence, because full range of possibilities not considered yet.

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

Direct impact of Fishing	Fishing Activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (from S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence score (1-2)	Rationale
Capture	Bait collection	0									
	Fishing	1	3	4	Population size	Doughboy scallop, Mimachlamys asperrima	1.3	3	3	1	Fishing does result in the elimination of beds of scallops, it is local mining. Are beds of doughboys ever targeted? Recovery of beds is uncertain; fishery is a boom-bust fishery, with closed seasons common in the history of the fishery. Confidence in long term effects is low, even though existing data shows that beds are eliminated/reduced during the season. Does this apply to doughboys scallops
	Incidental behaviour	1	4	4	Population size	Doughboy scallop, Mimachlamys asperrima	1.3	2	1	1	Collection of the byproduct species, by crew in their downtime probably very rare, as can use harvested animals. Capture with other methods, such as fishing lines, will not capture target sp. Uncertainty about other fishing methods in this activity is high, but consequence is negligible as volumes of animals would not be captured. May be regulated?
Direct impact without capture	Bait collection	0									
	Fishing	1	3	4	Population size	Doughboy scallop, Mimachlamys asperrima	1.3	3	2	1	Fishing also results in damage to animals that are not captured. Possibility that damaged animals attracts scavenging species to the area, which increase predation on damaged and intact animals. Confidence low, as unsure of effect of dredge on beds, with regard to damaged and non-captured animals.
	Incidental behaviour	1	4	4	Population size	Doughboy scallop, Mimachlamys asperrima	1.3	2	1	1	Collection of the target species, by crew in their downtime probably very rare, as can use harvested animals. Capture with other methods, such as fishing lines, will not capture target sp. Failure to capture animals that are damaged by the incidental capture methods is likely to have no impact on any sub-component. Uncertainty about this activity is high, but consequence is negligible.
	Gear loss	1	3	4	Population size	Doughboy scallop, Mimachlamys asperrima	1.3	1	1	1	Lost gear, such as a dredge, may have a full load of catch, yet will not continue to fish, will also likely be recovered. Other types of lost gear will not fish, or impact the target species.
	Anchoring/ mooring	1	3	3	Population size	Doughboy scallop, Mimachlamys asperrima	1.3	1	1	2	Anchoring on the scallop beds is not considered to occur. The consequence is the minimum score. Confidence is high, based on consensus and expert opinion, also logic.

Direct impact of Fishing	Fishing Activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (from S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence score (1-2)	Rationale
	Navigation/ steaming	1	4	4	Population size	Doughboy scallop, Mimachlamys asperrima	1.3	2	1	2	This activity is widespread, but consequence for the target species is negligible. Confidence constrained by logic, consensus.
Addition/ movement of biological material	Translocation of species	1	4	4	Population size	Doughboy scallop, Mimachlamys asperrima	1.3	3	4	1	fishers do hold permits in state and commonwealth fisheries, boats may use harbors in Tasmania and Victoria, even further afield, thus the chance for introduced pests (such as Asterias amurensis, North Pacific sea star, Mariocolpis) being translocated on vessels, ballast, brine tanks, might occur. Introduction of this type of pest to the scallop beds could be disastrous. Not known if any animals have been observed. Consequence considered major. uncertainty high
	On board processing	0									
	Discarding catch	1	3	4	Age-size structure	Doughboy scallop, Mimachlamys asperrima	4.1	3	2	1	Discarding of undersize animals occurs. This may change the size structure on the beds; juveniles will be proportionately more common. However, adult beds are targeted. Are the beds commonly single-size class?
	Stock enhancement	0									
	Provisioning	0									
	Organic waste disposal	1	4	4	Reproductive output	Doughboy scallop, Mimachlamys asperrima	5.1	1	1	2	Food scraps etc are discarded, but impact on the target species, might be on reproductive output if the extra food makes it up the food chain, likely as scavenging solid material more likely. Confidence is high due to logical constraints
Addition of non-biological material	Debris	1	4	4	Population size	Doughboy scallop, Mimachlamys asperrima	1.3	2	1	2	Debris might include packing material for the catch, anything that can be washed off a fishing boat. This may occur, however, the consequence for the target species, which are mobile and filter feeders (thus can move and don't ingest materials) is considered to be negligible. consequence high, logic
	Chemical pollution	1	4	4	Reproductive output	Doughboy scallop, Mimachlamys asperrima	5.1	1	2	1	Chemical pollution may impact the quantity or quality of gametes, direct evidence is lacking, but scenarios judged to have negligible consequence at this stage and intensity of the fishery. Materials used to paint the dredges might be abraded and enter the sediments in the beds, confidence about the consequence considered low.

Direct impact of Fishing	Fishing Activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (from S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence score (1-2)	Rationale
	Exhaust	1	4	4	Reproductive output	Doughboy scallop, Mimachlamys asperrima	5.1	2	1	1	Most exhaust enters the atmosphere, or immediately below the water from engines, dissolved gases and particulates not believed to be of consequence to benthic target species. Confidence high to logical consideration
	Gear loss	1	3	4	Population size	Doughboy scallop, Mimachlamys asperrima	1.3	1	1	2	Lost gear does become a structure, but not expected to have any impact on mobile target species. Confidence high by logic and consensus
	Navigation/ steaming	1	4	4	Age-size structure	Doughboy scallop, Mimachlamys asperrima	4.1	2	1	2	Introduction of noise and light not considered to be a threat at all for benthic target species, like scallops. Might scare some of the size classes such that size structure changes on the fishing ground through different movements
	Activity/ presence on water	1	4	4	Behavior and Movement	Doughboy scallop, Mimachlamys asperrima	6.1	3	1	2	Simple presence of vessels on water might change the behavior, but hard to envisage for the target species. High confidence by consensus and lack of scenarios.
Disturb physical processes	Bait collection	0									
	Fishing	1	4	4	Reproductive output	Doughboy scallop, Mimachlamys asperrima	5.1	3	3	1	Same species are exploited by adjacent fisheries in Tasmanian and Victorian scallop fisheries. Major impacts documented, such as depletion, for some of these stocks. Linkage between the stocks is expected but unknown. Confidence low.
	Boat launching	0									
	Anchoring/ mooring	1	3	4	Population size	Doughboy scallop, Mimachlamys asperrima	1.3	1	1	2	Effects on any subcomponent hard to envisage for this species. Confidence high through logical constraints
	Navigation/steaming	1	4	4	Population size	Doughboy scallop, Mimachlamys asperrima	1.3	1	1	2	Effects on any subcomponent hard to envisage for the target species. Confidence high through logical constraints

Direct impact of Fishing	Fishing Activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (from S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence score (1-2)	Rationale
External hazards (specify the particular example within each activity area)	Other fisheries	1	5	6	Population size	Doughboy scallop, Mimachlamys asperrima	1.3	3	3	1	This species is not targeted in any other fisheries, but is a bycatch species in a number of other fisheries (e.g. SE Trawl)
	Aquaculture	1	3	6	Population size	Doughboy scallop, Mimachlamys asperrima	1.3	3	2	1	Some operations in the region, may remove some of the coastal production if filter feeders like mussel cultures, oyster beds. There is spatial segregation between fishing and aquaculture at this time.
	Coastal development	1	4	6	Population size	Doughboy scallop, Mimachlamys asperrima	1.3	3	2	1	if target species beds are close to the coast, runoff from developed lands may lead to greater inputs of freshwater, nutrients, fertilizers, impacts on target species considered minor, confidence low due to lack of data
	Other extractive activities	1	5	6	Population size	Doughboy scallop, Mimachlamys asperrima	1.3	3	2	1	Dredging activities for harbors, seawalls etc, may dump materials, (e.g. Port of Burnie) in Bass Strait areas. Effect on target species is unknown. Confidence low, due to lack of data.
	Other non extractive activities	1	6	6	Reproductive output	Doughboy scallop, Mimachlamys asperrima	5.1	3	2	1	Effect of things like Basslink hard to understand. Confidence low, conservative score with regard to consequence used.
	Other anthropogenic activities	1	5	5	Population size	Doughboy scallop, Mimachlamys asperrima	1.3	2	1	1	The nearby tourism activities may occasionally interact with the region, perhaps through anchoring, collecting, pollution etc. Hard to come up with a scenario for this example. Low confidence, because full range of possibilities not considered yet.

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

Direct impact of Fishing	Fishing Activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (from S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence score (1-2)	Rationale
Capture	Bait collection	0									
	Fishing	1	4	4	Population size	Big-bellied seahorse	1.3	3	2	1	Incidental capture during fishing does occur, species reported in scientific surveys. This example selected as most vulnerable. Confidence low, due to lack of data.
	Incidental behaviour	1	4	4	Population size	Australian Gannet	6.1	2	2	1	Attraction of some species to the vessels when crew might be fishing in the down time. Occasional capture might occur, such as through diving for bait, resulting in death. Consequence minor. Confidence low, lack of data or expert opinion
Direct impact without capture	Bait collection	0									
	Fishing	1	4	4	Population size	Big-bellied seahorse	1.3	2	2	1	Incidental capture during fishing does occur, species reported in scientific surveys. This example selected as most vulnerable. Confidence low, due to lack of data.
	Incidental behaviour	1	4	4	Behavior and Movement	Fur seal, common dolphin	6.1	2	2	1	Attraction of some species to the vessels when crew might be fishing in the down time. Behavior might change, in that species modify behavior, but short term effects. Confidence low, lack of data, consensus
	Gear loss	1	4	4	Population size	Fur seal	1.3	2	1	2	Some species may get entanglements or swallow material to reduce feeding ability. Confidence low due to lack of data.
	Anchoring/ mooring	1	3	4	Population size	Pipefish	1.3	2	1	2	Anchoring and mooring can aggregate some species on the chain, which can be injured or killed when anchors are recovered. Uncertainty high.
	Navigation/ steaming	1	4	4	Behavior and Movement	Fur seal, common dolphin, seabirds	6.1	2	2	1	Attraction of some species to the vessels. Behavior might change, in that species modify behavior, but short term effects. Confidence low, lack of data, consensus
Addition/ movement of biological material	Translocation of species	1	4	4	Population size	seabirds	1.3	2	2	1	Introduction of marine species can lead to impacts on the TEP species, especially where prey is impacted. With taxa that may be introduced, hard to see strong links to TEP; minor consequence, low confidence.
	On board processing	0									
	Discarding catch	1	4	4	Behavior and Movement	Fur seal, common dolphin	6.1	2	2	1	Animals modify behavior, especially to feed on discards. Minor consequence due to restricted area of fishing. Confidence low due to lack of information.
	Stock enhancement	0									
	Provisioning	0									

Direct impact of Fishing	Fishing Activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (from S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence score (1-2)	Rationale
	Organic waste disposal	1	4	4	Behavior and Movement	Fur seal, common dolphin	6.1	2	2	1	Animals modify behavior, especially to feed. Minor consequence due to restricted area of fishing. Confidence low due to lack of information.
Addition of non-biological material	Debris	1	4	4	Population size	fur seal	1.3	2	1	1	Debris might include packing material for the catch, anything that can be washed off a fishing boat. This may occur, and possibilities for ingestion exist and have been documented. Problematic in attributing source of debris.
	Chemical pollution	1	4	4	Reproductive output	seabirds	5.1	1	2	1	Chemical pollution may impact the quantity or quality of gametes, direct evidence is lacking, but scenarios judged to have negligible consequence at this stage and intensity of the fishery. Materials used to paint the dredges might be abraded and enter the sediments in the beds, confidence about the consequence considered low.
	Exhaust	1	4	4	Behavior and Movement	seabirds	6.1	2	1	1	Most exhaust enters the atmosphere, or immediately below the water from engines, dissolved gases and particulates not believed to be of consequence to TEP species. Confidence high to logical consideration
	Gear loss	1	4	4	Population size	sygnathids	1.3	1	1	2	Lost gear does become a structure, can provide substrate, or smother some species. Confidence high, constrained by logic regarding volumes.
	Navigation/ steaming	1	4	4	Behavior and Movement	Fur seal, common dolphin, seabirds	6.1	2	2	1	Introduction of noise and light not considered to be a threat at all for benthic target species, like scallops. Might scare some of the size classes such that size structure changes on the fishing ground through different movements
	Activity/ presence on water	1	4	4	Behavior and Movement	seabirds	6.1	3	1	2	Simple presence of vessels on water might change the behavior, but hard to envisage for the target species. High confidence by consensus and lack of scenarios.
Disturb physical processes	Bait collection	0									
	Fishing	1	4	4	Population size	sygnathids	1.3	3	2	1	Dredging may lead to changes in turbidity, reducing the ability of the animals to find prey, find attachment sites. This impact is expected to be of short duration, unless the size structure of the sediments is changed, such that natural events are more easily able to disrupt the sediments from now on. Uncertainty high with this scenario.
	Boat launching	0									
	Anchoring/ mooring	1	3	4	Population size	sygnathids	1.3	2	1	2	Inshore where anchoring can occur, might disrupt the sediments reintroduce organic material, decrease the cover of oxygenizing biota (sea grasses, bacterial mats), or anoxic muds that kill sygnathids. Confidence high due to logical considerations
	Navigation/steaming	1	4	4	Population size	seabirds	1.3	1	1	2	Mix the water column changing the productivity of the water column, thus reducing the ability of seabirds to forage effectively. Confidence high due to logical constraints.

Direct impact of Fishing	Fishing Activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (from S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence score (1-2)	Rationale
External hazards (specify the particular example within each activity area)	Other fisheries	1	5	6	Population size	Fur seal, common dolphin, seabirds	3.1	2	3	1	Capture of seals in other fisheries such as blue grenadier, otter trawl is reported. Conservatively scored, but considerable uncertainty about the consequence for population size.
	Aquaculture	1	3	6	Behavior and Movement	Fur seal, common dolphin, seabirds	3.1	2	2	1	Animals modify behavior in response to feeding or activity around boast or harvesting within aquaculture. But species being cultured (abalone, oysters) not strongly attractive to the predator TEP species. Confidence low, lack of data
	Coastal development	1	4	6	Geographic range	Seabirds	3.1	3	3	2	Changes to the distribution such as location of breeding colonies have occurred. Impact on populations is known, and has resulted in listed species, Bass Strait Albatross colonies.
	Other extractive activities	1	5	6	Behavior and Movement	Marine mammals, whales	6.1	2	2	1	Shipping and seismic surveys, oil and gas exploration all make noise which may disrupt the movement/migration paths of TEP species.
	Other non extractive activities	1	6	6	Behavior and Movement	sharks, e.g. grey nurse	6.1	2	2	1	Effect of things like Basslink hard to understand. Confidence low, conservative score with regard to consequence used.
	Other anthropogenic activities	1	5	5	Reproductive output	seabirds	4.2	3	2	1	tourism on islands can lead to disturbance of nesting seabirds, and reproductive capacity

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	0	0	0							
	Fishing	1	3	4	Habitat structure and function	coarse sediments, wave rippled, large sponges, inner shelf	5.1	3	3-4	2	Most dredging occurs within a defined area of Bass Strait that supports commercially viable beds of scallops. Intensity: moderate. Dredge gear has an intermediate footprint; small, heavy, high mobility and robustness. Target species typically found in coarse sediments in highly dynamic current zones. In the course of fishing, interaction with benthos results in significant disturbance of the substratum to a depth of ~50mm. Consequence: Moderate to major. All habitat on the surface (epifauna) e.g. sponges, bryozoans, sea squirts, corals, pebbles/cobbles and shallow burrowing infauna, in the path of the dredge shot are at risk of removal. Mortality related to taxa, but can be expected to be high, even if returned to the sea after haul and surface time. Intentional skimming off of sediments to get to target sp. in furrows causes sediment resuspension, translocation in currents and particle size sorting (winnowing), which alters substrate and habitat structure, and biogeochemical processes in a way that requires years to at least a decade to recover. Confidence: High, data available - despite industry related studies focusing on target species abundance not habitat sustainability.
	Incidental behaviour	1	4	4	Habitat structure and function	Southern Pelagic Province - Coastal	5.1	1	1	2	Fishing using recreational gear (mainly trolling) on way to and from grounds. Not likely to affect benthic habitats. Intensity: negligible. Consequence: negligible. Confidence: high, MAC advice.
Direct impact without capture	Bait collection	0	0	0							
	Fishing	1	3	4	Habitat structure and function	coarse sediments, wave rippled, bioturbators, inner shelf	5.1	3	3	1	Infaunal habitat (within the substrate) is most at risk of direct impact without capture from the dredge gear. Intensity: moderate. Consequence: moderate. Effects of dredging disturbance on post encounter status of fauna and habitat is largely unquantified. Bioturbators are unlikely to be identified in bycatch; however habitat architecture will be destroyed in the act of fishing. Time for recovery of substrate unknown, sessile infauna likely to be months to years, providing recruitment possible (requires longer cycles of disturbance). Confidence: low due to lack of information on substratum infaunal processes in this region.
	Incidental behaviour	1	4	4	Habitat structure and	Southern Pelagic Province - Coastal	5.1	1	1	2	Fishing using recreational gear (mainly trolling) on way to and from grounds. Not likely to affect benthic habitats through contact without capture. Intensity: negligible. Consequence: negligible. Confidence: high, MAC advice.

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
					function						
	Gear loss	1	3	4	Habitat structure and function	coarse sediments, wave rippled, large sponges, inner shelf	5.1	1	2	2	Amount of gear lost not well understood. Dredges can be lost, however uncommon and expensive, may crush fauna in vicinity. Intensity: negligible. Consequence: minor, Gear will remain on bottom till breaks down, to eventually become new habitat, if not buried. Confidence High, MAC advice
	Anchoring/ mooring	1	3	3	Habitat structure and function	fine sediments, wave rippled, large sponges, inner shelf	5.1	1	1	2	Where anchoring does occur, it is likely to be in shallow inshore areas. Intensity: negligible, infrequent. Consequence: negligible. Impact of the anchor localized and negligible for large sponge habitat, over scale of possible anchoring sites. Confidence high, logic based
	Navigation/ steaming	1	4	4	Water quality	Southern Pelagic Province - Coastal	1.1	3	2	2	Light and noise from steaming likely to impact the pelagic habitat over greater scale than that of fishing effort. Intensity, negligible. Consequence: minor, as soon as activity ceases, no evidence of activity remains. Confidence high, and constrained by logic
Addition/ movement of biological material	Translocation of species	1	4	4	Substrate quality	coarse sediments, wave rippled, large sponges, inner shelf	3.1	5	3	1	The influence of this fishery on the ecology of the introduced New Zealand screw shell is unclear at present. Intensity: Impact considered to be very severe locally, the mechanism driving this is not understood. Consequence: This introduced species may disrupt the sediments directly in foraging, or by displacing important structuring species, which interact with and provide native habitat. Confidence low, considerable uncertainty about changes in habitat function as introduced species proliferate, and relationship to fishing.
	On board processing	0	0	0							
	Discarding catch	1	3	4	Substrate quality	fine sediments, unrippled, bioturbators, inner shelf	3.1	3	3	1	Bycatch discarding is high; mortality status of fauna variable and taxa dependent. Hard bodied discards may settle on the substrate, possibly in localised accumulations. Bioturbated fine sediments may become anoxic (lowest oxygen content below the surface compared with other habitat types) particularly in areas of slower flushing times typical within areas of Bass Strait. Scavenging animals will process material in time, and discarding may be dispersed if vessel underway, which would reduce the concentration of the discards. Intensity: moderate due to uncertainty. Consequence: moderate, Volumes of discards unknown. Confidence: low require information about discards and benthos.
	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	0	0	0							
	Organic waste disposal	1	4	4	Water quality	Southern Pelagic Province - Coastal	1.1	1	2	1	The level of organic waste could be expected to be minimal, however may be highly localised due to the spatial scale of the effort within this fishery. Excess waste could accumulate in quiescent periods but is unlikely generally, as dispersal could be expected to be relatively rapid in this region of strong currents and wave/ swell action, and shifting coarser grained sediments. Intensity low. Consequence minor, generally undetectable. Confidence low, no information available.
Addition of non-biological material	Debris	1	4	4	Water quality	Southern Pelagic Province - Coastal	1.1	2	2	1	MARPOL regulations apply. Assumed that accidental loss occurs, and that debris will generally sink, where it will eventually form habitat where breakdown times are long. Some will float, drifting about until washed ashore, otherwise impact the pelagic habitat and species dwelling within it, e.g. small scraps of plastic may be ingested. Intensity is minor. Consequence: minor if minimal. Sinking debris may not be buried easily, and may accumulate, although uncertain in dynamic wave and storm swell environments. Confidence low.
	Chemical pollution	1	4	4	Water quality	Southern Pelagic Province - Coastal	1.1	1	1	2	Chemical spills (inadvertent) and operation of vessel, affects pelagic water quality. Intensity: negligible, Volumes of material expected to be quickly dispersed. Consequence: therefore also negligible. Confidence: high and constrained by logic
	Exhaust	1	4	4	Air quality	Southern Pelagic Province - Coastal	2.1	2	1	2	Emissions from operation of vessel may disturb air quality of species above vessel. Intensity: Minor, though may be concentrated at a local level. Consequence: negligible, volumes of material expected to disperse rapidly. Confidence high and constrained by logic
	Gear loss	1	3	4	Habitat structure and function	coarse sediments, wave rippled, large sponges, inner shelf	5.1	1	2	2	Amount of gear lost not well understood. Intensity: Dredges can be lost, however uncommon. Consequence: minor, some detectibility will exist where gear remains on bottom, to eventually become a new substrate/ habitat, if not buried. Confidence High; MAC advice.
	Navigation/ steaming	1	4	4	Water quality	Southern Pelagic Province - Coastal	1.1	2	1	2	Light and noise are additions to the pelagic habitat during fishing operations. Intensity: minor, as soon as activity ceases, no evidence of activity remains. Consequence: negligible. Confidence high, and constrained by logic
	Activity/ presence on water	1	4	4	Water quality	Southern Pelagic Province - Coastal	1.1	3	1	2	The noise and visual stimuli related to the presence of vessels impact the pelagic habitat for as long as the fishing activity occurs. As soon as activity ceases, no evidence in terms of air and water quality remains. Confidence high, and constrained by logic
Disturb physical	Bait collection	0	0	0							

Direct impact of fishing	Fishing Activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
processes	Fishing	1	4	4	Substrate quality	fine sediments, wave rippled, mixed faunal community, inner shelf	3.1	3	3	2	Dredging disturbs benthic sediments to an approximate depth of 50mm. The resulting suspension of sediments will temporarily increase water turbidity, the extent is influenced by sediment type (greater in fine sands and mud), and the strength of currents present. The major commercial beds of Bass Strait are characterised by coarse sediments, which are unlikely to remain suspended for long, however during resettlement may smother sessile fauna, resorted sediments (winnowing) alter substrate architecture, and change the mineralization of settled organic material within the substrate. Intensity and consequence: moderate; reflect that raking of the substrate alters infaunal and epifaunal habitat structure, both locally severely and in the immediate surrounds, to a lesser degree. Confidence is based on scientific studies into the effects of dredging and trawling on the benthos.
	Boat launching	0	0	0							
	Anchoring/ mooring	1	3	3	Habitat structure and function	coarse sediments, wave rippled, mixed faunal community, inner shelf	5.1	1	1	2	Where anchoring does occur, it is likely to be in shallow inshore areas where the impact of the anchor on sediment processes is localized and negligible compared with the regular mixing and disturbance due to physical processes. Confidence high, logic based
	Navigation/steaming	1	4	4	Water quality	Southern Pelagic Province - Coastal	1.1	2	1	2	Mixing of the water column is unlikely to have more than a minor intensity and negligible consequence on water quality, structure of the water column, or pelagic productivity. Confidence high, constrained by logic
External Impacts (specify the particular example within each activity area)	Other fisheries	1	5	6	Habitat structure and function	coarse sediments, wave rippled, mixed faunal community, inner shelf	5.1	3	3	1	Other fisheries that operate within the BSCZSF are SET OT and Danish Seine, GHAT scale and shark capture methods. Few of these overlap the active zone of effort, although trawls may tow over grounds adding to trashing effect over scallop beds in an attempt to attract species. Intensity: moderate. Consequence: at least moderate, frequency of disturbance affects recovery of habitat. Confidence: low, need data on frequency of overlap when scallop beds closed to scalloping.
	Aquaculture	1	3	6	Substrate quality	fine sediments, current rippled, bioturbators, inner shelf	3.1	1	1	2	Changes in water quality and sediment anoxia may result if pen wastes or extra feed in the water accumulate at the bottom of pens. Intensity: Negligible. Considered an unlikely scenario for this fishery as aquaculture in region, not feeding its animals, and more inshore effect. Consequence: therefore negligible. Confidence high, aquaculture not in region of fishing effort.

Direct impact of fishing	Fishing Activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
	Coastal development	1	4	6	Habitat structure and function	coarse sediments, wave rippled, mixed faunal community, inner shelf	5.1	2	2	1	If target species beds are close to the coast, habitat structure and function may be impacted from coastal development, runoff from developed lands may lead to greater inputs of freshwater, nutrients, fertilizers, impacts on target species habitats. Intensity: minor, due to the lack of development on that coast of Flinders. Consequence: minor, unlikely that this effect will expand in the near future. Confidence low due to lack of data
	Other extractive activities	1	5	6	Habitat structure and function	coarse sediments, wave rippled, mixed faunal community, inner shelf	5.1	3	3	1	Drilling for oil and gas, may discharge new substrates into an area, altering habitat structure. Intensity: moderate- locally intense. Consequence: possibly moderate, how these are advected to other areas, depends on the materials. Confidence low.
	Other non extractive activities	1	6	6	Habitat structure and function	coarse sediments, wave rippled, mixed faunal community, inner shelf	5.1	2	2	2	Laying of cables (Bass Link, Telstra, Duke Energy) either adds substrate in terms of anchors, cable, rubble to bury, or materials dug to make a channel, including activities surrounding ongoing maintenance. Intensity and consequence: Considered minor as occurs in locations away from current fishery grounds (central zone). Scale of these activities small over area of the BSCZSF area, and do not overlap with the active area of the fishing. Confidence High, data available.
	Other anthropogenic activities	1	5	5	Water quality	Southern Pelagic Province - Coastal	1.1	1	1	2	Impact low, scenarios hard to envisage, compared with scale of natural disturbance. Confidence high due to logic and lack of other scenarios

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	0									
	Fishing	1	3	4	Functional group composition	SET inner shelf	2.1	3	3	1	Fishing will likely remove the filter feeding sessile and mobile (scallops) members of the communities. Most fishing effort for the Bass Strait Scallop fishery occurs north east of Flinders Island, corresponding to the area of the South East Transition Province. Victorian and Tasmanian scallop fisheries also operate in the same fishery area and the same stock is fished. However direct fishing impacts of these state managed fisheries are not assessed, but they can potentially impact the stock. Intensity: High, as impact of fishing likely to be loss of a species within a functional group, and possibly the trophic structure and distribution of communities altered. Consequence: High impact on community. Confidence: Low due to lack of state fisheries data.
	Incidental behaviour	1	4	4	Species composition	Southern coastal pelagic	1.1	2	1	2	Capture due to trolling of the larger members of the inshore community, such as fish, may occur. Intensity: Minor, as trolling expected to have minimal impact on community. Consequence: Negligible impact on community. Confidence: High due to scale of activity and logical consideration.
Direct impact without capture	Bait collection	0									
	Fishing	1	3	4	Functional group composition	SET inner shelf	1.1	3	3	1	Damage to the structure as a result of dredging will change the size structure, as species may survive and be buried in the sediment. Only larger infauna, deeper in the substrate will persist. Intensity: Moderate. Consequence: Moderate impact on community. Confidence: Low due to lack of data.
	Incidental behaviour	1	4	4	Species composition	Southern coastal pelagic	1.1	2	1	2	Damage to the larger members of the inshore community, such as fish may occur by trolling. The impact is judged to be negligible. Intensity: Minor. Consequence: Negligible as impact unlikely to be detectable at scale of community. Confidence: High due to scale of activity and logical consideration
	Gear loss	1	3	4	Species composition	SET inner shelf	1.1	2	1	2	Gear that damages epifauna and infauna by contact may change species composition. Intensity: Minor. Consequence: Negligible impact on community, as gear is seldom lost, and unlikely to be detectable at scale of community. Confidence: High that this is not a big impact, due to logical consideration.
	Anchoring/ mooring	1	3	3	Species composition	SET inner shelf	1.1	2	1	2	Vessels rarely anchor while at sea. If it occurs, may change species composition of community through mortality of megabenthos. Intensity: Minor. Consequence: Negligible impact as activity is unlikely to be detectable at scale of community. Confidence: High due to logical consideration.

Direct impact of fishing	Fishing Activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
	Navigation/ steaming	1	4	4	Species composition	Southern coastal pelagic	1.1	2	1	2	Navigation/steaming occur during fishing season. However, this mostly occurs in areas of greatest fishing effort. Intensity: Minor due to small spatial overlap of fishing with community. Consequence: Negligible impact, as activity is unlikely to be detectable at scale of community. Confidence: High, logical consideration, but more data required.
Addition/ movement of biological material	Translocation of species	1	4	4	Species composition	SET inner shelf	1.1	3	3	1	Addition of a new species may change the species composition, and impact the community that may be dependent on the species. If the translocated species is an introduced marine pest (e.g. Northern Pacific sea star (*Asterias amurensis*), New Zealand screwshell *(Maoricolpus roseus*), seballa worm (*Sabella spallanzanii*)) then this activity may spread the potential range of these pests, and hence contribute to a major change to the community. Intensity: Moderate. Consequence: Moderate impact on community. Confidence: Low due to lack of information.
	On board processing	0									
	Discarding catch	1	3	4	Distribution of community	SET inner shelf; Southern coastal pelagic	1.1	2	2	1	Discarding target species due to high grading or damage, and discarding byproduct species of low value or lack of market demand may occur in areas of greatest fishing effort. Dumping of dredged material may also occur. Intensity: Minor, since waste expected to be taken up quickly by opportunistic species or scavengers or sink to the benthos and scavenged by benthic species. Consequence: Minor, unlikely to affect the species composition of community. Confidence: Low due to lack of verified observer data.
	Stock enhancement	0									
	Provisioning	0									
	Organic waste disposal	1	4	4	Distribution of community	SET inner shelf	5.1	1	1	1	Fishing trips usually last for a day. Vessels subject to MARPOL rules. Intensity: Negligible, provided MARPOL rules are adhered to. Consequence: Negligible, because organic waste likely to be scavenged or break down quickly, so unlikely persistent effect of distribution of community. Confidence: Low due to lack of verified observer data.
Addition of non-biological material	Debris	1	4	4	Species composition	SET inner shelf; Southern coastal pelagic	5.1	1	1	1	Plastics may be an issue, entanglement, ingestion, litter. Vessels subject to MARPOL. Otherwise if debris sinks to the benthos can provide further refuge or hinder the species. Intensity: Negligible if MARPOL rules followed. Consequence: Negligible, as debris by this fishery expected to be accidental and not routine. Confidence: Low, due to 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
	Chemical pollution	1	4	4	Species composition	SET inner shelf; Southern coastal pelagic	5.1	1	1	1	Chemicals used during fishing activities may be an issue, but unlikely as vessels are out at sea for usually a day at a time. Community unlikely to be affected unless a major spill. Boats subject to MARPOL rules. Intensity: Negligible if MARPOL rules followed. Consequence: Negligible because chemical pollution impacts expected to be minimal and therefore unlikely to directly impact community. Confidence: Low due to lack of verified observer data.
	Exhaust	1	4	4	Distribution of community	Southern coastal pelagic	5.1	1	1	2	Exhaust emissions likely to affect the bio and geo chemical cycles of community. Intensity: Negligible because exhaust considered low impact to community i.e. physically affected, unlikely to be measurable. Possible effects on air quality more likely to be short term. Consequence: Negligible because impact on community unlikely to be detected. Confidence: High because exhaust unlikely to impact community.
	Gear loss	1	3	4	Distribution of community	SET inner shelf	1.1	2	1	2	Gear loss that smothers part of the substrate, or allows build up of sand, around a structure may affect species composition, or the addition of new species to the substrate may provide a refuge. Intensity: Minor, for this fishery direct impact expected to be minimal unlikely to be detectable against background variability. 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 species composition. Confidence: Low because of a lack of data on interactions.
	Navigation/ steaming	1	4	4	Distribution of community	Southern coastal pelagic	1.1	1	1	2	Navigation/steaming occur throughout fishing season over a small area of the fishery. Intensity: Negligible because it is unlikely to have measurable/detectable impact on species composition (e.g. seabirds). Consequence: Negligible because interactions remote, and impact on community unlikely. Confidence: High because it was considered unlikely for there to be strong interactions between navigation/steaming and community.
	Activity/ presence on water	1	4	4	Distribution of community	Southern coastal pelagic	3.1	1	1	2	The environment will be impacted by noise and visual stimuli could temporarily effect distribution of the community. Intensity: Negligible because it is unlikely to have measurable/detectable impact on community. Consequence: Negligible because type of impact on community. Confidence: High because it was considered unlikely for there to be strong impacts between activity and presence and community.
Disturb physical	Bait collection	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
processes	Fishing	1	4	4	Distribution of community	SET inner shelf	5.1	2	2	2	Fishery occurs throughout fishing season over a small area of the fishery. Smothers part of the substrate, or allows build up of sand, around a structure, dredging may stir sediments and therefore increase turbidity and sedimentation affecting the distribution of the community members. Intensity: Minor detectable effect on the physical processes important to the demersal community. Consequence: Given scale of disturbance relative to natural, considered minor at most. Confidence: High due to logical consideration.
	Boat launching	0									
	Anchoring/ mooring	1	3	4	Distribution of community	SET inner shelf	5.1	1	1	2	Disturbance due to anchoring/mooring may disrupt the sediments causing immediate disruption to distribution of animals and further bacterial decomposition in the substrates, liberating the particulate organic matter before it becomes dissolved organic matter. Vessels rarely anchor or moor. Intensity: Negligible, given scale of disturbance relative to natural cycles. 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	4	4	Distribution of community	Southern coastal pelagic	1.1	1	1	2	Navigation/steaming occur throughout fishing season over a small area of the fishery. Intensity: Negligible. Consequence: Negligible. Confidence: High because it was considered unlikely for there to be strong interactions between navigation/steaming and community.
External Impacts (specify the particular example within each activity area)	Other fisheries - SET etc	1	5	6	Trophic/size structure	SET inner shelf; Southern coastal pelagic	4.1	3	3	1	Fishery covers a large spatial area in which many other state and commonwealth fisheries occur, using wide range targeting methods and catch species. These state fisheries target apex predators in the same area, will remove the larger animals, and thus would release the predation and competition pressure of lower trophic groups. Trawling by other fisheries also an issue here. Intensity: Moderate, could have measurable major direct or indirect impact on communities once linkages fully understood. Consequence: Moderate. Confidence: Low.
	Aquaculture	1	3	6	Bio and geo chemical cycles	SET inner shelf; Southern coastal pelagic	5.1	1	1	1	Aquaculture sites generally located adjacent to Tasmanian coast. Changes in bio and geochemical cycles due to discharges or additional feed through the water column not believed to have large impact on community. Intensity: Negligible, as any effects on community likely to be highly localized. Consequence: Negligible, as any effect on community unlikely to be measurable. Confidence: Low due to lack of data, as it requires further discussion.

Direct impact of fishing	Fishing Activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale
	Coastal development	1	4	6	Bio and geo chemical cycles	SET inner shelf	5.1	3	3	1	Fishery occurs in a small area relative to the community. Sewage from major settlements, eutrophication and algal blooms may occur. Intensity: Moderate, impact both direct and indirect on community. May be different around a major population centre but linkages need to be better understood. Consequence: Moderate, cumulative effects could be moderate and may impact community. Also, changes to bio or geochemical cycles may be measurable. Confidence: Until there is better information difficult to score therefore low confidence.
	Other extractive activities	1	5	6	Distribution of community	SET inner shelf	3.1	2	2	1	Ongoing development and expansion of oil and gas pipelines, oil and gas exploration and extraction drilling, and seismic survey for further oil and gas exploration occurs across southern Australia (notably Bass Strait). Drilling for oil and gas, may discharge new substrates in an area. Also, pollution in both shallow and deep water, noise and visual stimuli may affect community. Intensity: Minor, as any effects on community likely to be highly localized. Consequence: Assumed to have minor direct and indirect impacts on community, but linkages need to be better understood. Confidence: Until there is better information difficult to score therefore low confidence.
	Other non-extractive activities	1	6	6	Distribution of community	SET inner shelf	3.1	2	2	1	Installation of high voltage direct current (HVDC) sub-sea cables (notably Basslink across Bass Strait) may affect distribution of the community via emissions that could affect fish populations. Intensity: Minor, as local affects are possible. Consequence: Minor as impact probably in different locations to current fished areas and long-term effects on community expected to be minimal. Confidence: Low, as scale of these activities and overlap with the BSS fishery is unknown.
	Other anthropogenic activities	1	5	5	Distribution of community	SET inner shelf	3.1	1	1	1	Community may be disturbed by tourism (whale watching) using charter boats, other shipping. Intensity: Assumed to have negligible impact on both direct and indirect 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.

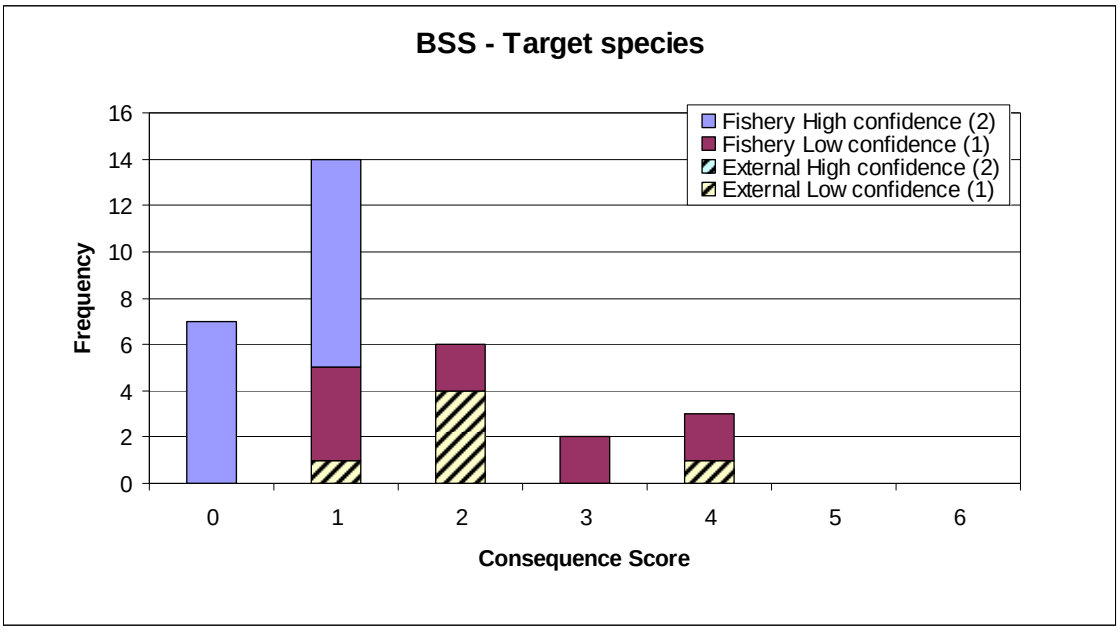
2.3.11 Summary of SICA results

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

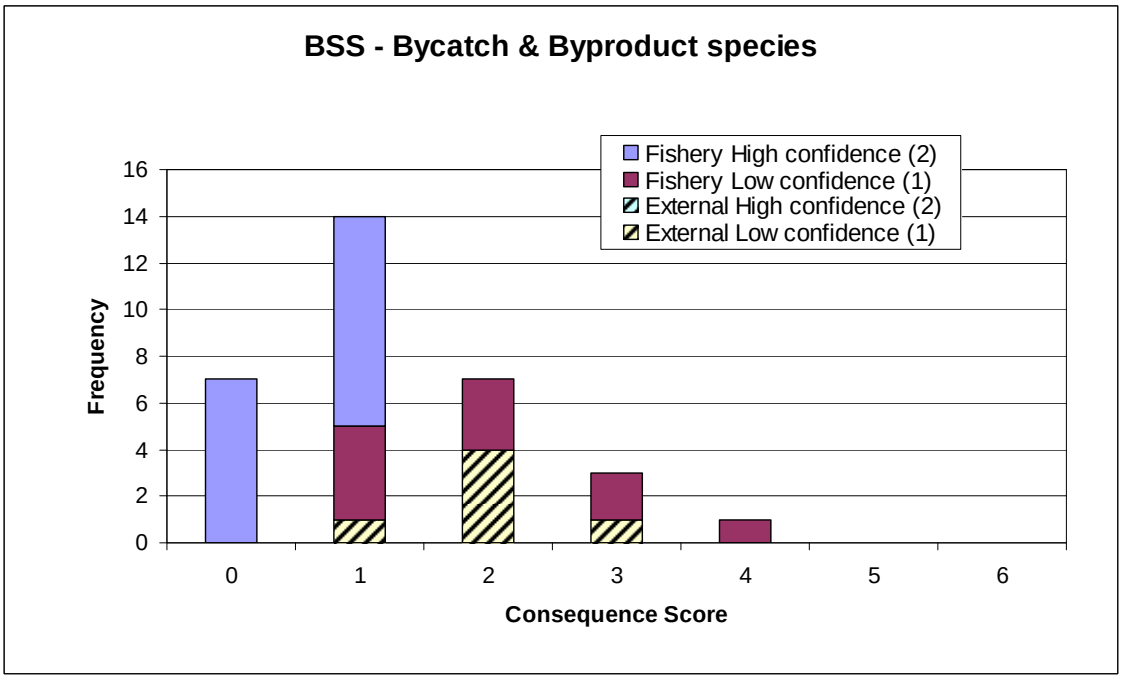
Level 1 (SICA) Document L1.6. Summary table of consequence scores for all activity/component combinations.

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

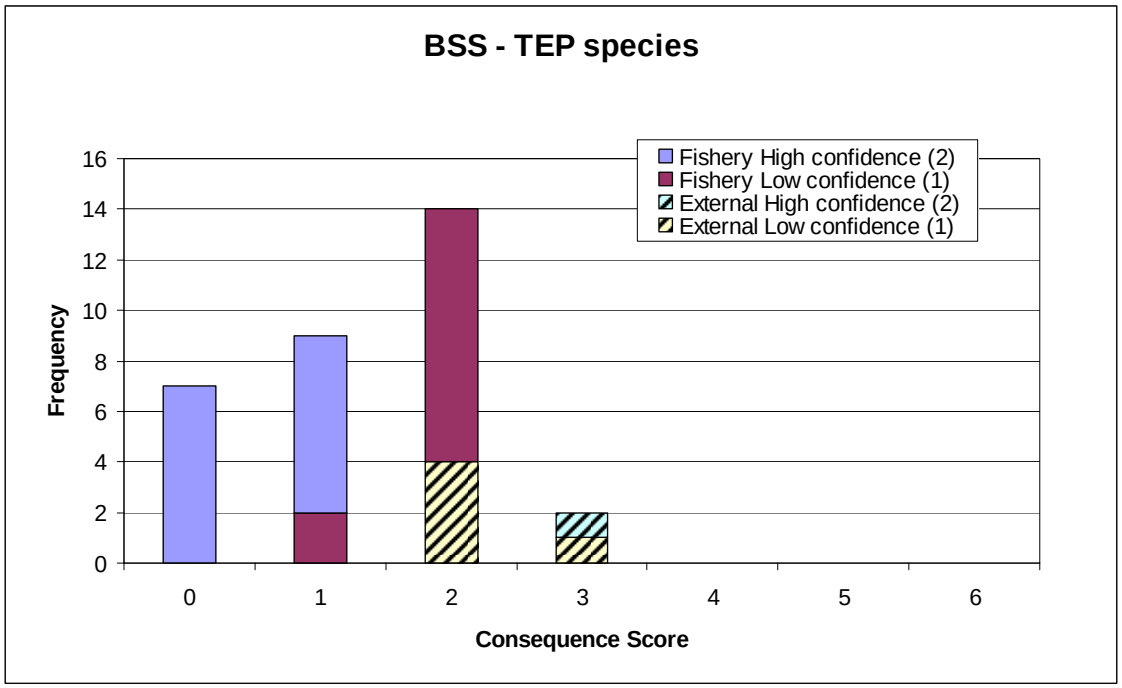
Target species: Frequency of consequence score differentiated between high and low confidence.



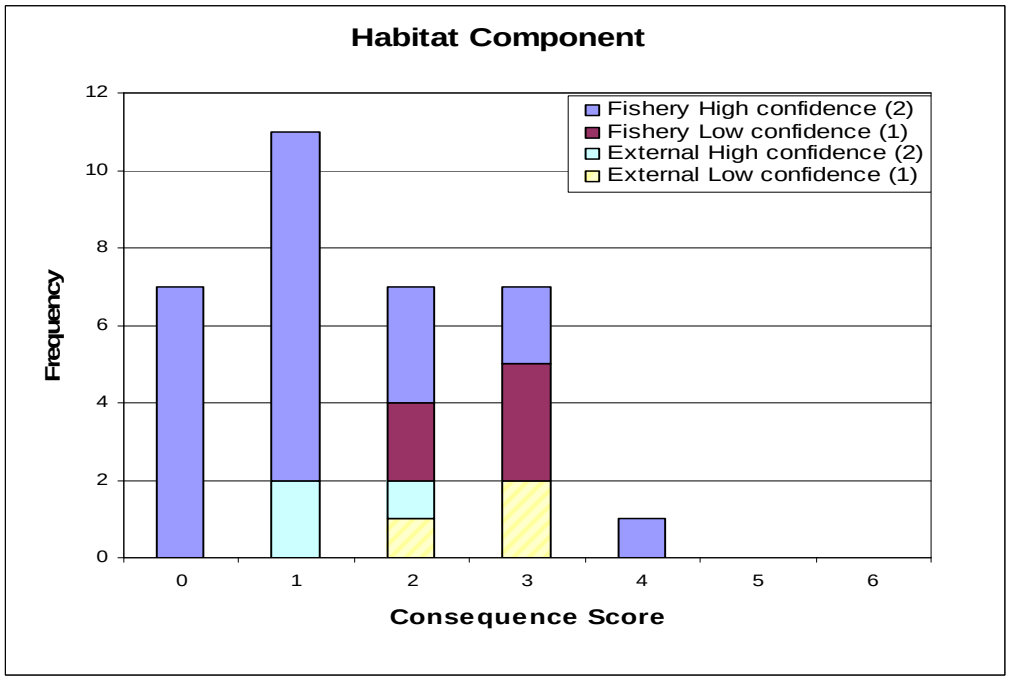
Byproduct and bycatch species: Frequency of consequence score differentiated between high and low confidence



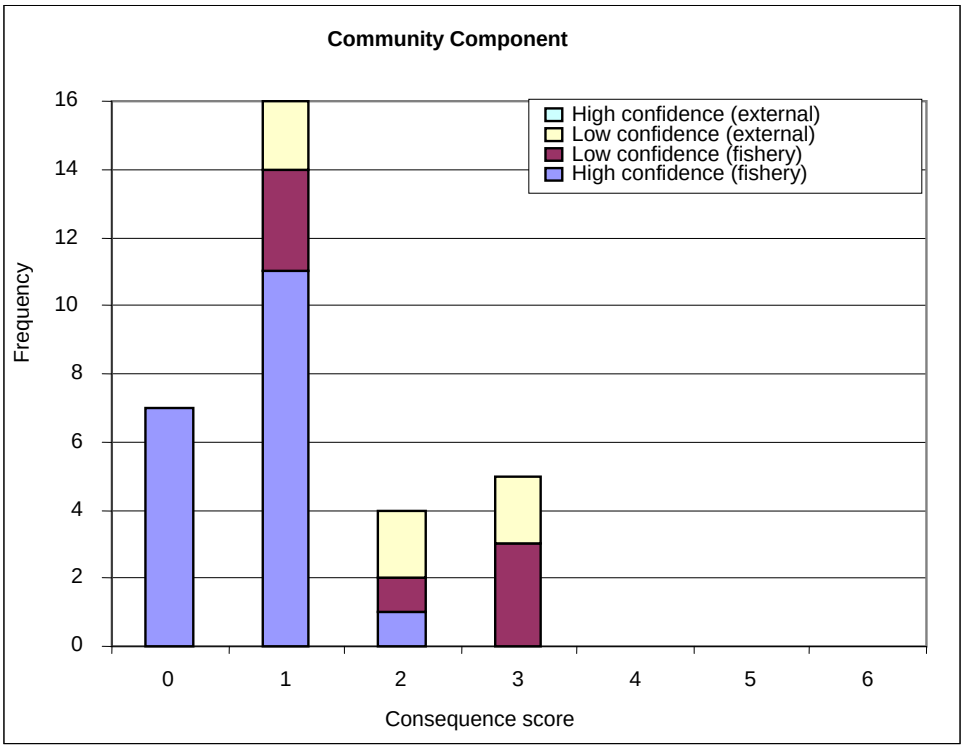
TEP species: Frequency of consequence score differentiated between high and low confidence (SICA excel workbook)



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



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



2.3.12 Evaluation/discussion of Level 1

Four components had Level 1 scores of 3 or more, while the TEP component did not for any of the internal scenarios, and was thus eliminated from further analysis.

Fishing was the main hazard, and was involved in scenarios with direct and indirect impacts of capture, and disturbance of physical processes through the action of the fishing gear. The only other hazard identified was translocation of species, via the potential for introduced species, such as New Zealand screw shell to be introduced to the fishing grounds, where it might become abundant.

The significant external hazards were the other fisheries in the general area, although there may be little other impact on the scallop fishing grounds. Coastal development and extractive activities, such as oil rig-based drilling were also recognized as potential ecological hazards in the area of the BSS.

2.3.13 Components to be examined at Level 2

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

- *Target species*
- *Bycatch species*
- *Habitats*
- *Communities*

Thus, a single component was eliminated from further analysis

- *TEP species*

2.4 Level 2 Productivity and Susceptibility Analysis (PSA)

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

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

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

Species

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

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

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

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

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

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

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

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

Habitats

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

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

Communities

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

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

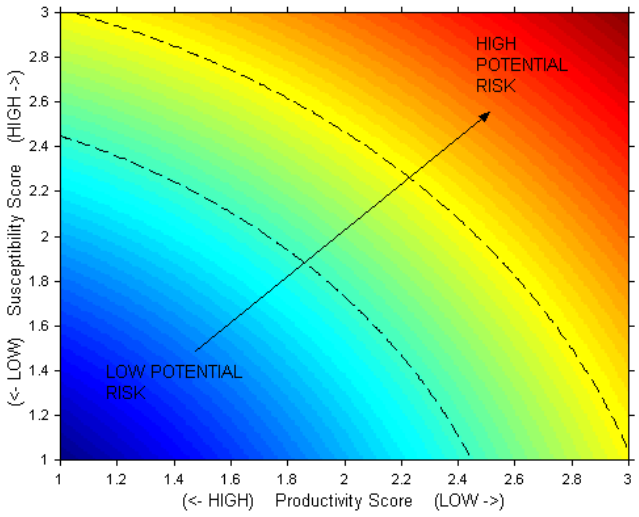


Figure 13. The axes on which risk of the ecological units is plotted. The *x*-axis includes attributes that influence the productivity of a unit, or its ability to recover after impact from fishing. The *y*-axis includes attributes that influence the susceptibility of the unit to impacts from fishing.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

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

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

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

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

A number of taxa identified from survey data were excluded from this PSA, as they were not identified at the species level. Most of these higher taxa were represented at the species level. For example *Ophiothrix sp.* was represented by 3 individual species in the PSA.

ERA species ID	Taxa	Scientific name	CAAB code	Family name	Common name	Explanation of why taxa excluded	Source
1805	Chondrichthyan	Shark Egg case			Shark Egg case	unknown taxa	New list from Noel Coleman: 20050804
1765	Chondrichthyan	Sharks - other	37990003	Multi-family group	Sharks (other)	unknown taxa	Species added from GENLOG species list 2001-2004
2026	Invertebrate	Brachyura - undifferentiated	28850000	infraorder Brachyura	crabs	unknown taxa	Species added from GENLOG species list 2001-2004
1804	Invertebrate	Ophiothrix sp.			Brittle star : ophiuroid brittlestar	unknown taxa	New list from Noel Coleman: 20050804
2003	Invertebrate	Order Octopoda - undifferentiated	23650000	Order Octopoda	octopods	unknown taxa	Species added from GENLOG species list 2001-2004
1981	Invertebrate	Porifera - undifferentiated	10000000		sponges	unknown taxa	Species added from GENLOG species list 2001-2004
1820	Invertebrate	Pyura sp.		Pyuridae	Stalked sea squirt : Pyura sp.	unknown taxa	New list from Noel Coleman: 20050804
2023	Invertebrate	Scyllaridae - undifferentiated	28821000	Scyllaridae	shovel-nosed/slipper lobsters	unknown taxa	Species added from GENLOG species list 2001-2004
1825	Invertebrate	Sponges various unidentified			Sponges various unidentified	unknown taxa	New list from Noel Coleman: 20050804
2148	Not Allocated	Ostreidae & Pteriidae spp	23255901		oyster	unknown taxa	Species added from GENLOG species list 2001-2004
1818	Invertebrate	Stony coral			Stony coral	unknown taxa	New list from Noel Coleman: 20050804
2143	Teleost	Bothidae, Psettodidae & Pleuronectidae (all spp)	37990009	Multi-family group	flounder	unknown taxa	Species added from GENLOG species list 2001-2004
1444	Algae	Carpoglossum confluens	54103002	Cystoseiraceae	Carpoglossum	Habitat forming kelp -assessed in habitat section	Haddon and Semmens 2001, 2002
1442	Algae	Ecklonia radiata	54080001	Alariaceae	Common kelp	habitat forming kelp - assessed in	Haddon and Semmens 2001, 2002

						habitat section	
1443	Algae	Phyllospora comosa	54102001	Seirococcaceae	[a brown alga]	habitat forming kelp - assessed in habitat section	Haddon and Semmens 2001, 2002

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 (which is closed). In the past there has been occasional scientific involvement on fishing vessels, and this data were used to derive a bycatch species list.

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 *BSS fishery*

ERA species ID	Scientific name	Common name	Average logbook catch (kg) (2001-04)	Missing > 3 attributes (Y/N)	Missing productivity attributes (out of 7)	Missing susceptibility attributes (out of 5)	Productivity (additive) (1- low, 3-high)	Susceptibility (mult) (1- low, 3-high)	Risk value (P&S) (low-high range=1.41-4.24)	Susceptibility override used?	PSA risk category	High/Med risk category (Refer 2.4.8)	Comments
Invertebrate													
1272	Pecten fumatus	Scallop	445,548	N	0	0	1.14	3.00	3.21	Y	High	Low overlap	Availability override: wider distribution, fishery information

Byproduct species *BSS fishery*

ERA species ID	Scientific name	Common name	Average logbook catch (kg) (2001-04)	Missing > 3 attributes (Y/N)	Missing productivity attributes (out of 7)	Missing susceptibility attributes (out of 5)	Productivity (additive) (1- low, 3-high)	Susceptibility (mult) (1- low, 3-high)	Risk value (P&S) (low-high range=1.41-4.24)	Susceptibility override used?	PSA risk category	High/Med risk category (Refer 2.4.8)	Comments
Invertebrate													
1271	Mimachlamys asperrima	Doughboy Scallop	14,091	N	2	1	1.57	2.33	2.81	Y	Med	Spatial uncertainty	Availability override: not concentrated in fishing area, stakeholder opinion

Bycatch species *BSS fishery*

ERA species ID	Scientific name	Common name	Average logbook catch (kg) (2001-04)	Missing > 3 attributes (Y/N)	Missing productivity attributes (out of 7)	Missing susceptibility attributes (out of 5)	Productivity (additive) (1- low, 3-high)	Susceptibility (mult) (1- low, 3-high)	Risk value (P&S) (low-high range=1.41-4.24)	Susceptibility override used?	PSA risk category	High/Med risk category (Refer 2.4.8)	Comments
Chondrichthyan													
493	Cephaloscyllium laticeps	Draughtboard Shark	0	N	2	0	2.57	1.67	3.06	N	Med	Low overlap	
760	Dipturus lemprieri	Thornback skate	0	N	0	0	1.86	2.33	2.98	N	Med	*Other	
764	Dasyatis brevicaudata	Smooth stingray	0	N	0	0	2.29	1.67	2.83	N	Med	Low overlap	
260	Heterodontus portusjacksoni	Port Jackson Shark	0	N	1	0	2.29	1.67	2.83	N	Med	Low overlap	
775	Trygonoptera testacea	Common stingaree	0	N	2	0	2.29	1.67	2.83	N	Med	Low overlap	
687	Trygonorrhina fasciata	Fiddler ray	0	N	0	0	2.29	1.67	2.83	N	Med	Low overlap	
1065	Dipturus whitleyi	Whitley's (melbourne) skate	0	N	0	0	2.43	1.44	2.83	N	Med	Low overlap	
744	Narcine tasmaniensis	Little numbfish	0	N	1	0	2.00	1.67	2.60	N	Low		
772	Urolophus cruciatus	Banded stingaree	0	N	0	0	1.86	1.67	2.50	N	Low		
774	Urolophus paucimaculatus	Sparsely-spotted stingaree	0	N	0	0	1.71	1.67	2.39	N	Low		
Invertebrate													
1807	Astropecten pectinatus	Seastar	0	Y	6	2	2.71	3.00	4.05	N	High	Missing data	
1274	Eucrassatella kingicola	Crassatella	0	Y	6	2	2.71	3.00	4.05	N	High	Missing data	
1808	Luidia australiae	Black and white seastar	0	Y	5	0	2.43	3.00	3.86	N	High	Missing data	
762	Hapalochlaena maculosa	southern blue ringed octopus	0	N	0	1	1.71	3.00	3.46	N	High	Spatial uncertainty	

ERA species ID	Scientific name	Common name	Average logbook catch (kg) (2001-04)	Missing > 3 attributes (Y/N)	Missing productivity attributes (out of 7)	Missing susceptibility attributes (out of 5)	Productivity (additive) (1- low, 3-high)	Susceptibility (mult) (1- low, 3-high)	Risk value (P&S) (low-high range=1.41-4.24)	Susceptibility override used?	PSA risk category	High/Med risk category (Refer 2.4.8)	Comments
1329	Alpheus spp.	Snapping shrimp	0	Y	7	2	3.00	1.67	3.43	Y	High	Missing data	Availability override: wider distribution outside fished area
1308	Heliocidaris erythrogramma	Common urchin	0	Y	7	1	3.00	1.67	3.43	Y	High	Missing data	Availability override: wider distribution outside fished area
1357	Herdmania momus	Sea squirt	0	Y	7	2	3.00	1.67	3.43	Y	High	Missing data	Availability override: wider distribution outside fished area
1520	Holopneustes inflatus	[a sea urchin]	0	Y	7	2	3.00	1.67	3.43	Y	High	Missing data	Availability override: wider distribution outside fished area
1300	Nectria ocellata	Oreasterid	0	Y	7	2	3.00	1.67	3.43	Y	High	Missing data	Availability override: wider distribution outside fished area
1270	Ostrea (Eostrea) angasi	Mud oyster	0	Y	7	2	3.00	1.67	3.43	Y	High	Missing data	Availability override: wider distribution outside fished area
1263	Primnoella australasiae	Sea whip	0	Y	7	2	3.00	1.67	3.43	Y	High	Missing data	Availability override: wider distribution outside fished area
2263	Membranipora perfragilis	bryozoan	0	Y	7	2	3.00	1.67	3.43	Y	High	Missing data	Availability override: wider distribution outside fished area
1343	Dromia wilsoni	Sponge crab	0	Y	6	2	2.86	1.67	3.31	Y	High	Missing data	Availability override: wider distribution outside fished area

ERA species ID	Scientific name	Common name	Average logbook catch (kg) (2001-04)	Missing > 3 attributes (Y/N)	Missing productivity attributes (out of 7)	Missing susceptibility attributes (out of 5)	Productivity (additive) (1- low, 3-high)	Susceptibility (mult) (1- low, 3-high)	Risk value (P&S) (low-high range=1.41-4.24)	Susceptibility override used?	PSA risk category	High/Med risk category (Refer 2.4.8)	Comments
1296	Fusinus (Fusinus) novaehollandiae	New Holland spindle shell	0	Y	6	2	2.86	1.67	3.31	Y	High	Missing data	Expert override : PCM reduced to low, is a snail in shell (Alistair Hobday)
1342	Lamarckdromia globosa	Sponge crab	0	Y	6	2	2.86	1.67	3.31	Y	High	Missing data	Availability override: wider distribution outside fished area
1523	Leptomithrax gaimardii	great spider crab	0	Y	6	2	2.86	1.67	3.31	Y	High	Missing data	Availability override: wider distribution outside fished area
1350	Liocarcinus corrugatus	Swimming crab	0	Y	6	2	2.86	1.67	3.31	Y	High	Missing data	Availability override: wider distribution outside fished area
1349	Nectocarcinus tuberculosus	Red swimmer crab	0	Y	6	2	2.86	1.67	3.31	Y	High	Missing data	Availability override: wider distribution outside fished area
1285	Octopus berrima	Sand octopus	0	Y	6	1	2.86	1.67	3.31	Y	High	Missing data	Availability override: wider distribution outside fished area
1353	Pilumnus etheridgei	Hairy shore crab	0	Y	6	2	2.86	1.67	3.31	Y	High	Missing data	Availability override: wider distribution outside fished area
1344	Bellidilia undecimspinosa	Pebble Crab	0	Y	4	0	2.29	2.33	3.27	N	High	Missing data	
2007	Aplysiidae - undifferentiated	sea hares	0	Y	7	2	3.00	1.22	3.24	Y	High	Missing data	Availability override: wider distribution outside fished area

ERA species ID	Scientific name	Common name	Average logbook catch (kg) (2001-04)	Missing > 3 attributes (Y/N)	Missing productivity attributes (out of 7)	Missing susceptibility attributes (out of 5)	Productivity (additive) (1- low, 3-high)	Susceptibility (mult) (1- low, 3-high)	Risk value (P&S) (low-high range=1.41-4.24)	Susceptibility override used?	PSA risk category	High/Med risk category (Refer 2.4.8)	Comments
1299	Bollonaster pectinatus	Astropectinid	0	Y	6	2	2.71	1.67	3.19	Y	High	Missing data	Availability override: wider distribution outside fished area
1268	Glycymeris (Veletuceta) grayana	Dog cockle	0	Y	6	2	2.71	1.67	3.19	Y	High	Missing data	Expert override : PCM reduced to low, is a snail in shell (Alistair Hobday)
1819	Polycitor giganteus	Colonial ascidian	0	Y	6	2	2.71	1.67	3.19	Y	High	Missing data	Availability override: wider distribution outside fished area
1518	Conus anemone	[a cone shell]	0	Y	6	2	2.86	1.22	3.11	Y	Med	Missing data	Expert override : PCM reduced to low, is a snail in shell (Alistair Hobday)
1293	Cymatium (Monoplex) parthenopeum	Triton	0	Y	6	2	2.86	1.22	3.11	Y	Med	Missing data	Expert override : PCM reduced to low, is a snail in shell (Alistair Hobday)
1290	Cypraea (Notocypraea) comptoni	Cowrie	0	Y	6	2	2.86	1.22	3.11	Y	Med	Missing data	Expert override : PCM reduced to low, is a snail in shell (Alistair Hobday)
1275	Dosinia caerulea	Venus shell	0	Y	6	2	2.86	1.22	3.11	Y	Med	Missing data	Expert override : PCM reduced to low, is a snail in shell (Alistair 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 5)	Productivity (additive) (1- low, 3-high)	Susceptibility (mult) (1- low, 3-high)	Risk value (P&S) (low-high range=1.41-4.24)	Susceptibility override used?	PSA risk category	High/Med risk category (Refer 2.4.8)	Comments
1289	Maoricolpus roseus	Screw shell	0	Y	6	2	2.86	1.22	3.11	Y	Med	Missing data	Expert override : PCM reduced to low, is a snail in shell (Alistair Hobday)
2259	Adeana cellulosa	lace coral : bryozoan	0	Y	6	2	2.71	1.22	2.98	Y	Med	Missing data	Availability override: wider distribution outside fished area
1802	Venericardia amabilis	False cockle	0	Y	6	1	2.71	1.22	2.98	Y	Med	Missing data	Expert override : PCM reduced to low, is a snail in shell (Alistair Hobday)
1266	Myxicola infundibulum	Fan worm	0	Y	5	1	2.43	1.67	2.95	Y	Med	Missing data	Availability override: wider distribution outside fished area
1803	Ophiocrossota multispina	Brittle star	0	Y	4	0	2.43	1.67	2.95	Y	Med	Missing data	Availability override: wider distribution outside fished area
1303	Ophiomyxa australis	Ophiomyxid	0	Y	4	0	2.43	1.67	2.95	Y	Med	Missing data	Availability override: wider distribution outside fished area
1519	Ophioplocus bispinosus	[a brittlestar]	0	Y	4	1	2.43	1.67	2.95	Y	Med	Missing data	Availability override: wider distribution outside fished area
1306	Ophiothrix (Ophiothrix) caespitosa	Ophiotrichid	0	Y	4	0	2.43	1.67	2.95	Y	Med	Missing data	Availability override: wider distribution outside fished area

ERA species ID	Scientific name	Common name	Average logbook catch (kg) (2001-04)	Missing > 3 attributes (Y/N)	Missing productivity attributes (out of 7)	Missing susceptibility attributes (out of 5)	Productivity (additive) (1- low, 3-high)	Susceptibility (mult) (1- low, 3-high)	Risk value (P&S) (low-high range=1.41-4.24)	Susceptibility override used?	PSA risk category	High/Med risk category (Refer 2.4.8)	Comments
1809	Peronella peronii	Hat urchin	0	Y	5	0	2.43	1.67	2.95	Y	Med	Missing data	Availability override: wider distribution outside fished area
1301	Plectaster decanus	Echinasterid	0	Y	5	0	2.43	1.67	2.95	Y	Med	Missing data	Availability override: wider distribution outside fished area
1264	Sarcoptilus grandis	Sea pen	0	Y	5	1	2.43	1.67	2.95	Y	Med	Missing data	Availability override: wider distribution outside fished area
1351	Actaea peronii peronii	Stone crab	0	Y	4	0	2.29	1.67	2.83	Y	Med	Missing data	Availability override: wider distribution outside fished area
1810	Acuminia brazieri	Brazier's auger	0	Y	4	0	2.29	1.67	2.83	Y	Med	Missing data	Availability override: wider distribution outside fished area
1812	Argobuccinum bassi	Bass Triton	0	Y	4	1	2.29	1.67	2.83	Y	Med	Missing data	Expert override : PCM reduced to low, is a snail in shell (Alistair Hobday)
1813	Astele (Astele) subcarinatum	Umbilicated top shell	0	Y	4	0	2.29	1.67	2.83	Y	Med	Missing data	Expert override : PCM reduced to low, is a snail in shell (Alistair Hobday)
1298	Ceratosoma brevicaudatum	Nudibranch	0	Y	4	1	2.29	1.67	2.83	Y	Med	Missing data	Availability override: wider distribution outside fished area

ERA species ID	Scientific name	Common name	Average logbook catch (kg) (2001-04)	Missing > 3 attributes (Y/N)	Missing productivity attributes (out of 7)	Missing susceptibility attributes (out of 5)	Productivity (additive) (1- low, 3-high)	Susceptibility (mult) (1- low, 3-high)	Risk value (P&S) (low-high range=1.41-4.24)	Susceptibility override used?	PSA risk category	High/Med risk category (Refer 2.4.8)	Comments
1302	Coscinasterias muricata	11-armed starfish	0	Y	4	0	2.29	1.67	2.83	Y	Med	Missing data	Availability override: wider distribution outside fished area
1815	Gazameda gunni	Gunn's screw shell	0	Y	4	1	2.29	1.67	2.83	Y	Med	Missing data	Expert override : PCM reduced to low, is a snail in shell (Alistair Hobday)
1339	Ibacus alticrenatus	Deepwater bug; Wollongong bug	0	Y	4	0	2.29	1.67	2.83	N	Med	Missing data	
1806	Ibacus peronii	Balmain bug	0	Y	4	0	2.29	1.67	2.83	Y	Med	Missing data	Availability override: wider distribution outside fished area
1801	Myochama anomoides	False jingle shell	0	Y	4	1	2.29	1.67	2.83	Y	Med	Missing data	Availability override: wider distribution outside fished area
1273	Neotrigonia margaritacea	Brooch shell	0	Y	4	1	2.29	1.67	2.83	Y	Med	Missing data	Availability override: wider distribution outside fished area
1345	Notomithrax ursus	Decorator crab	0	Y	4	0	2.29	1.67	2.83	Y	Med	Missing data	Availability override: wider distribution outside fished area
1286	Octopus pallidus	Pale octopus	0	Y	4	0	2.29	1.67	2.83	Y	Med	Missing data	Availability override: wider distribution outside fished area
1305	Ophiarachnella ramsayi	Ophiodermatid	0	Y	4	0	2.29	1.67	2.83	Y	Med	Missing data	Availability override: wider distribution outside fished area

ERA species ID	Scientific name	Common name	Average logbook catch (kg) (2001-04)	Missing > 3 attributes (Y/N)	Missing productivity attributes (out of 7)	Missing susceptibility attributes (out of 5)	Productivity (additive) (1- low, 3-high)	Susceptibility (mult) (1- low, 3-high)	Risk value (P&S) (low-high range=1.41-4.24)	Susceptibility override used?	PSA risk category	High/Med risk category (Refer 2.4.8)	Comments
1348	Ovalipes australiensis	Sand crab	0	Y	4	1	2.29	1.67	2.83	Y	Med	Missing data	Availability override: wider distribution outside fished area
1522	Stimdromia lateralis	ridged sponge crab	0	Y	4	0	2.29	1.67	2.83	Y	Med	Missing data	Availability override: wider distribution outside fished area
1341	Strigopagurus strigimanus	Hermit crab	0	Y	4	1	2.29	1.67	2.83	Y	Med	Missing data	Availability override: wider distribution outside fished area
2265	Paguristes tuberculatus	friendly hermit crab	0	Y	4	0	2.29	1.67	2.83	Y	Med	Missing data	Availability override: wider distribution outside fished area
2266	Penion maximus	[a whelk]	0	Y	4	0	2.29	1.67	2.83	Y	Med	Missing data	Availability override: wider distribution outside fished area
2267	Pinnoctopus cordiformis (syn Octopus maorum)	Maori octopus	0	Y	4	1	2.29	1.67	2.83	Y	Med	Missing data	Availability override: wider distribution outside fished area
1307	Amblypneustes ovum	Temnopleurid urchin	0	Y	4	0	2.14	1.67	2.71	Y	Med	Missing data	Availability override: wider distribution outside fished area
1269	Atrina (Atrina) tasmanica	Razor clam	0	Y	4	0	2.14	1.67	2.71	Y	Med	Missing data	Availability override: wider distribution outside fished area
1799	Corbula stolata	Little basket shell (a cockle)	0	Y	4	0	2.14	1.67	2.71	Y	Med	Missing data	Availability override: wider distribution outside fished area

ERA species ID	Scientific name	Common name	Average logbook catch (kg) (2001-04)	Missing > 3 attributes (Y/N)	Missing productivity attributes (out of 7)	Missing susceptibility attributes (out of 5)	Productivity (additive) (1- low, 3-high)	Susceptibility (mult) (1- low, 3-high)	Risk value (P&S) (low-high range=1.41-4.24)	Susceptibility override used?	PSA risk category	High/Med risk category (Refer 2.4.8)	Comments
1267	Glycymeris (Glycymeris) striatularis	Dog cockle	0	Y	4	1	2.14	1.67	2.71	Y	Med	Missing data	Expert override : PCM reduced to low, is a snail in shell (Alistair Hobday)
1304	Ophionereis schayeri	Ophionereid	0	N	3	0	2.14	1.67	2.71	Y	Med	Low attribute score	Availability override: wider distribution outside fished area
1358	Pyura stolonifera	Cunjevoi	0	Y	4	1	2.14	1.67	2.71	Y	Med	Missing data	Availability override: wider distribution outside fished area
1320	Stichopus mollis	Stichopodid	0	Y	4	0	2.14	1.67	2.71	Y	Med	Missing data	Availability override: wider distribution outside fished area
1297	Amoria undulata	Wavy volute	0	Y	4	1	2.29	1.22	2.59	Y	Low		Expert override : PCM reduced to low, is a snail in shell (Alistair Hobday)
1814	Austrosipho maxima	Large whelk	0	Y	4	0	2.29	1.22	2.59	Y	Low		Expert override : PCM reduced to low, is a snail in shell (Alistair Hobday)
1292	Cabestana spengleri	Triton	0	Y	4	0	2.29	1.22	2.59	Y	Low		Expert override : PCM reduced to low, is a snail in shell (Alistair 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 5)	Productivity (additive) (1- low, 3-high)	Susceptibility (mult) (1- low, 3-high)	Risk value (P&S) (low-high range=1.41-4.24)	Susceptibility override used?	PSA risk category	High/Med risk category (Refer 2.4.8)	Comments
1294	Charonia lampas rubicunda	Triton	0	Y	4	0	2.29	1.22	2.59	Y	Low		Expert override : PCM reduced to low, is a snail in shell (Alistair Hobday)
1288	Clanculus undatus	Top shell	0	Y	4	0	2.29	1.22	2.59	Y	Low		Expert override : PCM reduced to low, is a snail in shell (Alistair Hobday)
1816	Cypraea (Umbilia) hesitata	Umbilicated cowry	0	Y	4	0	2.29	1.22	2.59	Y	Low		Expert override : PCM reduced to low, is a snail in shell (Alistair Hobday)
1516	Ericusa sowerbyi	[a volute]	0	Y	4	1	2.29	1.22	2.59	Y	Low		Expert override : PCM reduced to low, is a snail in shell (Alistair Hobday)
1265	Magellania flavacens	Lamp shell	0	Y	4	1	2.29	1.22	2.59	Y	Low		Expert override : PCM reduced to low, is a snail in shell (Alistair Hobday)
1276	Placamen placidum	Venus shell	0	Y	4	1	2.29	1.22	2.59	Y	Low		Expert override : PCM reduced to low, is a snail in shell (Alistair 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 5)	Productivity (additive) (1- low, 3-high)	Susceptibility (mult) (1- low, 3-high)	Risk value (P&S) (low-high range=1.41-4.24)	Susceptibility override used?	PSA risk category	High/Med risk category (Refer 2.4.8)	Comments
1295	Pleuroploca australasia	Tulip shell	0	Y	4	1	2.29	1.22	2.59	Y	Low		Expert override : PCM reduced to low, is a snail in shell (Alistair Hobday)
1817	Semicassis pyrum	Pear helmet	0	Y	4	1	2.29	1.22	2.59	Y	Low		Expert override : PCM reduced to low, is a snail in shell (Alistair Hobday)
1811	Semicassis (Antephalium) semigranosum	Half-grained helmet	0	Y	4	0	2.29	1.22	2.59	Y	Low		Expert override : PCM reduced to low, is a snail in shell (Alistair Hobday)
1291	Semicassis (Semicassis) pyrum	Helmut shell	0	Y	4	0	2.29	1.22	2.59	Y	Low		Expert override : PCM reduced to low, is a snail in shell (Alistair Hobday)
1277	Tawera gallinula	Venus shell	0	Y	4	0	2.29	1.22	2.59	Y	Low		Expert override : PCM reduced to low, is a snail in shell (Alistair Hobday)
1278	Tawera lagopus	Venus shell	0	Y	4	0	2.29	1.22	2.59	Y	Low		Expert override : PCM reduced to low, is a snail in shell (Alistair Hobday)
1515	Bassina (Callanaitis) disjecta	Wedding-cake cockle	0	Y	4	1	2.14	1.22	2.47	Y	Low		Expert override : PCM reduced to low, is a snail in shell (Alistair 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 5)	Productivity (additive) (1- low, 3-high)	Susceptibility (mult) (1- low, 3-high)	Risk value (P&S) (low-high range=1.41-4.24)	Susceptibility override used?	PSA risk category	High/Med risk category (Refer 2.4.8)	Comments
1800	Tucetona flabellata	Fan-like dog cockle	0	Y	4	1	2.14	1.22	2.47	Y	Low		Expert override : PCM reduced to low, is a snail in shell (Alistair Hobday)
1823	Balanus trigonus	Barnacle	0	N	3	0	2.00	1.02	2.25	Y	Low		Expert override : PCM reduced to low, is a snail in shell (Alistair Hobday)
1280	Sepioteuthis australis	Southern calamari	0	N	0	0	1.43	1.67	2.20	Y	Low		Availability override: wider distribution outside fished area
11	Nototodarus gouldi	Arrow Squid	125	N	0	0	1.43	1.44	2.03	Y	Low		Availability override: wider distribution outside fished area
7	Melicertus plebejus	eastern king prawn	0	N	0	0	1.14	1.67	2.02	Y	Low		Availability override: wider distribution outside fished area
Teleost													
99	Gymnapistes marmoratus	cobbler	0	N	2	0	1.71	2.33	2.90	N	Med	*Other	
928	Ophisurus serpens	Serpent eel	0	N	3	0	2.57	1.22	2.85	N	Med	Low overlap	
931	Eocallionymus papilio	painted stinkfish	0	N	1	0	1.43	2.33	2.74	N	Med	Low overlap	
156	Parequula melbournensis	silverbelly	0	N	1	0	1.43	2.33	2.74	N	Med	Low overlap	
874	Gonorynchus greyi	sandfish	0	N	3	0	2.14	1.67	2.71	N	Med	Low overlap	
95	Neosebastes scorpaenoides	ruddy gurnard perch	0	N	3	0	2.14	1.67	2.71	N	Med	Low overlap	

ERA species ID	Scientific name	Common name	Average logbook catch (kg) (2001-04)	Missing > 3 attributes (Y/N)	Missing productivity attributes (out of 7)	Missing susceptibility attributes (out of 5)	Productivity (additive) (1- low, 3-high)	Susceptibility (mult) (1- low, 3-high)	Risk value (P&S) (low-high range=1.41-4.24)	Susceptibility override used?	PSA risk category	High/Med risk category (Refer 2.4.8)	Comments
929	Scolecenchelys australis	Short-finned worm eel	0	N	3	0	2.14	1.67	2.71	N	Med	Low overlap	
235	Meuschenia australis	brown-striped leatherjacket	0	N	0	0	1.29	2.33	2.66	N	Med	Low overlap	
122	Acanthopegasus lancifer/Pegasus lancifer	sea moth	0	N	3	0	2.00	1.67	2.60	Y	Low		Availability override: wider distribution outside fished area
241	Aracana aurita	shaw's cowfish	0	N	3	0	2.00	1.67	2.60	N	Low		
239	Aracana ornata	ornate cowfish	0	N	3	0	2.00	1.67	2.60	N	Low		
194	Kathetostoma laeve	common stargazer	0	N	1	0	2.00	1.67	2.60	N	Low		
311	Acanthaluteres vittiger	Toothbrush leatherjacket	0	N	0	0	1.00	2.33	2.54	N	Low		
941	Helicolenus percoides	Ocean Perch - inshore	0	N	0	0	1.86	1.67	2.50	N	Low		
249	Diodon nicthemerus	globe fish	0	N	0	0	1.57	1.67	2.29	N	Low		
26	Zebrias fasciatus	many-banded sole	0	N	1	0	1.57	1.67	2.29	N	Low		
906	Pseudophycis barbata	bearded rock cod	0	N	2	0	1.86	1.22	2.22	N	Low		
1821	Arnoglossus muelleri	Mueller's flounder	0	N	1	0	1.43	1.67	2.20	N	Low		
1824	Enigmapercis reducta	Broad sandfish	0	N	1	0	1.43	1.67	2.20	N	Low		
201	Foetorepus calauropomus	common stinkfish	0	N	1	0	1.43	1.67	2.20	N	Low		
1012	Nemadactylus macropterus	Jackass Morwong	0	N	0	0	1.43	1.67	2.20	N	Low		
225	Ammotretis lituratus	spotted flounder	0	N	0	0	1.29	1.67	2.10	N	Low		
124	Caesioperca lepidoptera	butterfly perch	0	N	0	0	1.29	1.67	2.10	N	Low		
125	Caesioperca rasor	barber perch	0	N	0	0	1.29	1.67	2.10	N	Low		
214	Cyttus australis	Silver dory	0	N	0	0	1.29	1.67	2.10	N	Low		

ERA species ID	Scientific name	Common name	Average logbook catch (kg) (2001-04)	Missing > 3 attributes (Y/N)	Missing productivity attributes (out of 7)	Missing susceptibility attributes (out of 5)	Productivity (additive) (1- low, 3-high)	Susceptibility (mult) (1- low, 3-high)	Risk value (P&S) (low-high range=1.41-4.24)	Susceptibility override used?	PSA risk category	High/Med risk category (Refer 2.4.8)	Comments
110	Lepidotrigla modesta	grooved gurnard	0	N	0	0	1.29	1.67	2.10	N	Low		
104	Lepidotrigla papilio	spiny gurnard	0	N	0	0	1.29	1.67	2.10	N	Low		
106	Lepidotrigla vanessa	butterfly gurnard	0	N	0	0	1.29	1.67	2.10	N	Low		
307	Lophonectes gallus	Crested flounder	0	N	0	0	1.29	1.67	2.10	N	Low		
232	Meuschenia scaber	velvet leatherjacket	0	N	0	0	1.29	1.67	2.10	N	Low		
1037	Neoplatycephalus richardsoni	Flathead	11	N	0	0	1.29	1.67	2.10	N	Low		
109	Pterygotrigla polyommata	Latchet	0	N	0	0	1.29	1.67	2.10	N	Low		
224	Rhombosolea tapirina	greenback flounder	0	N	0	0	1.29	1.67	2.10	N	Low		
18	Thamnaconus degeni	degen's leatherjacket	0	N	0	0	1.29	1.67	2.10	N	Low		
231	Eubalichthys mosaicus	mosaic leatherjacket	0	N	0	0	1.14	1.67	2.02	Y	Low		Availability override: wider distribution outside fished area
1822	Sillago bassensis	School whiting	0	N	0	0	1.14	1.67	2.02	N	Low		
310	Acanthaluteres spilomelanurus	Bridled leatherjacket	0	N	0	0	1.00	1.67	1.94	N	Low		
236	Eubalichthys gunnii	velvet leatherjacket	0	N	0	0	1.00	1.67	1.94	N	Low		
309	Dotalabrus aurantiacus	Castlenau's wrasse	0	N	0	0	1.29	1.44	1.93	N	Low		
930	Hypoplectrodes maccullochi	Half-banded sea perch	0	N	0	0	1.29	1.44	1.93	N	Low		
97	Scorpaena papillosa	Red Rock Cod	0	N	1	0	1.43	1.22	1.88	N	Low		
188	Pseudolabrus mortonii	rosy wrasse	0	N	0	0	1.29	1.22	1.77	N	Low		

Summary of Habitat PSA results

A summary of the habitats considered at Level 2 is presented below, and is sorted by the overall risk score (high, medium, low) by sub-biome, and by SGF score (Habitat type).

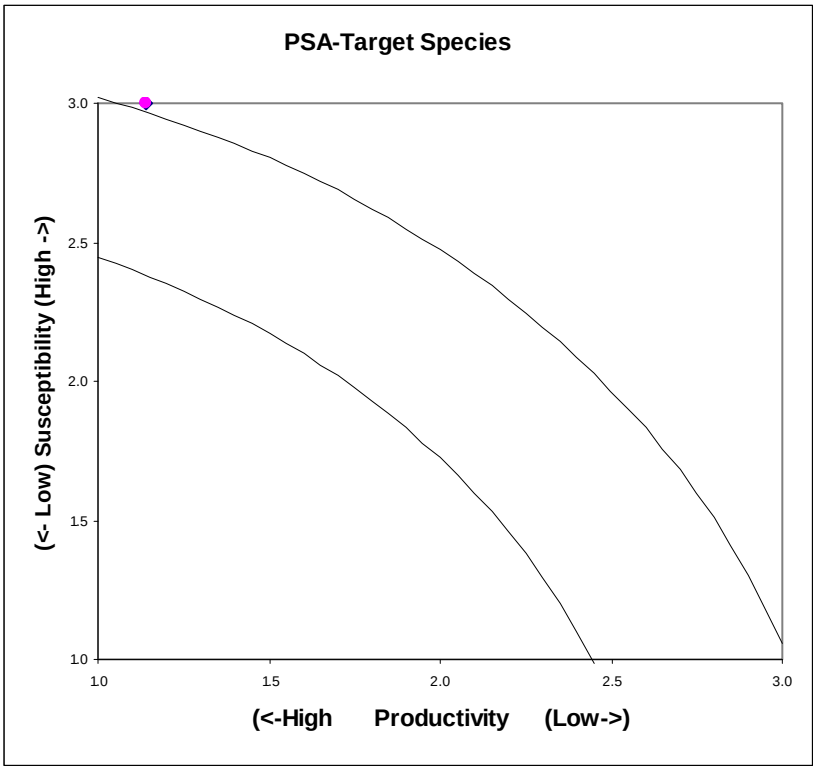
Record #	ERA habitat #	Sub-biome	Feature	Habitat Name	SGF Score	Productivity score (Average)	Susceptibility score (Multiplicative)	Overall risk Value (P&Sm)	Overall risk Ranking	Risk ranking override	Rationale
0122	012	inner shelf	shelf	fine sediments, unrippled, large sponges	101	2.00	2.04	2.85	Med		
0158	016	inner shelf	shelf	fine sediments, unrippled, mixed faunal community	103	2.00	2.04	2.85	Med		
0870	091	inner shelf	shelf	fine sediments, irregular, large sponges	131	2.00	2.04	2.85	Med		
0134	013	inner shelf	shelf	coarse sediments, unrippled, large sponges	201	2.00	2.04	2.85	Med		
0109	011	inner shelf	shelf	coarse sediments, wave rippled, large sponges	221	2.00	2.04	2.85	Med		
0146	014	inner shelf	shelf	fine sediments, wave rippled, large sponges	111	1.50	2.04	2.53	Low	Med	located in <60m therefore driven down by Productivity of '1'
0001	001	inner shelf	shelf	gravel, current rippled, mixed faunal community	313	1.50	2.14	2.61	Low	Med	located in <60m therefore driven down by Productivity of '1'
0073	007	inner shelf	shelf	gravel, debris flow, mixed faunal community	343	1.50	2.14	2.61	Low	Med	located in <60m therefore driven down by Productivity of '1'
0061	006	inner shelf	shelf	coarse sediments, subcrop, large sponges	251	2.00	2.14	2.93	Med	Low	if subcrops encountered likely to be avoided.
0906	094	inner shelf	shelf	fine sediments, unrippled, small sponges	102	1.50	2.04	2.53	Low		
0894	093	inner shelf	shelf	fine sediments, unrippled, bioturbators	109	1.50	2.04	2.53	Low		
0918	095	inner shelf	shelf	fine sediments, wave rippled, no fauna	120	1.50	2.04	2.53	Low		
0930	096	inner shelf	shelf	fine sediments, wave rippled, small sponges	122	1.50	2.04	2.53	Low		
0882	092	inner shelf	shelf	fine sediments, irregular, small sponges	132	1.50	2.04	2.53	Low		
0097	010	inner shelf	shelf	coarse sediments, current rippled, no fauna	210	1.00	2.04	2.27	Low		
0858	090	inner shelf	shelf	coarse sediments, current rippled, bioturbators	219	1.50	2.04	2.53	Low		
1991	191	inner shelf	shelf	coarse sediments, wave rippled, small sponges	222	1.50	2.04	2.53	Low		
2080	200	inner shelf	shelf	coarse sediments, wave rippled, encrustors	226	1.50	2.14	2.61	Low		

Record #	ERA habitat #	Sub-biome	Feature	Habitat Name	SGF Score	Productivity score (Average)	Susceptibility score (Multiplicative)	Overall risk Value (P&Sm)	Overall risk Ranking	Risk ranking override	Rationale
0085	009	inner shelf	shelf	coarse sediments, wave rippled, sedentary	227	1.50	2.04	2.53	Low		
0846	089	inner shelf	shelf	coarse sediments, irregular, encrustors	236	1.50	2.04	2.53	Low		
0955	098	inner shelf	shelf	gravel, wave rippled, no fauna	320	1.00	2.14	2.36	Low		
0943	097	inner shelf	shelf	gravel, wave rippled, bioturbators	329	1.00	2.14	2.36	Low		
2067	199	inner shelf	shelf	cobble, wave rippled, low/ encrusting mixed fauna	426	1.50	2.14	2.61	Low		
0049	005	inner shelf	shelf	cobble, debris flow, large sponges	441	1.50	2.14	2.61	Low		
0967	099	inner shelf	shelf	Igneous rock, high outcrop, large sponges	591	2.00	1.59	2.56	Low		
0037	004	inner shelf	shelf	Sedimentary rock, outcrop, large sponges	671	2.00	1.67	2.60	Low		
0013	002	inner shelf	shelf	Sedimentary rock, outcrop, large sponges	691	1.50	1.67	2.24	Low		
0025	003	inner shelf	shelf	Sedimentary rock, outcrop, mixed faunal community	693	2.00	1.67	2.60	Low		

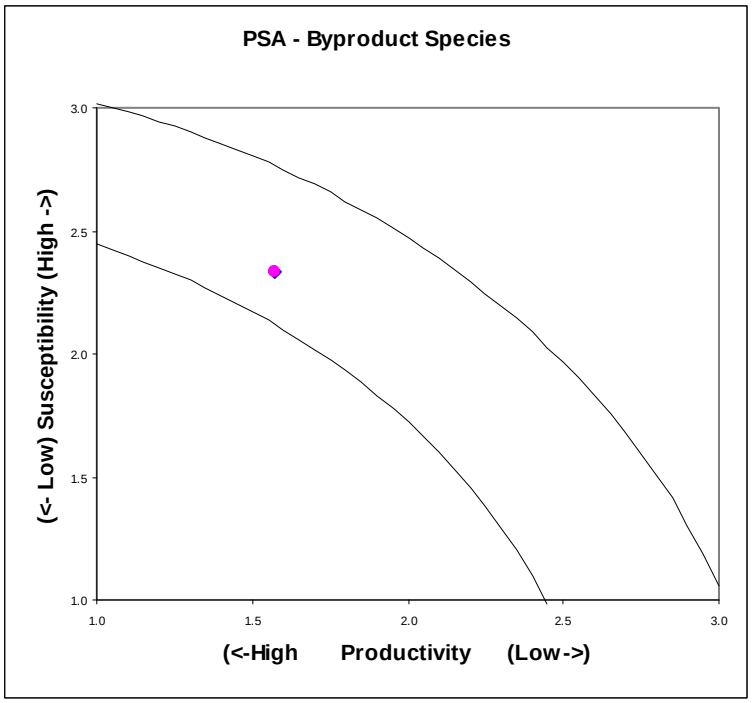
2.4.4 PSA Plot for individual units of analysis (Step 4)

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

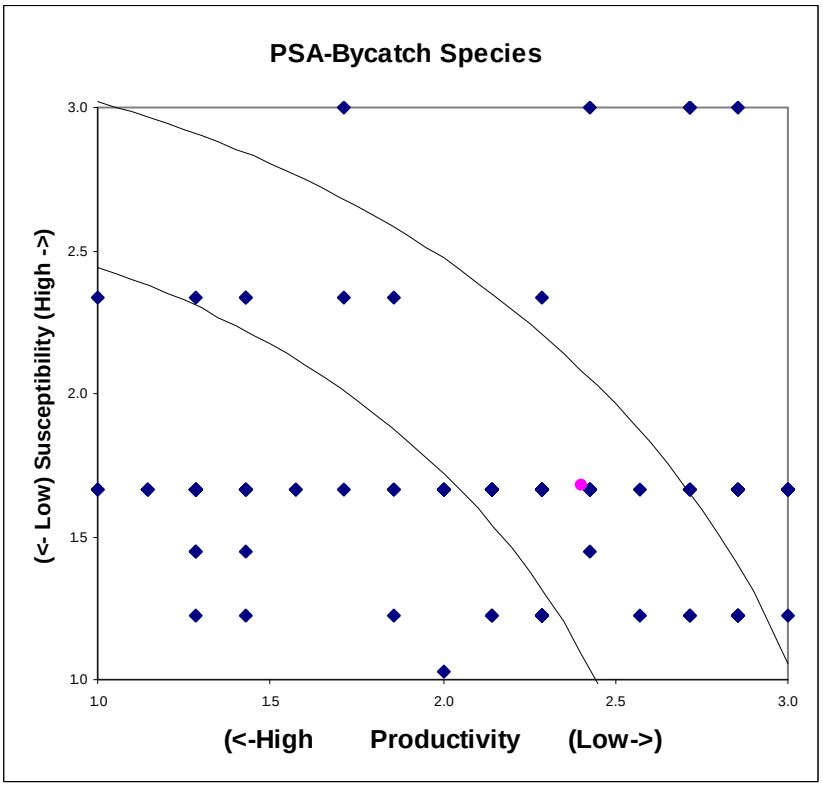
Results of the PSA plot from PSA workbook ranking worksheet



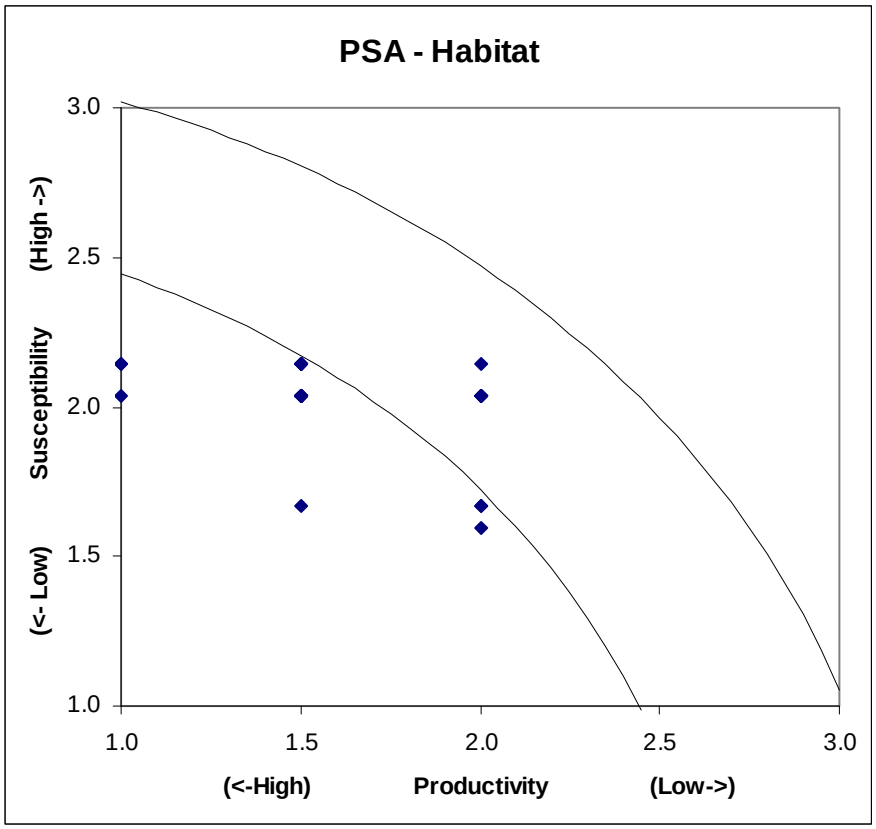
PSA plot for target species in the Bass Strait Scallop sub-fishery. The magenta dot in the center of the blue diamonds is the average risk for this component.



PSA plot for byproduct species in the Bass Strait Scallop sub-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 Bass Strait Scallop sub-fishery. The magenta dot in the center of the blue diamonds is the average risk for this component.



PSA plot for habitats in the Bass Strait Scallop sub-fishery.

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)**.

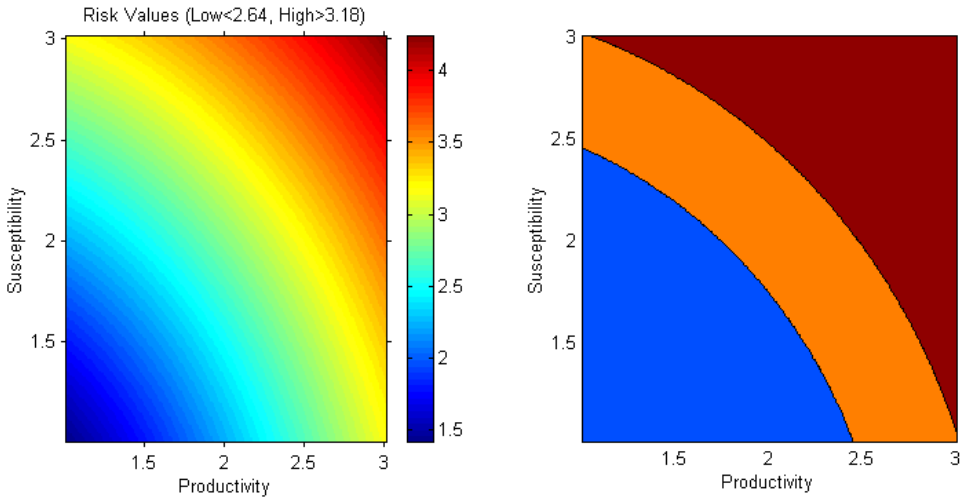


Figure 17. Overall risk values in the PSA plot. Left panel. Colour map of the distribution of the euclidean overall risk values. Right panel. The PSA plot contoured to show the low risk (blue), medium risk (orange) and high risk (red) values.

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

2.4.5 Uncertainty analysis ranking of overall risk (Step 5)

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

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

The validity of the ranking can also be examined by comparing the results with those from other data sources or modelling approaches that have already been undertaken in specific fisheries. For example, the PSA results of the individual species (target, byproduct and bycatch) 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 missing in 55% of species, and so the most conservative score was used, while information on average maximum size was missing for only 11% 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.

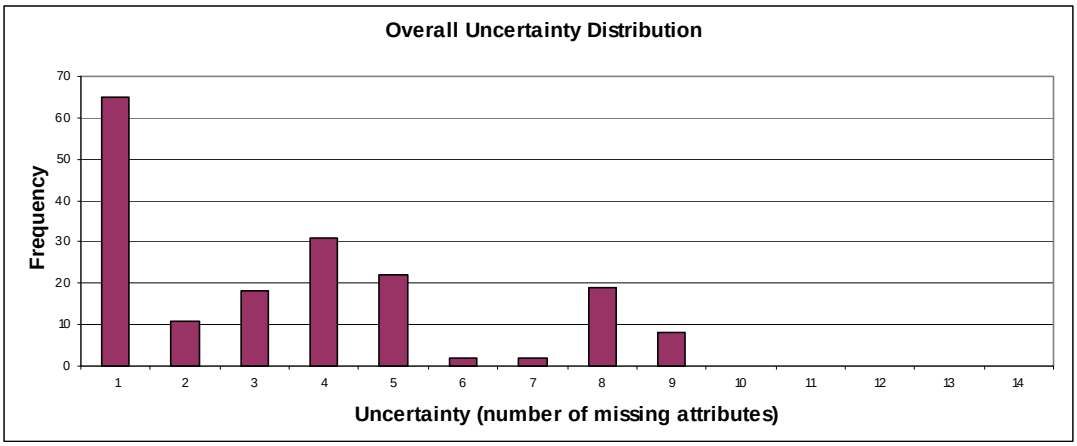
Results from PSA workbook ranking worksheet (species only)

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	274	274	274	274	274	274	274
n species scores with attribute unknown, (conservative score used)	102	113	105	29	29	117	151
% unknown information	37	41	38	11	11	43	55
Susceptibility Attributes	Availability	Encounterability	Selectivity	PCM			
Total species scores for attribute	274	274	274	274			
% unknown information	0.0	0.0	0.0	0.0			

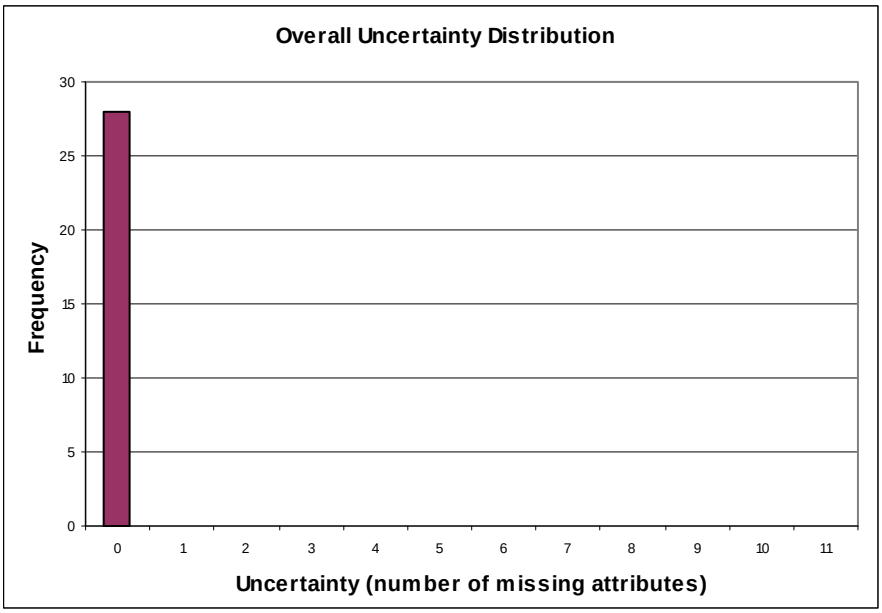
Each species considered in the analysis had information for an average of 5 out of 7 productivity attributes and all four susceptibility attributes. This meant that, on average, conservative scores were used for less than 18% of the attributes for a single species. Species had missing information for between 1 and 7 (average 2.28) of the combined 12 productivity and susceptibility attributes.

Results Overall uncertainty distribution in PSA workbook ranking graphs worksheet



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

Habitats: Eleven attributes were used in the habitat PSA. All attributes were scored according to Habitat attribute tables 9-27 (ERAEF Methodology). Only attributes that could be ranked were utilised and therefore there are no missing attributes.



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

Correlation between attributes

Species component:

The attributes selected for productivity were often strongly correlated (as per correlation matrix below for productivity). The strongest productivity attribute correlation was between maximum size and minimum size at maturity. This is why the attributes for productivity are averaged, as they are all in turn correlated with the intrinsic rate of increase (see *ERAEF: Methodology* document for more details). In contrast the susceptibility attributes were less correlated, which is to be expected as they measure independent aspects of this dimension, and are multiplied to obtain the overall susceptibility score. The strongest susceptibility correlation was between encounterability and selectivity, while the rest were very weak (see matrix below). This suggests, once a species was encountered, it was retained by the gear. This is true for the majority of the demersal invertebrates in the analysis.

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	0.68	X					
Fecundity	0.54	0.62	X				
Max size	0.24	0.37	0.34	X			
Min size at maturity	0.25	0.46	0.44	0.90	X		
Reproductive strategy	0.00	0.28	0.46	0.32	0.42	X	
Trophic level	0.54	0.72	0.74	0.35	0.45	0.48	X

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

	Availability	Encounterability	Selectivity	Post-capture mortality
Availability	X			
Encounterability	-0.14	X		
Selectivity	-0.04	0.78	X	
Post-capture mortality	-0.03	-0.27	-0.21	X

Habitat Component

There was a slightly negative correlation between the productivity attributes Regeneration of Fauna and Natural disturbance (r = -0.18). The susceptibility correlation could not be calculated between the availability and any other aspect, because there was no variation in the availability score. There is however, a strong correlation between the attributes used to calculate encounterability and selectivity (r=0.77)

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

Productivity Correlation Matrix	Regeneration of fauna	Natural disturbance
Regeneration of fauna	X	
Natural disturbance	-0.18	X

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

Susceptibility Correlation Matrix	Availability score	Encounterability score (average)	Selectivity score (average)
Availability score	X		
Encounterability score (average)	X	X	
Selectivity score (average)	X	0.77	X

<u>Productivity and susceptibility values for Species</u>

The average productivity score for all species was 2.19 ± 0.11 (mean ± SD of scores calculated using n-1 attributes) and the mean susceptibility score was 1.49 (as per summary of average productivity and susceptibility scores as below). Individual scores are shown in Section 2.4.2: 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.

<u>Productivity and susceptibility values for Habitats</u>

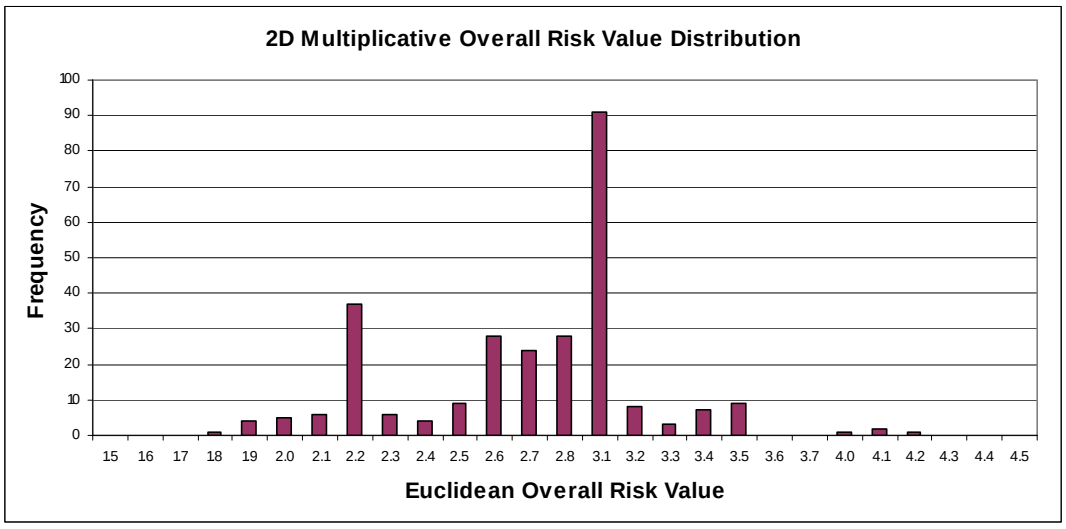
The average productivity score for all habitats was 1.61 ± 0.31 (mean ± SD of scores calculated using n-1 attributes) and the mean susceptibility score was 2.01 ± 0.16 (as per summary of average productivity and susceptibility scores as below). Individual scores are shown in Section 2.4.3: Summary of PSA results. Due to relying on only two

productivity attributes, a small variation in these scores does have a considerable effect on the overall productivity score, somewhat enhancing the effect of depth. Only attributes that could be scored were used in the analysis, therefore there are no missing attributes.

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 2.70, with a range of 1.8 – 4.2**.** The actual values for each species are shown in Section 2.4.2: Summary of PSA results. A total of 26 species, (9%) were classed as high risk, 134 (49%) were in the medium risk category, and 114 (42%) as low risk**.**

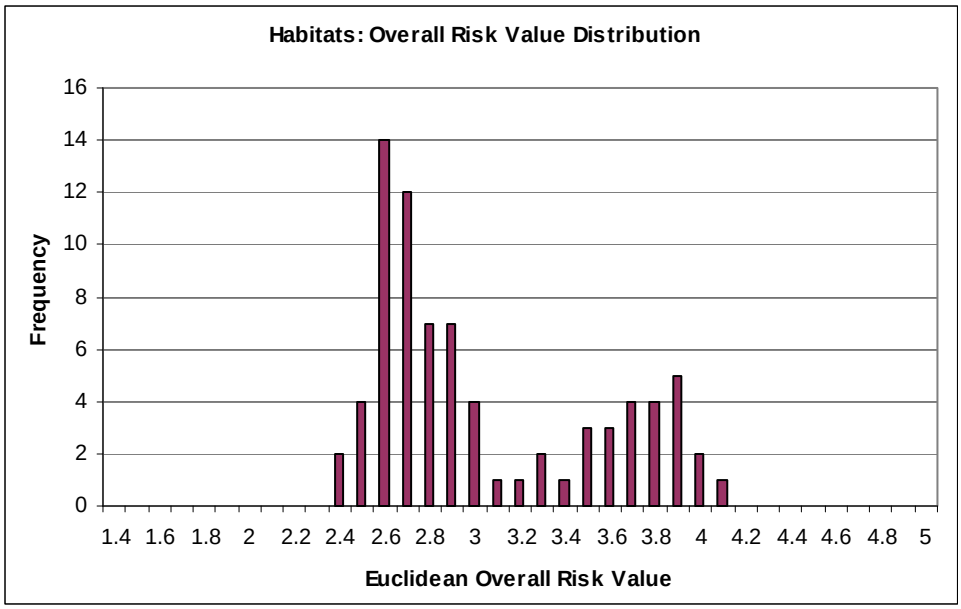
Results: Frequency distribution of the overall PSA risk values



Frequency distribution of the overall risk values generated for the species in the Bass Strait Central Zone Scallop Fishery PSA.

Overall Risk Values for Habitats

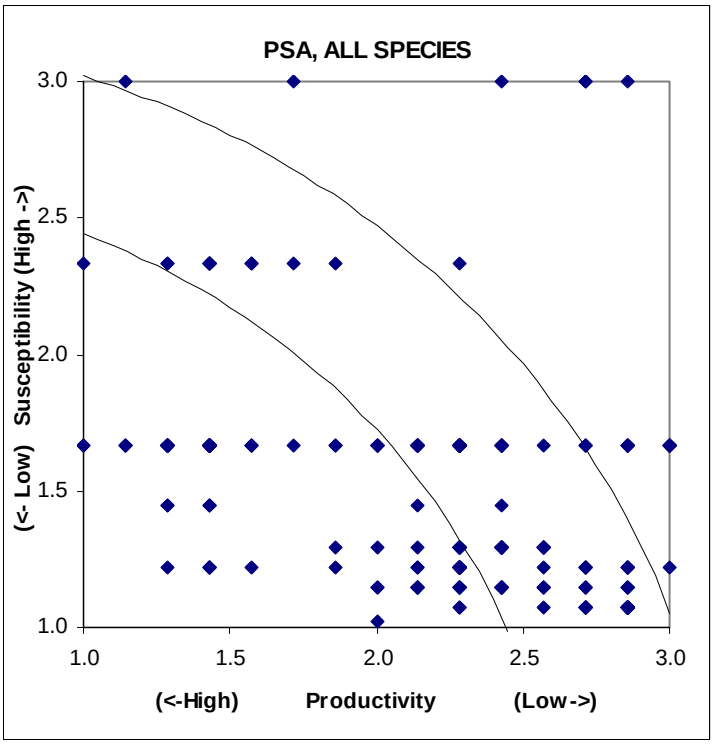
The overall risk values (Euclidean distance on the PSA plot) could fall between 1 and 4.24 (scores of 1&1 and 3&3 for both productivity and susceptibility respectively). The mean observed overall risk score was 2.59, with a range of 2.24- 2.93. The actual values for each species are shown in Section 2.4.3: Summary of PSA results. No habitats were classed as high risk, 8 habitats, (29%) were in the medium risk category, and 20 (71%) as low risk**.**



Frequency distribution of the overall risk values generated for the 28 habitat types in the Bass Strait Central Zone Scallop Fishery PSA.

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

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



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

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

2.4.6 Evaluation of the PSA results (Step 6)

Species Components

The PSA analysis of the BSS fishery was presented to a FAG meeting on 15 August 2005. The PSA methodology has since been reviewed and revised. The following results reflect the revised methodology (as at 1 June 2006).

Overall
A total of 142 species were considered in the target, bycatch and byproduct components (TEP was eliminated at Level 1). For many of the bycatch invertebrate species there was considerable missing data. The average number of missing attributes was 2.28 out of a possible 12. About 9% of the total species fell into the high risk category, and equal amounts into the medium and low categories. Of the 142 species assessed, expert over rides were used on 85 species. Of the 26 species assessed to be at high risk, 24 species had more than 3 missing attributes. Most of these high risk species were invertebrates lacking attribute data, meaning they are potential false positives. Effort to gather data for these species is suggested.

Results: Summary of average productivity and susceptibility scores and overall risk values for all components. (This information comes from the excel PSA workbook graphs spreadsheet)

Summary of average productivity, susceptibility and overall risk scores for each species component evaluated at Level 2.

Component	Measure	
All species	Number of species	142
	Average of productivity total	2.19
	Average of susceptibility total	1.49
	Average of overall risk value (2D)	2.70
	Average number of missing attributes	2.28
Target species	Number of species	1
	Average of productivity total	1.14
	Average of susceptibility total	3.00
	Average of overall risk value (2D)	3.21
	Average number of missing attributes	0
Byproduct species	Number of species	1
	Average of productivity total	2.33
	Average of susceptibility total	1.57
	Average of overall risk value (2D)	2.81
	Average number of missing attributes	3.00

Bycatch species	Number of species	140
	Average of productivity total	1.64
	Average of susceptibility total	2.13
	Average of overall risk value (2D)	2.73
	Average number of missing attributes	3.73

PSA 2D (productivity and susceptibility) risk categories for each species component evaluated at Level 2**.**

Risk Category	High	Medium	Low	Total
Target species	1	0	0	1
Byproduct species	0	1	0	1
Bycatch species	25	57	58	140
Total	26	58	58	142

PSA 2D (productivity and susceptibility) risk categories for each taxon in components evaluated at Level 2.

Risk Category	High	Medium	Low	Total
Chondrichthyan	0	7	3	10
Invertebrate	26	43	21	90
Teleost	0	8	34	42
Total	26	58	58	142

Discussion: species components

Target species

The single target species, commercial scallop, was rated as a high risk species. This is due to the high susceptibility to the fishing method, and should be considered in more detail than the Level 2 assessment. In fact, this does occur, with surveys of bed density and size structure.

Byproduct species

The single bycatch species, doughboy scallop, was rated a medium risk species. This is due to the moderate overlap with the fishery, and the effectiveness of the fishing gear.

Bycatch species

Of the 140 bycatch species, 25 are classified as high risk, 57 as medium risk and 58 as low risk. Of all the species components, bycatch had the highest proportion of missing attributes, with an average of 4.94 attributes missing.

The high risk bycatch species, all benthic invertebrates, are all missing between 4 and 8 attributes, and are almost certainly false positives, as the low productivity scores are due to missing data.

Habitat Component

The PSA analysis of the habitats of the Bass Strait Scallop Central Zone Fishery was presented to a FAG meeting on 15 August 2005. The PSA methodology has since been

reviewed and revised. The following results reflect the revised methodology (as at 26 April 2006).

Overall

A total of 28 habitat types were considered and eleven attributes were scored for all habitats. Risk ranking categories in the PSA analysis incorporated stakeholder feedback and expert opinion. This resulted in four overrides being included for BSS. The resulting 2D PSA risk rankings (H, M or L) are considered in the following discussion.

Summary of average productivity, susceptibility and overall risk scores for habitats

Component	Measure	
All habitats	Number of habitats	28
	Average of productivity total	1.61
	Average of susceptibility total	2.01
	Average of overall risk value (2D)	2.59
	Average number of missing attributes	0

PSA (productivity and susceptibility) risk categories for sub-biome (depth zone) fished (before override adjustment).

2D Risk Score	Coastal Margin	Inner-shelf	Outer-shelf	Upper-slope	Mid-slope	Total habitats
High	0	0	0	0	0	0
Medium	0	6	0	0	0	6
Low	0	22	0	0	0	22
Total	Not in fishery	28	no effort	no effort	no effort	28

PSA (productivity and susceptibility) risk categories for sub-biome fished after Risk Ranking adjustment (stakeholder/expert override).

2D Risk Score	Coastal Margin	Inner-shelf	Outer-shelf	Upper-slope	Mid-slope	Total habitats
High	0	0	0	0	0	0
Medium	0	8	0	0	0	8
Low	0	20	0	0	0	20
Total	Not in fishery	28	no effort	no effort	no effort	28

Only habitats of the inner shelf were fishing occurs were included. A total of 20 were scored as low risk, 8 as medium risk, and none at high risk.

PSA (productivity and susceptibility) risk categories for the habitat component.

Risk Category	High	Medium	Low	Total
Total Habitats	0	8	20	28

Discussion: Habitats

Despite the jurisdictional boundary showing the Bass Strait Central Zone Scallop Fishery having a large spatial extent, scallop fishing occurs only on the inner shelf and in few restricted localities. As a consequence, relatively few inner shelf habitat types (n=28) were identified and scored for the PSA analysis. These detailed habitat types can

be readily aggregated into a smaller number of general categories for interpretation. This is because many types are similar, differing in only one respect of substratum, geomorphology or dominant fauna, and therefore attracting similar PSA scores and the same risk rankings.

The distribution of risk values for the Bass Strait Scallop Fishery is highly skewed, containing mainly low risk, few at medium risk but no high risk categories: 20 (71%) low, 8 (29%) medium risk.

Although scallop dredging has a high potential to severely impact benthic habitat, and attract the highest ranks for two susceptibility attributes – 'the level of disturbance' and 'removeability/ mortality of fauna', several other factors drove the end result to low and medium risk rankings. Most important were (1) the relatively high productivity of the inner shelf (compared to the deeper ecosystems of the regional fishery used by other subfisheries) based on a faster regeneration time of fauna, and adaptation of fauna to a greater degree of natural disturbance, (2) the large areal extent of the habitat types within Bass Strait in combination with the small areas used for fishing; (3) the preponderance of small encrusting and burrowing faunas associated with sediment habitats, and (4) the inability of scallop dredges/ vessels to negotiate rocky bottom.

In overview, the 20 low risk inner shelf habitats were:

- 11 types of fine and coarse sediment habitats, variously current and wave rippled, irregular or flat, and characterised by faunas of small sponges, encrustors and bioturbators and burrowing (bioturbating) animals
- 2 types of gravel habitats with burrowing (bioturbating) animals or no visible fauna
- 7 types of hard bottom habitats – sub-cropping rock, boulder flow and outcrop – all supporting an erect attached fauna of large sponges or mixed fauna

The 8 medium risk habitats were:

- 6 types of fine and coarse sediment habitats, variously current and wave rippled, irregular or flat, and characterised by faunas of large sponges or mixed erect fauna
- 2 types of gravel habitats characterised by faunas of large sponges or mixed erect fauna

One outcome of this PSA analysis may include false negatives: attributing only medium risk of habitats with vulnerable structural fauna on the inner shelf (25-100 m depths) where scallop fishing occurs. In large part the medium risk score stems from the low risk ranking for Productivity on the inner shelf, driven by the assumption of high benthic production in <60 m depth. At Level 2, generalizations about the ability of structural fauna to recover from impact are made for high-level taxa (e.g. all sponges are considered as a single group) and do not take into account the characteristics of individual species, or the ecosystem services they provide at fine scales. Because no information is available to further refine this approach, and because this approach has been applied to other sub-fisheries, expert over-rides have not been put in place. This ranking should be reviewed if new information alters our understanding of the productivity of inner shelf benthic epifauna. However, two factors in addition to the

four listed above, underpin the non-conservative approach taken here (1) the likelihood that many of the same structural fauna also exist on hard bottom not accessible to scallop dredge – including on high relief, hard, outcropping rock that is relatively abundant on the inner shelf (compared to deeper waters); and (2) that substantial areas of soft bottom inner shelf seabed habitat are now protected by State and Commonwealth MPAs.

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

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

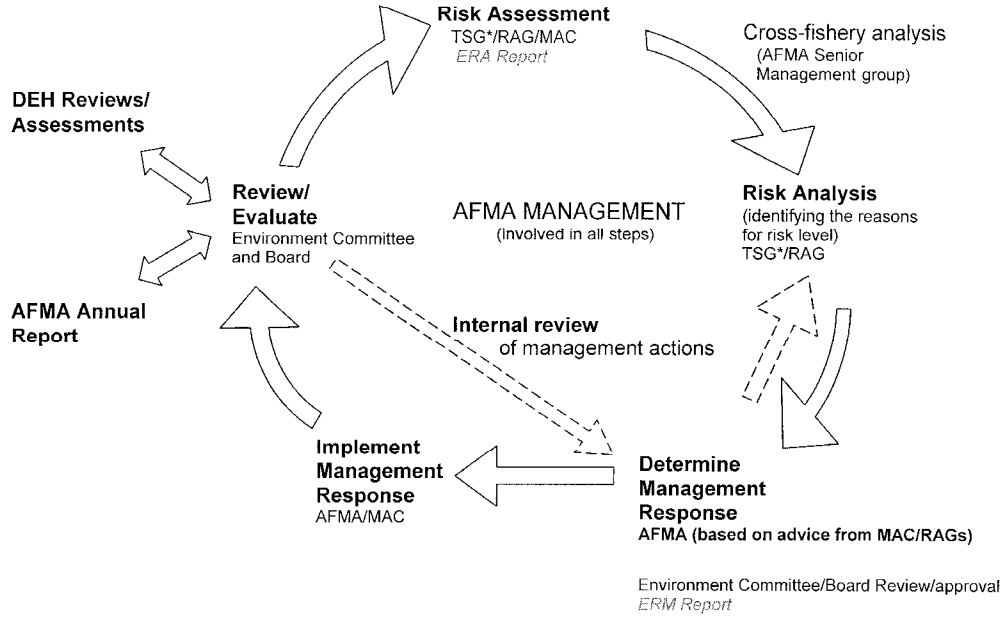
For example, if in a Level 2 analysis of habitat types, two of seven habitat types were determined to have high risk to the sub-fishery, only those two habitat types would be considered at Level 3.

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

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

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

Figure x: Ecological Risk Management Framework



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

2.4.8 High/Medium risk categorisation (Step 8)

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

- **Category 1: Missing data** (*>3 missing attributes in either Productivity or Susceptibility estimation)*. Rationale: A total of more than 3 missing attributes (out of 12 possible) could lead to a change in risk score if the information became known. This is because where information is missing for an attribute, that attribute is automatically scored as high risk. The choice of 3 attributes was identified using sensitivity analysis.
- **Category 2**: **Spatial overlap**
    - **2A. Widely distributed** *(More than 80% of the full range of a species is outside the jurisdictional boundary of the fishery)*. Rationale: These species may have refuge outside the fishery.
    - **2B. Low overlap** *(<20% overlap between effort and the species distribution inside the fishery).* Refers to the preferred Availability attribute used to calculate Susceptibility. Rationale: This cutoff (20%) has no strong rationale, other than being a low percentage overlap. Additional work to

determine what threshold might be applicable is required. However, the categories are to be used as a guide for management, and additional effort to decide on cutoffs may be misplaced if the categories are just used as a guide. A similar analysis could be undertaken for the encounterability and selectivity attributes, but there is more information available for availability (overlap) for most species and overlap may be more informative about risk. A subtle change in fishing practice could modify encounterability or selectivity, while to change availability requires a major change in fleet location, which will be easier to detect.

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

Categorisation results - High risk species

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

In the BSS fishery of the 26 species classified as high risk, 24 had missing information (Category 1), 1 had low overlap inside the fishery (Category 2B), and 1 had spatial uncertainty (Category 4). There were no Other high risk species.

Risk Category	Description	Total
Category 1	High risk - Missing data	24
Category 2A	High risk - Widely distributed outside fishery	0
Category 2B	High risk - Low overlap inside fishery	1
Category 3	High risk – One susceptibility attribute scored low	0
Category 4	High risk - Spatial uncertainty	1
Category 5	High risk - Other	0
	Total High risk	26

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

There is no formal stock assessment for the target species, however, prior to closure of the fishery, there were annual stock surveys of the fishing beds, plus others to be opened in future years. The management for this fishery was proactive in spatial closures, designed to protect future scallop beds.

3. General discussion and research implications

The Bass Strait Central Zone Scallop sub-fishery is now closed (2006). It formerly operated in a restricted area east of Flinders Island in depths of 20-100 m, using a single dredge of average width 3-4 meters and scraper teeth that penetrated the soft sediments to a depth of 50 mm. The management approach included pre-season surveys, and opening and closing of scallop beds within this restricted area.

3.1 Level 1

The main issue identified through this Level 1 assessment was the risks associated with dredging on the target and bycatch species, and habitats. The gear method employed is non-selective, although is deployed in areas with high scallop densities, can impact on both species and habitat assessments. Ecological communities were assessed at risk, not due to fishing, but to the potential for fishing boats to introduce species, such as screw shells, to the fishing grounds.

With regard to habitat, the methods associated with demersal trawl fishing-methods present hazards both with and without capture. At present, no data is available to provide certainty on the risk levels associated with this hazard. Discussions at Stakeholder meetings have recognised the value that could be gained by obtaining underwater video footage as a means of monitoring habitat issues, disturbance of the physical processes, and community interactions. This method is strongly recommended to providing baseline data on which further risk assessment could be based.

3.2 Level 2

Only two of the four components that Level 1 analyses suggested were at risk from fishing were found to contain units at risk when evaluated at Level 2: this was the target species and the bycatch/byproduct species components. Of the 142 species assessed, only 1 target species, and 25 bycatch species were found to be at high risk. None of the 28 habitats assessed were found to be at high risk to scallop fishing.

3.2.1 Species at risk

Of the list of species rated as high risk from the PSA analyses, the authors consider that at least 1 species needs management response.

Species	*Risk Category*	*Role*
Invertebrate		
• Commercial scallop	Low overlap	Target

The target species, commercial scallop, is a vulnerable species, consistent with the history of the fishery both in this location and elsewhere in southern Australia.

The bycatch species assessed to be at high risk were in this category on the basis of missing data on the biological attributes, as well as distributional information used in assessing susceptibility.

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

No habitats scored at high risk but we note that other vulnerable types occur on the inner shelf where scallop fishing occurs. Because no habitats were scored at high risk current management actions are deemed effective (although this is moot, as the fishery is closed). This finding is consistent with the current operation of the fishery – restricted in area, using mostly unstructured, high energy (current swept) sediment plains, and managed with a well-informed regime of rotating spatial closures and performance indicators.

Possible 'false negatives' (rankings that under-estimate risk) are inner shelf habitats supporting large, erect or delicate epifauna scored at medium risk. This ranking should be reviewed if new information showed either a change or expansion in the distribution of fishing effort (of this sub-fishery or other sectors using the same habitats), or that

these habitats are important in some way that was previously unrecognised, e.g. susceptible individual species or habitat components, areas that function as a key link in a chain of habitats used by different life-history stages of a fish species, or as being vital to maintaining habitat connectedness via larval dispersal.

3.2.3 Community assemblages at risk

Communities not evaluated as methods not complete.

3.3. Key Uncertainties / Recommendations for Research and Monitoring

In assessing risk to target byproduct, bycatch, it is not possible to assess absolute risk without supplementary information on either abundance or total mortality rates, and such data are not available for the vast majority of such species. This is the kind of analyses that occur at Level 3 in the ERAEF framework. However, it may be possible to draw inferences from information that may be available for some species, either from catch records of occurrence from other fisheries, from fishery independent survey data, or from examination of trends in CPUE from survey data. For the bycatch species, an effort to gather information on the missing productivity and susceptibility attributes should be the first step, as similar species with available information were not classified as high risk.

In assessing risk to habitats, similar issues arise. In general we do not have detailed information on the amount of each habitat type present in the area of the fishery, nor of its spatial distribution. However, some data and information do exist from which inferences can be drawn, and piecing this together in the form of maps, particularly for those habitats identified as high risk, should be a priority.

References

Ecological Risk Assessment References - BSS

AFMA (2001a) Strategic Assessment Report - Bass Strait Central Scallop Fishery. Australian Fisheries Management Authority

AFMA (2001b) Bass Strait Central Zone Scallop Fishery. Bycatch Action Plan. Australian Fisheries Management Authority.

AFMA (2002a) Fishery Assessment Report – Bass Strait Central Scallop Fishery. Australian Fisheries Management Authority.

AFMA (2002b) Bass Strait Central Zone Scallop Fishery Management Plan 2002. Australian Fisheries Management Authority.

AFMA (2002) Regulation Impact Statement for the Bass Strait Central Zone Scallop Fishery Management Plan 2002. Australian Fisheries Management Authority.

Haddon, M. & J.M. Semmens (2001) Bass Strait central zone scallop survey, June 2001. AFMA Final Report Tasmanian Aquaculture and Fisheries Institute, Taroona, Tasmania, Australia.

Haddon, M. & J.M. Semmens (2002) Bass Strait central zone scallop survey, March 2002. AFMA Final Report Tasmanian Aquaculture and Fisheries Institute, Taroona, Tasmania, Australia.

McLoughlin R. J. *et al*. (1991). The Australian scallop dredge: estimates of catching efficiency and associated indirect fishing mortality. Fisheries Research 11, 1-24

Semmens, J.M., M. Haddon & J.M. Lyle (2000) Bass Strait central zone scallop survey, June 2000. AFMA Final Report Tasmanian Aquaculture and Fisheries Institute, Taroona, Tasmania, Australia.

Woodburn, 1989

Yearsley, G.K., P.R. Last and R.D. Ward (eds) (1999) Australian seafood handbook: an identification guide to domestic species. CSIRO Marine Research, Australia.

Young, P.C. and Martin, R.B. (1989). The scallop fisheries of Australia and their management. Reviews in aquatic sciences 1, 615:63*8*

General Methodology References

Fletcher, W. J. (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.

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

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

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

Appendix A: General summary of stakeholder feedback

Date	Format received	Comment from stakeholder	Action/explanation
October 2006	Written comments consolidated and supplied by AFMA	Extent of assessment needs to be clearly articulated in the report: It is not clearly stated within the document whether the risk assessment is directed towards species, habitat types and communities that occur within the Commonwealth managed area of the Bass Strait Scallop Fishery (treating them as isolated entities) or whether it refers to the interaction between the Bass Strait scallop fishery and these species and communities in their broader distribution.	This report covers the Commonwealth managed area of the fishery, and considers impacts in the area of management. The first line in the Executive Summary reads "This assessment of the ecological impacts of the Bass Strait Central Zone Scallop Fishery (BSS)" To clarify it was modified to "This assessment of the ecological impacts of the Australian Government managed Bass Strait Central Zone Scallop Fishery (BSS)"
October 2006	Written comments consolidated and supplied by AFMA	1. The document refers to scallop catch of 445,548 (kg??). Log book data do not support this level of precision - getting data to within +/- a few tonnes is as good as you could hope for. 2. Page iii includes the comment "however, hard grounds exhibit a low accessibility to trawl gears therefore emerged as low risk". I assume this is an editing error – it should refer to dredging gear.	1. This logbook data was supplied by AFMA. No change. 2. Trawl gear used here to indicate gear that drags along the bottom. A generic phrase. Modified because of potential confusion to "….hard grounds exhibit a low accessibility to trawling and dredging gears therefore emerged as low risk (dredging gear used in this fishery)."
October 2006	Written comments consolidated and supplied by AFMA	I'm not sure how much reference to relevant literature is contained in the full body of the report, I would be disturbed if the report did not take into account the findings and conclusions of the extensive Parish and Currie study on impacts of scallop dredging in Port Phillip Bay, which was conducted in the late 1980s – early 1990s and which has been fully documented.	Unclear on what the point is here? None of the habitats were shown to be at high risk to dredging? No change at this stage.

Appendix B: PSA results summary of stakeholder discussions

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

There were no issues when the BSS Level 2 PSA was presented to the stakeholders.

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 consequence scores for ecological components

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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