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Australian Government
Australian Fisheries Management Authority

Ecological Risk Assessment for Effects of Fishing

REPORT FOR THE DANISH SEINE SUB-FISHERY OF THE COMMONWEALTH TRAWL SECTOR OF THE SOUTHERN AND EASTERN SCALEFISH AND SHARK FISHERY

Authors
Sally Wayte
Cathy Bulman
Jo Dowdney
Miriana Sporcic
Alan Williams
Mike Fuller
Tony Smith

CSIRO

Natural Heritage Trust
Helping Communities Helping Australia
An Australian Government Initiative

This fishery ERA report should be cited as

Wayte, S., Bulman, C., Dowdney, J., Sporcic, M., Williams, A., Fuller, M., Smith, A. (2007) Ecological Risk Assessment for the Effects of Fishing: Report for the Danish seine sub-fishery of the Commonwealth Trawl Sector of the Southern and Eastern Scalefish and Shark Fishery. Report for the Australian Fisheries Management Authority, Canberra.

Notes to this document:

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

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

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

This assessment of the Danish seine fishery includes the following:

- Scoping
- Level 1 results for all components
- Level 2 results for target and TEP species and for habitats

Fishery Description

Gear:	Danish seine (minimum 38mm cod-end)
Area:	Continental shelf close to Lakes Entrance (Victoria)
Depth range:	down to 250m
Fleet size:	18 vessels active in 2005
Effort:	Approximately 8,000 shots per year
Landings:	1,870 t in 2005
Discard rate:	Quota species 0%; non-quota species 80% (2004)
Main target species:	flathead, school whiting
Management:	Quota management system for target species
Observer program:	ISMP program operating since mid 1990s

Ecological Units Assessed

Target species:	6
Byproduct species:	31
Discard Species:	116
TEP species:	198
Habitats:	82
Communities:	11 demersal, 2 pelagic

Level 1 Results

Two ecological components were eliminated at Level 1 – byproduct/discard species and communities.

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

- Fishing (direct impacts on target and TEP species and habitats)
- Fishing without capture (indirect impact on habitats)
- Discarding catch (impact on TEP species)

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

Risks rated as major or above (risk scores 4 or 5) are all related to direct or indirect impacts from primary fishing operations. The only risk score of 5 was for impacts of external fisheries on habitats.

Impacts from fishing on target and TEP species components and on habitats are assessed in more detail at Level 2.

Level 2 Results

Species

Six target species and 198 TEP species were assessed at Level 2 using the PSA analysis. Of these, only one was assessed to be potentially at high risk – Australian fur seal. This species is at high risk due to its low productivity and high susceptibility. Observer reports show that seals are encountered in the fishery, and do come into contact with the gear. However the overall population has increased in recent years (Stewardson and Knuckey (2005)).

The spiny pipehorse was identified at Level 1 as a TEP species potentially at risk in this fishery, as it is known to be caught in the fishery (Bowles and Martin-Smith, 2003), and has low fecundity. However this species scores as low risk in the PSA because the Danish seine fishery overlaps with only a small proportion of its range in the SESSF.

Of the 204 species assessed at Level 2, expert over rides were used on 133 species.

Habitats

82 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 82 habitat types, three were assessed to be at high risk, 20 medium, and 59 low. Of the high risk habitats, none were found on the inner shelf (0-100m), three were on the outer shelf (100-200m), and none were on the upper slope (200-700m). There is no fishing deeper than 250m.

High risk habitats on the outer shelf include soft sediment seabed types interspersed with harder bottom supporting large sponges, mixed epifauna, and the bryozoan communities at the shelf break.

Communities

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

Summary

In general, the Danish seine fishery scores as a low risk fishery. The fishery targets both flathead and school whiting, and Level 3 assessments show that both of these are currently near target biomass levels. Of the TEP species examined, only Australian fur seals were found to be potentially at high risk. The overall population of this species has increased in recent years (Stewardson and Knuckey 2005), so actual risk may not be high for this species. The highest risk component for this fishery is a set of three outer shelf benthic habitats on generally smooth bottom supporting erect epifauna such as large sponges. These habitats are also at risk from other fishing methods such as demersal otter trawling.

Managing identified risks

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

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1. Overview

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

The Hierarchical Approach

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

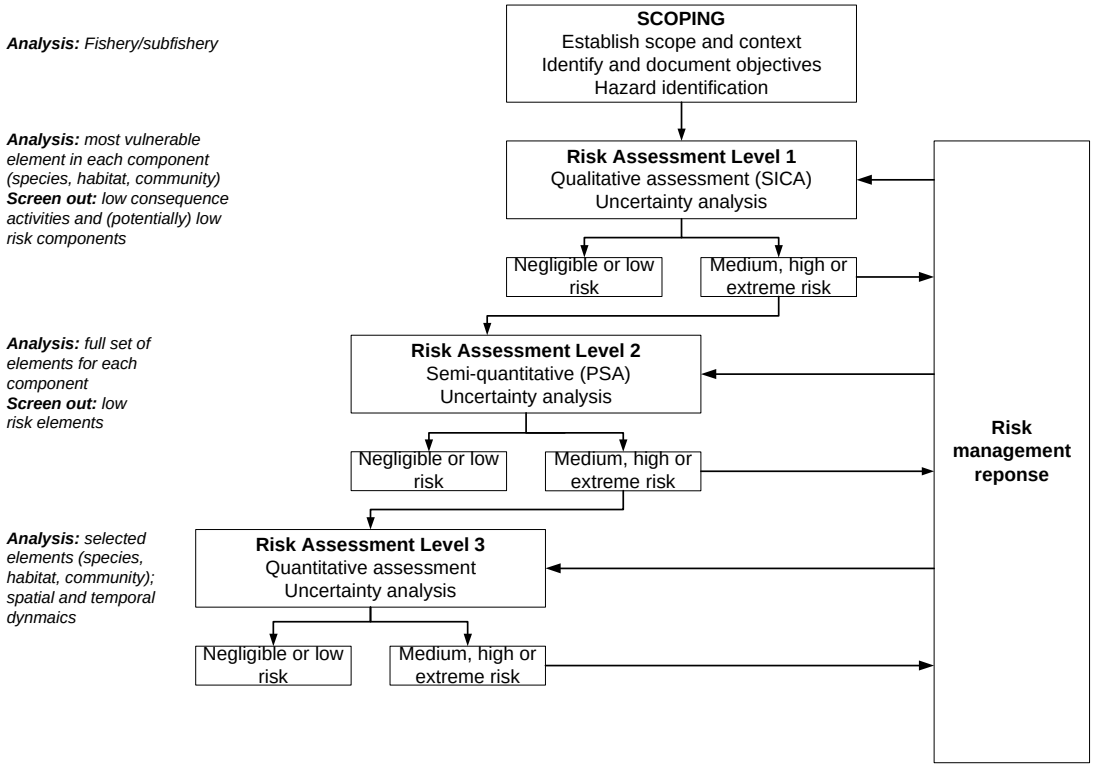

Figure 1. Overview of ERAEF showing focus of analysis for each level at the left in italics.

Conceptual Model

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

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

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

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

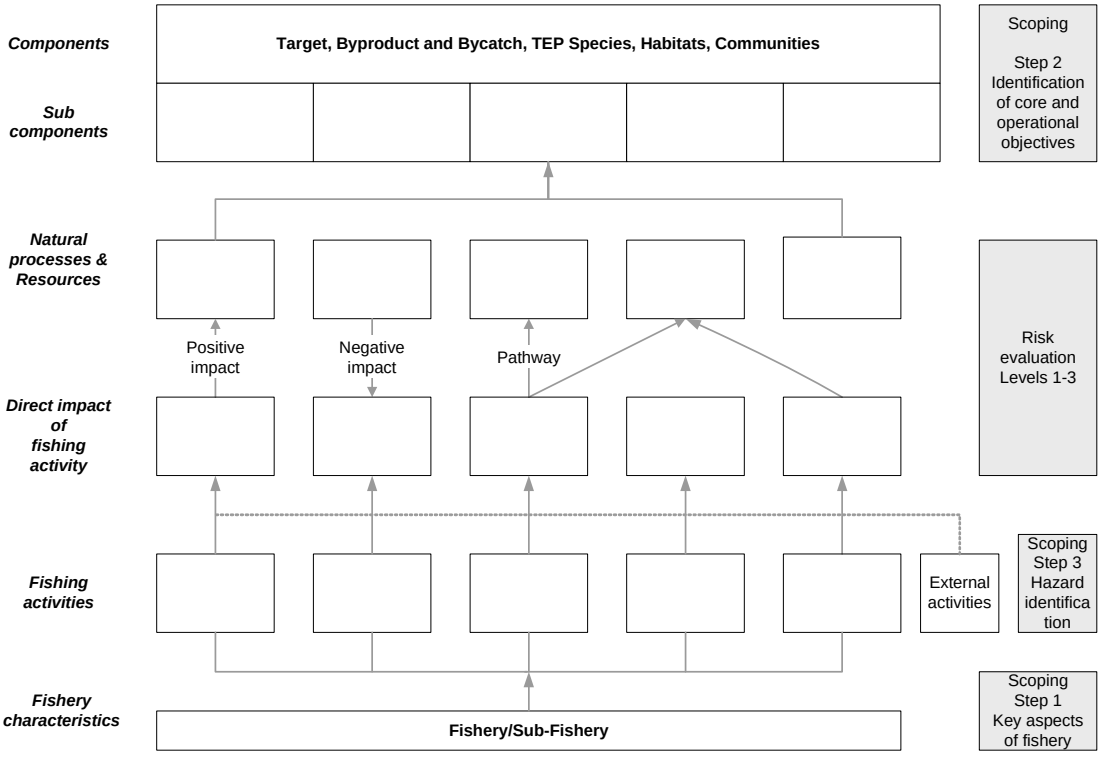

Figure 2. Generic conceptual model used in ERAEF.

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

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

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

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

ERAEF stakeholder engagement process

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

Scoping

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

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

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

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

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

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

Level 2. PSA (Productivity Susceptibility Analysis)

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

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

Level 3

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

Conclusion and final risk assessment report

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

Subsequent risk assessment iterations for a fishery

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

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

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

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

2. Results

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

The results presented below are for the Danish seine component of the Commonwealth Trawl Sector of the Southern and Eastern Scalefish and Shark Fishery.

2.1 stakeholder engagement

2.1 Summary Document SD1. Summary of stakeholder involvement for fishery

ERA report stage	Type of stakeholder interaction	Date of stakeholder interaction	Composition of stakeholder group (names or roles)	Summary of outcome
Level 1(SICA)	Phone call and email	9 April 2003	Barry Baker, EA	Provided list of all TEP species in area of fishery
Level 1(SICA)	Discussion	15 April 2003	John Stevens, CSIRO	Discussion re stock status of sharks caught in SEF, and possibility of sharks scavenging bycatch and offal thrown overboard.
Level 1 (SICA)	Discussion	23 April 2003	Cathy Bulman, CSIRO	Discussion re SICA analysis for non-target species.
Level 1 (SICA)	email	24 April 2003	Nic Bax, CSIRO	Provided information on marine pests in SEF
Level 1 (SICA)	Workshop	6 May 2003	SETFEAG and other invited experts. Participants: Barry Baker, EA; Matt Barwick, AFMA; Nic Bax, CSIRO; Michelle Besley, AFMA; Campbell Davies, NOO; Fritz Drenkhan, Industry; Rob Ferguson, EA; Jo Fisher, AFMA; Ian Knuckey, Fishwell Consulting; Paul Hedge, NOO; Katrina Maguire, AFMA; Joe Puglisi, Industry; Geoff Richardson, AFMA; Gail Richey, SETFIA;	Presented methodology. Reviewed results for Level 1.

ERA report stage	Type of stakeholder interaction	Date of stakeholder interaction	Composition of stakeholder group (names or roles)	Summary of outcome
			Katherine Short, WWF; Kerry Smith, AFMA; Tony Smith, CSIRO; Wayne Stephens, Industry; Sonia Talman, MAFRI; Ian Towers, AFMA; Sally Wayte, CSIRO; Helen Webb, CSIRO	
Level 1	email	9 May 2003	Rosemary Gales, DPIWE	Provided information on seabirds
Level 1	email	9 May 2003	Ashley Bunce, Deakin University	Provided information on seabirds
Level 1	email phone call	9 May 2003 13 May 2003	Keith Martin-Smith, University of Tasmania	Provided information on Syngnathids leading to increased consequence score
Level 1	email	13 May 2003	all participants at SETFEAG workshop	Revised copy of ERA report was sent to all workshop participants for comment by 10 June 2003
Level 1	meeting	19 May 2003	Rosemary Gales, DPIWE; Barry Baker, EA	Discussions re TEP species leading to increased consequence scores
Level 1	email	23 May 2003	Brad Page, Latrobe University	Provided information on seals
Level 1	email	7 August 2003	all participants at SETFEAG workshop	Revised copy of ERA report was sent to all workshop participants for comment by 22 August 2003
Level 1, Danish seine	Phone discussion	April 7 2004	Sue Smith, ex-scientific observer on the Danish Seine sub-fishery	provided information on the Danish Seine sub-fishery
Level 2, Danish seine	Phone discussion	April 14 2004	Barry Baker, AAD	discussion re seabirds in area of Danish Seine sub-fishery
Level 2 (PSA)	Email and phone	30 Sep 2003	Barry Baker, AAD	Provided information about bird distribution
	email	4 Oct 2003	Keith Martin-Smith, University of Tasmania	Provided references for Syngnathids
Level 2 Stage 2	meeting	16-17 June 2005		Discussed stage 2 improvements to methodology and latest PSA results
Level 2	workshop	15-16 August 2005	Observers	Focus on susceptibility of species – reliable information on susceptibility of TEP species in particular.
Level 2	meeting	22 November 2005	SETMAC	Presentation of latest PSA results. Some comments on individual species received

ERA report stage	Type of stakeholder interaction	Date of stakeholder interaction	Composition of stakeholder group (names or roles)	Summary of outcome
				and followed up.

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 five 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 4 Bibliography
Step 6 Decision rules to move to Level 1

2.2.1 General Fishery Characteristics (Step 1)

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

Scoping Document S1 General Fishery Characteristics

Fishery Name: Southern and Eastern Scalefish and Shark Fishery
Sub-fishery: Danish seine
Date of assessment: May 2006
Assessor: Sally Wayte

General Fishery Characteristics	
Fishery Name	Southern and Eastern Scalefish and Shark Fishery (SESSF)
Sub-fisheries	*Identify sub-fisheries on the basis of fishing method/area.* Commonwealth Trawl Sector (previously South East Trawl Fishery (SETF)) Otter trawl Danish seine Gillnet Hook and Trap Sector Scalefish Hook – demersal longline Scalefish Hook – auto-longline Scalefish Hook – dropline Scalefish trap Deep set gillnet Shark Hook Great Australian Bight Trawl Sector East Coast Deepwater Trawl Sector
Sub-fisheries assessed	*The sub-fisheries to be assessed on the basis of fishing method/area in this report.* This report deals only with the Danish seine component of the Commonwealth Trawl Sector
Start date/history	*Provide an indication of the length of time the fishery has been operating.* The Danish seine fishery started in the 1930s, and was the main method of catching tiger flathead during the 1950s and 1960s.
Geographic	*The geographic extent of the managed area of the fishery. Maps of the managed area*

<table>
<tr><td>extent of fishery</td><td>and distribution of fishing effort should be included in the detailed description below, or appended to the end of this table.
The fleet operates mainly out of the port of Lakes Entrance, Victoria, and fishing activities are centred on inshore grounds close to the shore as well as on the edge of the continental shelf in eastern Bass Strait.</td></tr>
<tr><td>Regions or Zones within the fishery</td><td>Any regions or zones used within the fishery for management purposes and the reason for these zones if known
none</td></tr>
<tr><td>Fishing season</td><td>What time of year does fishing in each sub-fishery occur?
Fishing occurs at all times of year</td></tr>
<tr><td>Target species and stock status</td><td>Species targeted and where known stock status.
Flathead and eastern school whiting are the target species. Stock levels for both appear to be steady. Catches of flathead have been cyclical over the past twenty years. Catches of the two target species are inversely related.
The flathead TAC includes tiger flathead and several other flathead species: sand flathead, yank flathead, bluespot flathead and toothy flathead. Tiger flathead comprises the bulk of the catch. The species are not identified in logbooks – they are all recorded as tiger flathead.</td></tr>
<tr><td>Bait Collection and usage</td><td>Identify bait species and source of bait used in the sub-fishery. Describe methods of setting bait and trends in bait usage.
No bait collection occurs.</td></tr>
<tr><td>Current entitlements</td><td>The number of current entitlements in the fishery. Note latent entitlements. Licences/permits/boats and number active.
18 Danish seiners were active in the fishery in 2005</td></tr>
<tr><td>Current and recent TACs, quota trends by method</td><td>The most recent catch quota levels in the fishery by fishing method (sub-fishery). Summary of the recent quota levels in the fishery by fishing method (sub-fishery).In table form
Quota is not applied separately to the Danish seine fishery. The quota in the following table is for the Danish seine and otter trawl fishery combined.
<table>
<tr><td></td><td>Agreed 2002</td><td>Agreed 2003</td><td>Agreed 2004</td><td>Agreed 2005</td><td>Agreed 2006</td></tr>
<tr><td>Flathead</td><td>3,500</td><td>3,499</td><td>3,500</td><td>3,150</td><td>3,000</td></tr>
</table></td></tr>
<tr><td>Current and recent fishery effort trends by method</td><td>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
<table>
<tr><th>Year</th><th>No. shots</th></tr>
<tr><td>2001</td><td>8,618</td></tr>
<tr><td>2002</td><td>8,958</td></tr>
<tr><td>2003</td><td>9,292</td></tr>
<tr><td>2004</td><td>7,662</td></tr>
<tr><td>2005</td><td>6,950</td></tr>
</table></td></tr>
<tr><td>Current and recent fishery catch trends by method</td><td>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
Total landed catch from Danish seine 2002-2005
<table>
<tr><th>Year</th><th>Landed catch (t)</th><th>Catch of school whiting (t)</th><th>Catch of flathead (t)</th></tr>
<tr><td>2002</td><td>1,844</td><td>456</td><td>1,193</td></tr>
<tr><td>2003</td><td>1,955</td><td>459</td><td>1,280</td></tr>
<tr><td>2004</td><td>1,896</td><td>369</td><td>1,271</td></tr>
<tr><td>2005</td><td>1,870</td><td>401</td><td>1,213</td></tr>
</table></td></tr>
</table>

<table>
<tr><td>Current and recent value of fishery ($)</td><td>Note current and recent value trends by sub-fishery. In table form
Estimated gross value of flathead and school whiting catches in the Danish seine fishery (based on combined otter trawl and Danish seine catch value provided by ABARE, and assuming Danish seine catches 40% of total SESSF flathead catch , and 90% of total SESSF school whiting catch)

<table>
<tr><th>Year</th><th>Flathead value ($000)</th><th>School whiting value ($000)</th></tr>
<tr><td>2000-01</td><td>2,494</td><td>559</td></tr>
<tr><td>2001-02</td><td>4,773</td><td>1,380</td></tr>
<tr><td>2002-03</td><td>3,274</td><td>1,113</td></tr>
<tr><td>2003-04</td><td>3,202</td><td>855</td></tr>
</table>
</td></tr>
<tr><td>Relationship with other fisheries</td><td>Commercial and recreational, state, national and international fisheries List other fisheries operating in the same region any interactions
Recreational catches may be significant for some species (e.g. flathead).

The following fisheries operate in the area coved by this fishery, either under Commonwealth jurisdiction or Joint jurisdiction between the Commonwealth and States:
Bass Straight Central Zone Scallop Fishery;
East Coast Tuna and Billfish Fishery;
Small Pelagics Fishery;
Southern Squid Jig Fishery;
Southern Bluefin Tuna Fishery

The following fisheries operate under Victorian jurisdiction in waters overlapping or adjacent to this fishery:
Abalone Fishery;
Victorian Inshore Prawn Trawl Fishery;
Rock Lobster Fishery;
Ocean Access Fishery;
Victorian Scallop Fishery.

(SESSF Assessment Report, 2002)</td></tr>
<tr><td colspan="2">Gear</td></tr>
<tr><td>Fishing gear and methods</td><td>Description of the methods and gear in the fishery, average number days at sea per trip.
Danish seine vessels fish along the seabed using a herding principle to catch fish mainly on the continental shelf. The net is similar to a trawl net but has wings and is attached halfway along a seine rope. To deploy the net, one end of the rope is attached to a buoy (the dan) and the gear is laid out in a pear shape as it is deployed from the vessel. The net forms the base of the pear and the ropes form the sides. The depth fished (up to 200m), together with the species sought determines the length of rope used (from 1 000m to 2 800m).

The two ends of the rope are then hauled in together, pulling the net over the seabed and herding the fish inwards towards the path of the net similar to trawling. Hauling, towing and winching techniques vary from one operator to another and are also depth and target species dependent. The minimum mesh size for Danish seiners is 38 mm.</td></tr>
<tr><td>Fishing gear restrictions</td><td>Any restrictions on gear
SESSF operators are only permitted to fish using the gear/methods specified on their boat statutory fishing right and/or fishing permit.</td></tr>
<tr><td>Selectivity of gear and fishing methods</td><td>Description of the selectivity of the sub-fishery methods
The minimum mesh size is 38 mm.</td></tr>
<tr><td>Spatial gear zone set</td><td>Description where gear set i.e. continental shelf, shelf break, continental slope (range nautical miles from shore)
continental shelf</td></tr>
</table>

Depth range gear set	*Depth range gear set at in metres* From a few metres down to 250m
How gear set	*Description how set, pelagic in water column, benthic set (weighted) on seabed* On seabed
Area of gear impact per set or shot	*Description of area impacted by gear per set (square metres)* Not recorded
Capacity of gear	*Description number hooks per set, net size weight per trawl shot* Not recorded
Effort per annum all boats	*Description effort per annum of all boats in fishery by shots or sets and hooks, for all boats* See above
Lost gear and ghost fishing	*Description of how gear is lost, whether lost gear is retrieved, and what happens to gear that is not retrieve, and impacts of ghost fishing* See SICA
Issues	
Target species issues	*List any issues, including biological information such as spawning season and spawning location, major uncertainties about biology* No major issues
Byproduct and bycatch issues and interactions	*List any issues, as for the target species above* No major issues
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.* Syngnathids are caught in this fishery.
Habitat issues and interactions	*List any issues for any of the habitat units identified in **Scoping Document S1.2**. This should include reference to any protected, threatened or listed habitats* Danish seining can result in impacts on seabed habitats as fishing gear contacts the seabed during fishing. While the extent of this impact is largely unknown, shallow sandy seabed types are fished mostly by this gear because the nature of the gear is such that it cannot negotiate rough grounds. Danish seining is therefore unlikely to impact on the more complex habitats that provide protection for a range of species. The habitats fished by this method correspond more closely to the less vulnerable habitats (high energy and unconsolidated substrates). (SESSF Assessment Report 2002)
Community issues and interactions	*List any issues for any of the community units identified in **Scoping Document S1.2**.* By removing one species or size range of the population, in addition to changes to the community from which it is removed, there is a possibility that food web dynamics may change, for example increased prey populations, displacement by competing species, or predators having to find alternative food sources. Removals of particular species do drive changes to the ecosystem. For example, Klaer (2001) reported increases in the catch of some species by steam trawlers between 1918 and 1957, and decreases of other species. (SESSF Assessment Report 2002)
Discarding	*Summary of discarding practices by sub-fishery, including bycatch, juveniles of target species, high-grading, processing at sea.* Discard rates are low for quota species, but high for non-quota species (%0 and 80% respectively in 2004).
Management: planned and those implemented	
Management Objectives	*The management objectives from the most recent management plan* Objectives of Southern and Eastern Scalefish and Shark Fishery Management Plan 2003 a) to implement efficient and cost-effective fisheries management of the fishery on behalf of 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-target species and the long-term sustainability of the marine environment; c) to maximise economic efficiency in the exploitation of scalefish and shark 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 fishery are not endangered by over-exploitation; g) to ensure the best use of the living resources of the fishery; h) to ensure that conservation and management measures in the fishery implement Australia's obligations under international agreements that deal with fish stocks, and other relevant international agreements; i) to ensure, as far as practicable, that measures adopted in pursuit of these objectives are not inconsistent with the preservation, conservation and protection of all whale species. (SESSF Management Plan 2003)
Fishery management plan	*Is there a fisheries management plan is it in the planning stage or implemented what are the key features* The Danish seine fishery is managed as part of the Commonwealth Trawl Sector under the Southern and Eastern Scalefish and Shark Fishery Management Plan 2003. The *Guide to the 2006 Management Arrangements* describes current arrangements. 20 species or species groups in the CTS have Total Allowable Catches (TACs) set which are allocated to fishers as quota Statutory Fishing Rights.
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.* A vessel must have a boat Statutory Fishing Right (SFR) allowing a vessel to trawl. This SFR will entitle a vessel to use trawl (including Danish seine) gear in a specific area of water. Other input controls include minimum mesh size in the codend to prevent the capture of juvenile fish. For Danish seine the minimum mesh size is 38 mm. (SESSF Assessment Report 2002)
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.* All of the major target and byproduct species in the south east trawl sector of the SESSF are managed under quota in the form of ITQs. Quota is issued in the form of 'quota' SFRs and an operator must hold both the appropriate boat SFR and Quota SFRs to fish for quota species. (SESSF Assessment Report 2002)
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.* Minimum mesh size 38 mm
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.* MARPOL applies
Initiatives and strategies	*BAPs; TEDs; industry codes of conduct, MPAs, Reserves* Industry code of conduct in place
Enabling	*Monitoring (logbooks, observer data, scientific surveys); assessment (stock*

processes	*assessments); performance indicators (decision rules, processes, compliance; education; consultation process* AFMA is responsible for data collection and monitoring in this fishery. Commonwealth scientific log books have been compulsory in the south east trawl sector since 1985. Prior to 1997, shark and non-trawl operators completed State logbooks. This data has been collated and is used in assessments. Landings are also recorded through the quota monitoring system by catch disposal records. The collection of age-length data for scalefish was conducted by State agencies and often sporadic or duplicated prior to 1991. The Central Aging Facility (CAF) was established in 1991 to conduct age estimation for these fisheries. The Central Aging Facility (CAF) also conducts routine age estimation on most target scalefish species in this fishery. The Integrated Scientific Monitoring Program (ISMP) was implemented in 1997 to replace the Scientific Monitoring Program in the SETF. It provides statistically rigorous port-based and at sea monitoring in the south-east trawl, south east non-trawl and GAB trawl sectors of this fishery. ISMP provides important information on discards, non commercial species and non-quota commercial species. (SESSF Assessment Report 2002) In 2003 four Commonwealth fisheries in the southern region were amalgamated into the Southern and Eastern Scalefish and Shark Fishery (SESSF) under a common set of management objectives. The component sectors of the SESSF are: the Commonwealth Trawl Sector (formerly the South East Trawl & Commonwealth Victorian Inshore Trawl Fisheries; includes the Danish seine fishery); the Great Australian Bight Trawl Sector (formerly the Great Australian Bight Trawl Fishery); the Gillnet Hook and Trap Sector (formerly the Gillnet Hook and Trap [and previously the Southern Shark and South East Non-trawl] Fishery) and the East Coast Deepwater Trawl Sector. The assessment group structure comprises: - SESSFAG (an umbrella assessment group for the whole SESSF) - Shelf Assessment Group (SHAG) - Slope Assessment Group (SlopeAG) - Deepwater Assessment Group (DAG) - Shark Assessment Group - Great Australian Bight Assessment Group Each of the three depth-related assessment groups (SHAG, SlopeAG and DAG) is responsible for undertaking stock assessments for a suite of key species, and for reporting on the status of those species to SESSFAG. The species caught in the Danish seine fishery are under the consideration of the Shelf Assessment Group (SHAG). SHAG is responsible for the assessment of scalefish species generally associated with the shallow areas of the continental shelf, from the low water line to the 200m depth contour. Species assessed by SHAG include jackass morwong, school whiting, flathead, John dory, inshore ocean perch, redfish, silver trevally and boarfish. (FAR 2004)
Other initiatives or agreements	*State, national or international conventions or agreements that impact on the management of the fishery/sub-fishery being evaluated.* United Nations Convention Law of the Sea FAO Code of Conduct for Responsible Fisheries Agenda 21 United Nations Fish Stocks Agreement Fisheries Management Act 1991 Environment Protection and Biodiversity Conservation Act 1999

	Oceans Policy (Bycatch Action Plan Background Paper)
Data	
Logbook data	*Verified logbook data; data summaries describe programme* Commonwealth scientific logbooks have been compulsory in the Danish seine sector since 1985. All fishing operators are required to record the location, catch of each species and effort in AFMA logbooks each time they deploy and retrieve their gear.
Observer data	*Observer programme describe parameters as below* Purpose: The Integrated Scientific Monitoring Programs (ISMP) was implemented in 1997 to replace the Scientific Monitoring program in the SETF. It provides statistically rigorous port-based and at-sea monitoring, which produces important information on discards, non-commercial species and non-quota commercial species. ISMP observers collect information on all species that come aboard for both discarded and retained species. Length, weight and maturity data and biological samples (e.g. otoliths and genetic samples) are routinely collected from both discarded and retained species. Port based observers provide additional biological data and samples from the landed catch. From 2003, the ISMP also collects information on the incidence of direct and indirect interaction with TEP species. Data collection: The level of coverage to achieve desired coefficients of variance (as determined by gear types, targeting practices, fishing locations, landing port) for each quota species is calculated. Better estimates of discarding are required where higher amounts of discarding occur; therefore the ISMP is largely directed at areas of the SETF where relatively high levels of quota species are discarded. This is monitored annually and observer effort is redirected as considered appropriate for stock assessment needs. Coverage of fishing shots to achieve statistically robust samples ranges from 2 – 8% of shots in the SETF. The SETF ISMP now contains 10 years data and 60% of south east trawl vessels participate voluntarily in the program. Otoliths collected from the ISMP are provided to the Central Ageing Facility (CAF), a national fish ageing laboratory established at MAFRI. The CAF is the primary source of validated age estimations in this fishery. These data provide growth parameters and age-length keys, which enable estimates of age composition from size composition data to feed into stock assessments. Otolith shape analysis is also conducted to provide information on stock structure. (SESSF Assessment Report 2002) Data collation: All data collected is entered onto the ISMP database which is maintained at the Primary Industry Victoria fishery laboratories in Queenscliff, Victoria. Data communication: The ISMP publishes an annual report summarising the year's observations, and responds to individual requests for information. A copy of the full database is provided to AFMA. Data checking: The data is validated after being entered onto the database. (ISMP SETF Annual Report 2004)
Other data	*Studies, surveys*

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
6	31	116	198	82	13

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 *Danish seine*

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.

The flathead TAC includes tiger flathead and several other flathead species: sand flathead, yank flathead, bluespot flathead and toothy flathead. Tiger flathead comprises the bulk of the catch. The species are not identified in logbooks – they are all recorded as tiger flathead.

Species Number	Taxa	Family name	Scientific name	Common Name	CAAB code
6	Teleost	Platycephalidae	*Neoplatycephalus aurimaculatus*	toothy flathead	37296035
1037	Teleost	Platycephalidae	*Neoplatycephalus richardsoni*	Flathead	37296001
115	Teleost	Platycephalidae	*Platycephalus bassensis*	Sand Flathead	37296003
2765	Teleost	Platycephalidae	*Platycephalus caeruleopunctatus*	bluespot flathead	37296007
118	Teleost	Platycephalidae	*Platycephalus speculator*	yank flathead	37296037
145	Teleost	Sillaginidae	*Sillago flindersi*	School Whiting	37330014

Byproduct species *Danish seine*

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.

For the Danish seine sub-fishery, byproduct has been defined to be all non-quota species recorded in daily logbooks from 2001-04.

Species Number	Taxa	Family name	Scientific name	Common Name	CAAB code
286	Chondrichthyan	Callorhinchidae	*Callorhinchus milii*	Elephantfish	37043001
535	Chondrichthyan	Carcharhinidae	*Carcharhinus brachyurus*	Bronze Whaler	37018001
551	Chondrichthyan	Carcharhinidae	*Galeocerdo cuvier*	Tiger Shark	37018022
964	Chondrichthyan	Lamnidae	*Isurus oxyrinchus*	Shortfinned Mako or Blue Pointer	37010001
660	Chondrichthyan	Squatinidae	*Squatina australis*	Australian Angel Shark	37024001
490	Chondrichthyan	Triakidae	*Furgaleus macki*	Whiskery Shark	37017003
936	Chondrichthyan	Triakidae	*Galeorhinus galeus*	School Shark, Tope shark	37017008
999	Chondrichthyan	Triakidae	*Mustelus antarcticus*	Gummy Shark	37017001
332	Teleost	Berycidae	*Centroberyx affinis*	Redfish	37258003
150	Teleost	Carangidae	*Pseudocaranx dentex*	Silver Trevally	37337062
1088	Teleost	Carangidae	*Trachurus declivis*	Jack Mackerel	37337002
958	Teleost	Centrolophidae	*Hyperoglyphe antarctica*	Blue Eye Trevalla	37445001
1068	Teleost	Centrolophidae	*Seriolella brama*	Blue Warehou	37445005
1069	Teleost	Centrolophidae	*Seriolella punctata*	Spotted Warehou	37445006
1012	Teleost	Cheilodactylidae	*Nemadactylus macropterus*	Jackass Morwong	37377003
919	Teleost	Gadidae	*Gadus morhua*	Cod - unspecified	37226790
1066	Teleost	Gempylidae	*Rexea solandri*	Gemfish	37439002
204	Teleost	Gempylidae	*Ruvettus pretiosus*	Oilfish	37439003
1087	Teleost	Gempylidae	*Thyrsites atun*	Barracouta	37439001
181	Teleost	Latridae	*Latridopsis forsteri*	Bastard Trumpeter	37378002
165	Teleost	Mullidae	*Upeneichthys lineatus*	Red Mullet/Blue- lined Goatfish	37355001
933	Teleost	Ophidiidae	*Genypterus blacodes*	Ling	37228002
941	Teleost	Sebastidae	*Helicolenus percoides*	Ocean Perch - inshore	37287001
135	Teleost	Serranidae	*Cephalopholis cyanostigma*	Tomato Cod / Bluespotted Hind	37311136

Species Number	Taxa	Family name	Scientific name	Common Name	CAAB code
142	Teleost	Sillaginidae	*Sillaginodes punctata*	King George Whiting	37330001
158	Teleost	Sparidae	*Pagrus auratus*	Snapper/Squirefish	37353001
539	Teleost	Triglidae	*Chelidonichthys Kumu*	Red Gurnard	37288001
109	Teleost	Triglidae	*Pterygotrigla polyommata*	Latchet	37288006
214	Teleost	Zeidae	*Cyttus australis*	Silver dory	37264002
1097	Teleost	Zeidae	*Zenopsis nebulosus*	Mirror Dory	37264003
72	Teleost	Zeidae	*Zeus faber*	John Dory	37264004

Discard species *Danish seine*

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.

For the Danish seine sub-fishery, discard species have been defined to be all species recorded by the ISMP since 1990, that are not also recorded in logbooks 2001-2004.
This list is ordered by taxon, family name, and scientific name.

Species Number	Taxa	Family name	Scientific name	Common Name	CAAB code
371	Chondrichthyan	Centrophoridae	*Centrophorus moluccensis (west)*	Endeavour Dogfish	37020001
956	Chondrichthyan	Chimaeridae	*Hydrolagus ogilbyi*	Ogilbys Ghost Shark	37042001
764	Chondrichthyan	Dasyatidae	*Dasyatis brevicaudata*	smooth stingray	37035001
767	Chondrichthyan	Dasyatidae	*Dasyatis thetidis*	black stingray	37035002
759	Chondrichthyan	Gymnuridae	*Gymnura australis*	rat tailed ray	37037001
260	Chondrichthyan	Heterodontidae	*Heterodontus portusjacksoni*	Port Jackson Shark	37007001
59	Chondrichthyan	Hexanchidae	*Heptranchias perlo*	sharpnose seven-gill shark	37005001
60	Chondrichthyan	Hexanchidae	*Notorynchus cepedianus*	Broadnose sevengill shark	37005002
784	Chondrichthyan	Myliobatidae	*Myliobatis australis*	Southern Eagle Ray	37039001
368	Chondrichthyan	Parascylliidae	*Parascyllium collare*	collared catshark	37013002
369	Chondrichthyan	Parascylliidae	*Parascyllium ferrugineum*	rusty catshark	37013005
436	Chondrichthyan	Rajidae	*Dipturus australis*	common skate	37031002
812	Chondrichthyan	Rajidae	*Dipturus cerva*	white spotted skate	37031003
760	Chondrichthyan	Rajidae	*Dipturus lemprieri*	thornback skate	37031007

Species Number	Taxa	Family name	Scientific name	Common Name	CAAB code
962	Chondrichthyan	Rajidae	*Irolita waitii*	round skate	37031001
761	Chondrichthyan	Rajidae	*Pavoraja nitida*	peacock skate	37031009
687	Chondrichthyan	Rhinobatidae	*Trygonorrhina fasciata*	fiddler ray	37027002
460	Chondrichthyan	Scyliorhinidae	*Asymbolus analis*	spotted catshark	37015027
331	Chondrichthyan	Scyliorhinidae	*Asymbolus parvus*	dwarf catshark	37015022
493	Chondrichthyan	Scyliorhinidae	*Cephaloscyllium laticeps*	Draughtboard Shark	37015001
495	Chondrichthyan	Scyliorhinidae	*Cephaloscyllium sp. A [in Last & Stevens, 1994]*	Whitefin Swell Shark	37015013
1078	Chondrichthyan	Squalidae	*Squalus megalops*	Piked Dogfish	37020006
1079	Chondrichthyan	Squalidae	*Squalus mitsukurii*	Green-Eyed Dogfish	37020007
668	Chondrichthyan	Squatinidae	*Squatina tergocellata*	ornate angel shark	37024002
714	Chondrichthyan	Torpedinidae	*Hypnos monopterygium*	numbfish	37028001
771	Chondrichthyan	Urolophidae	*Urolophus bucculentus*	sandy-backed stingaree	37038001
772	Chondrichthyan	Urolophidae	*Urolophus cruciatus*	banded stingaree	37038002
22	Chondrichthyan	Urolophidae	*Urolophus gigas*	spotted stingaree	37038003
774	Chondrichthyan	Urolophidae	*Urolophus paucimaculatus*	sparsely-spotted stingaree	37038004
23	Chondrichthyan	Urolophidae	*Urolophus sufflavus*	yellow-backed stingaree	37038005
777	Chondrichthyan	Urolophidae	*Urolophus viridis*	green-backed stingaree	37038007
1280	Invertebrate	Loliginidae	*Sepioteuthis australis*	Southern calamari	23617005
762	Invertebrate	Octopodidae	*Hapalochlaena maculosa*	southern blue ringed octopus	23659013
11	Invertebrate	Ommastrephidae	*Nototodarus gouldi*	Arrow Squid	23636004
920	Invertebrate	Ommastrephidae	*Ornithoteuthis volatilis*	long-tailed flying squid	23636008
1271	Invertebrate	Pectinidae	*Mimachlamys asperrima*	Doughboy Scallop	23270006
1272	Invertebrate	Pectinidae	*Pecten fumatus*	scallop	23270007
5	Invertebrate	Penaeidae	*Metapenaeus macleayi*	school prawn	28711029
17	Invertebrate	Solenoceridae	*Haliporoides sibogae*	Royal Red Prawn	28714005
129	Teleost	Acropomatidae	*Apogonops anomalus*	three-spined cardinalfish	37311053
154	Teleost	Arripidae	*Arripis truttaceus*	western australian salmon	37344004
859	Teleost	Aulopidae	*Aulopus purpurissatus*	sergeant baker	37117001
9	Teleost	Bovichthyidae	*Pseudaphritis urvillii*	congolli	37403003
126	Teleost	Callanthiidae	*Callanthias allporti*	rosy perch	37311004

Species Number	Taxa	Family name	Scientific name	Common Name	CAAB code
931	Teleost	Callionymidae	*Eocallionymus papilio*	painted stinkfish	37427014
201	Teleost	Callionymidae	*Foetorepus calauropomus*	common stinkfish	37427001
13	Teleost	Callionymidae	*Repomucenus calcaratus*	spotted stinkfish	37427015
149	Teleost	Carangidae	*Seriola hippos*	samsonfish	37337007
540	Teleost	Carangidae	*Trachurus novaezelandiae*	Yellow tail scad	37337003
90	Teleost	Centriscidae	*Macroramphosus scolopax*	common bellowsfish	37279002
217	Teleost	Centrolophidae	*Seriolella caerulea*	White Trevalla	37445011
177	Teleost	Cheilodactylidae	*Nemadactylus douglasii*	Grey Morwong	37377002
867	Teleost	Chlorophthalmidae	*Paraulopus nigripinnis*	Cucumber Fish - Montigue Mullet	37120001
825	Teleost	Clupeidae	*Sardinops neopilchardus*	pilchard	37085002
250	Teleost	Diodontidae	*Allomycterus pilatus*	deepwater burrfish	37469002
249	Teleost	Diodontidae	*Diodon nicthemerus*	globe fish	37469001
140	Teleost	Epigonidae	*Epigonus denticulatus*	white cardinalfish	37327010
141	Teleost	Epigonidae	*Epigonus robustus*	robust cardinalfish	37327018
157	Teleost	Gerreidae	*Gerres erythrourus*	Short Silverbiddy	37349007
156	Teleost	Gerreidae	*Parequula melbournensis*	silverbelly	37349001
874	Teleost	Gonorynchidae	*Gonorynchus greyi*	sandfish	37141001
120	Teleost	Hoplichthyidae	*Hoplichthys haswelli*	spiny flathead	37297001
91	Teleost	Macroramphosidae	*Centriscops humerosus*	Banded bellowsfish	37279001
366	Teleost	Macrouridae	*Caelorinchus acutirostris*	whiptail	37232010
977	Teleost	Macrouridae	*Lepidorhynchus denticulatus*	Toothed Whiptail	37232004
982	Teleost	Merlucciidae	*Macruronus novaezelandiae*	Blue Grenadier	37227001
237	Teleost	Monacanthidae	*Meuschenia freycineti*	six-spined leatherjacket	37465036
232	Teleost	Monacanthidae	*Meuschenia scaber*	velvet leatherjacket	37465005
18	Teleost	Monacanthidae	*Thamnaconus degeni*	degen's leatherjacket	37465037
911	Teleost	Moridae	*Lotella rhacina*	beardie	37224005
95	Teleost	Neosebastidae	*Neosebastes scorpaenoides*	ruddy gurnard perch	37287005
96	Teleost	Neosebastidae	*Neosebastes thetidis*	thetis fish	37287006
592	Teleost	Ophidiidae	*Dannevigia tusca*	Australian Tusk	37228001

Species Number	Taxa	Family name	Scientific name	Common Name	CAAB code
921	Teleost	Ophidiidae	*Genypterus tigerinus*	Rock Ling	37228008
790	Teleost	Ophidiidae	*Hoplobrotula armata*	spined headed cusk fish	37228007
305	Teleost	Ostraciidae	*Anoplocapros amygdaloides*	western smooth boxfish	37466015
240	Teleost	Ostraciidae	*Anoplocapros inermis*	eastern smooth boxfish	37466002
241	Teleost	Ostraciidae	*Aracana aurita*	shaw's cowfish	37466003
239	Teleost	Ostraciidae	*Aracana ornata*	ornate cowfish	37466001
456	Teleost	Ostraciidae	*Capropygia unistriata*	spiny boxfish	37466011
122	Teleost	Pegasidae	*Acanthopegasus lancifer/Pegasus lancifer*	sea moth	37309003
174	Teleost	Pentacerotidae	*Parazanclistius hutchinsi*	short boarfish	37367010
169	Teleost	Pentacerotidae	*Paristiopterus gallipavo*	Yellow-Spotted Boarfish	37367001
1	Teleost	Pentacerotidae	*Paristiopterus labiosus*	giant boarfish	37367002
171	Teleost	Pentacerotidae	*Pentaceros decacanthus*	big-spined boarfish	37367004
172	Teleost	Pentacerotidae	*Zanclistius elevatus*	long-finned boarfish	37367005
107	Teleost	Peristediidae	*Peristedion picturatum*	armoured gurnard	37288004
191	Teleost	Pinguipedidae	*Parapercis allporti*	barred grubfish	37390001
225	Teleost	Pleuronectidae	*Ammotretis lituratus*	spotted flounder	37461004
224	Teleost	Pleuronectidae	*Rhombosolea tapirina*	greenback flounder	37461003
146	Teleost	Pomatomidae	*Pomatomus saltatrix*	Tailor	37334002
137	Teleost	Priacanthidae	*Cookeolus japonicus*	long-finned bullseye	37326002
147	Teleost	Rachycentridae	*Rachycentron canadum*	cobia	37335001
210	Teleost	Scombridae	*Scomber australasicus*	Blue Mackerel	37441001
869	Teleost	Sebastidae	*Neosebastes nigropunctatus*	black-spotted gurnard perch	37287002
124	Teleost	Serranidae	*Caesioperca lepidoptera*	butterfly perch	37311002
125	Teleost	Serranidae	*Caesioperca rasor*	barber perch	37311003
26	Teleost	Soleidae	*Zebrias fasciatus*	many-banded sole	37462010
246	Teleost	Tetraodontidae	*Arothron firmamentum*	starry toadfish	37467005
248	Teleost	Tetraodontidae	*Contusus brevicaudus*	toadfish	37467044
242	Teleost	Tetraodontidae	*Contusus richei*	prickly toadfish	37467001
243	Teleost	Tetraodontidae	*Omegophora armilla*	ringed toadfish	37467002
245	Teleost	Tetraodontidae	*Sphoeroides pachygaster*	balloonfish	37467004

Species Number	Taxa	Family name	Scientific name	Common Name	CAAB code
244	Teleost	Tetraodontidae	*Tetractenos glaber*	smooth toadfish	37467003
247	Teleost	Tetraodontidae	*Torquigener pallimaculatus*	toadfish	37467009
99	Teleost	Tetrarogidae	*Gymnapistes marmoratus*	cobbler	37287018
208	Teleost	Trichiuridae	*Lepidopus caudatus*	Southern Frostfish	37440002
110	Teleost	Triglidae	*Lepidotrigla modesta*	grooved gurnard	37288007
111	Teleost	Triglidae	*Lepidotrigla mulhalli*	grooved and roundsnouted gurnard	37288008
106	Teleost	Triglidae	*Lepidotrigla vanessa*	butterfly gurnard	37288003
108	Teleost	Triglidae	*Pterygotrigla andertoni*	painted latchet	37288005
965	Teleost	Uranoscopidae	*Kathetostoma canaster*	speckled stargazer	37400018
194	Teleost	Uranoscopidae	*Kathetostoma laeve*	common stargazer	37400003
192	Teleost	Uranoscopidae	*Xenocephalus armatus*	bulldog stargazer	37400001
74	Teleost	Zeidae	*Cyttus novaezealandiae*	New Zealand Dory	37264005
71	Teleost	Zeidae	*Cyttus traversi*	King Dory	37264001

TEP species *Danish seine*

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/* However the list generated in this way is likely to exceed the list actually likely to encounter the fishery.

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

Species Number	Taxa	Family name	Scientific name	Common Name	CAAB code
315	Chondrichthyan	Lamnidae	*Carcharodon carcharias*	white shark	37010003
313	Chondrichthyan	Odontaspididae	*Carcharias taurus*	grey nurse shark	37008001
1067	Chondrichthyan	Rhincodontidae	*Rhincodon typus*	whale shark	37014001
1428	Marine bird	Diomedeidae	*Diomedea amsterdamensis*	Amsterdam Albatross	40040018
628	Marine bird	Diomedeidae	*Diomedea antipodensis*	Antipodean Albatross	40040011
1429	Marine bird	Diomedeidae	*Diomedea dabbenena*	Tristan Albatross	40040019
753	Marine bird	Diomedeidae	*Diomedea epomophora*	Southern Royal Albatross	40040005
451	Marine bird	Diomedeidae	*Diomedea exulans*	Wandering Albatross	40040006
755	Marine bird	Diomedeidae	*Diomedea gibsoni*	Gibson's Albatross	40040010
799	Marine bird	Diomedeidae	*Diomedea sanfordi*	Northern Royal Albatross	40040012
1008	Marine bird	Diomedeidae	*Phoebetria fusca*	Sooty Albatross	40040008
1009	Marine bird	Diomedeidae	*Phoebetria palpebrata*	Light-mantled Albatross	40040009
1032	Marine bird	Diomedeidae	*Thalassarche bulleri*	Buller's Albatross	40040001
1031	Marine bird	Diomedeidae	*Thalassarche carteri*	Indian Yellow-nosed Albatross	40040014
1033	Marine bird	Diomedeidae	*Thalassarche cauta*	Shy Albatross	40040002
1034	Marine bird	Diomedeidae	*Thalassarche chlororhynchos*	Yellow-nosed Albatross, Atlantic Yellow-	40040003
1035	Marine bird	Diomedeidae	*Thalassarche chrysostoma*	Grey-headed Albatross	40040004
889	Marine bird	Diomedeidae	*Thalassarche eremita*	Chatham albatross	40040017

Species Number	Taxa	Family name	Scientific name	Common Name	CAAB code
1084	Marine bird	Diomedeidae	*Thalassarche impavida*	Campbell Albatross	40040013
1085	Marine bird	Diomedeidae	*Thalassarche melanophrys*	Black-browed Albatross	40040007
894	Marine bird	Diomedeidae	*Thalassarche salvini*	Salvin's albatross	40040016
1086	Marine bird	Diomedeidae	*Thalassarche steadi*	White-capped Albatross	
918	Marine bird	Hydrobatidae	*Fregetta grallaria*	White-bellied Storm-Petrel (Tasman Sea),	40042001
917	Marine bird	Hydrobatidae	*Fregetta tropica*	Black-bellied Storm-Petrel	40042002
555	Marine bird	Hydrobatidae	*Garrodia nereis*	Grey-backed storm petrel	40042003
556	Marine bird	Hydrobatidae	*Oceanites oceanicus*	Wilson's storm petrel (subantarctic)	40042004
1004	Marine bird	Hydrobatidae	*Pelagodroma marina*	White-faced Storm-Petrel	40042007
203	Marine bird	Laridae	*Anous stolidus*	Common noddy	40128002
325	Marine bird	Laridae	*Catharacta skua*	Great Skua	40128005
973	Marine bird	Laridae	*Larus dominicanus*	Kelp Gull	40128012
974	Marine bird	Laridae	*Larus novaehollandiae*	Silver Gull	40128013
975	Marine bird	Laridae	*Larus pacificus*	Pacific Gull	40128014
1014	Marine bird	Laridae	*Sterna albifrons*	Little tern	40128022
1015	Marine bird	Laridae	*Sterna anaethetus*	Bridled Tern	40128023
1017	Marine bird	Laridae	*Sterna bergii*	Crested Tern	40128025
1018	Marine bird	Laridae	*Sterna caspia*	Caspian Tern	40128026
1019	Marine bird	Laridae	*Sterna dougallii*	Roseate tern	40128027
1020	Marine bird	Laridae	*Sterna fuscata*	Sooty tern	40128028
1021	Marine bird	Laridae	*Sterna hirundo*	Common tern	40128029
1022	Marine bird	Laridae	*Sterna nilotica*	Gull-billed tern	40128031
1023	Marine bird	Laridae	*Sterna paradisaea*	Arctic tern	40128032
1024	Marine bird	Laridae	*Sterna striata*	White-fronted Tern	40128033
1025	Marine bird	Laridae	*Sterna sumatrana*	Black-naped tern	40128034
912	Marine bird	Phalacrocoracidae	*Phalacrocorax fuscescens*	Black faced cormorant	40048003
1433	Marine bird	Physeteridae	*Sula dactylatra*	Masked Booby	40047004
1580	Marine bird	Procellariidae	*Calonectris leucomelas*	streaked shearwater	40041002
595	Marine bird	Procellariidae	*Daption capense*	Cape Petrel	40041003
314	Marine bird	Procellariidae	*Fulmarus glacialoides*	Southern fulmar	40041004
939	Marine bird	Procellariidae	*Halobaena caerulea*	Blue Petrel	40041005

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1052	Marine bird	Procellariidae	*Lugensa brevirostris*	Kerguelen Petrel	40041006
73	Marine bird	Procellariidae	*Macronectes giganteus*	Southern Giant-Petrel	40041007
981	Marine bird	Procellariidae	*Macronectes halli*	Northern Giant-Petrel	40041008
1003	Marine bird	Procellariidae	*Pachyptila turtur*	Fairy Prion	40041013
1006	Marine bird	Procellariidae	*Pelecanoides urinatrix*	Common Diving-Petrel	40041017
1041	Marine bird	Procellariidae	*Procellaria aequinoctialis*	White-chinned Petrel	40041018
494	Marine bird	Procellariidae	*Procellaria cinerea*	Grey petrel	40041019
1042	Marine bird	Procellariidae	*Procellaria parkinsoni*	Black Petrel	40041020
1043	Marine bird	Procellariidae	*Procellaria westlandica*	Westland Petrel	40041021
1691	Marine bird	Procellariidae	*Pseudobulweria rostrata*	Tahiti Petrel	40041022
1045	Marine bird	Procellariidae	*Pterodroma cervicalis*	White-necked Petrel	40041025
504	Marine bird	Procellariidae	*Pterodroma lessoni*	White-headed petrel	40041029
1046	Marine bird	Procellariidae	*Pterodroma leucoptera*	Gould's Petrel	40041030
1047	Marine bird	Procellariidae	*Pterodroma macroptera*	Great-winged Petrel	40041031
1048	Marine bird	Procellariidae	*Pterodroma mollis*	Soft-plumaged Petrel	40041032
1049	Marine bird	Procellariidae	*Pterodroma neglecta*	Kermadec Petrel (western)	40041033
1050	Marine bird	Procellariidae	*Pterodroma nigripennis*	Black-winged Petrel	40041034
1051	Marine bird	Procellariidae	*Pterodroma solandri*	Providence Petrel	40041035
1053	Marine bird	Procellariidae	*Puffinus assimilis*	Little Shearwater (Tasman Sea)	40041036
1054	Marine bird	Procellariidae	*Puffinus bulleri*	Buller's Shearwater	40041037
1055	Marine bird	Procellariidae	*Puffinus carneipes*	Flesh-footed Shearwater	40041038
1056	Marine bird	Procellariidae	*Puffinus gavia*	Fluttering Shearwater	40041040
1057	Marine bird	Procellariidae	*Puffinus griseus*	Sooty Shearwater	40041042
1058	Marine bird	Procellariidae	*Puffinus huttoni*	Hutton's Shearwater	40041043
1059	Marine bird	Procellariidae	*Puffinus pacificus*	Wedge-tailed Shearwater	40041045
1060	Marine bird	Procellariidae	*Puffinus tenuirostris*	Short-tailed Shearwater	40041047
898	Marine bird	Spheniscidae	*Eudyptula minor*	Little Penguin	40001008
1549	Marine bird	Sulidae	*Morus capensis*	Cape gannet	40047001
998	Marine bird	Sulidae	*Morus serrator*	Australasian Gannet	40047002
1673	Marine bird	Thalassarche	*Thalassarche nov. sp.*	Pacific Albatross	

Species Number	Taxa	Family name	Scientific name	Common Name	CAAB code
1672	Marine bird		*Pterodroma leucoptera (subsp. Caledonica)*	Gould's Petrel	
1439	Marine mammal	Balaenidae	*Balaenoptera bonaerensis*	Antarctic Minke Whale	41112007
289	Marine mammal	Balaenidae	*Caperea marginata*	Pygmy Right Whale	41110002
896	Marine mammal	Balaenidae	*Eubalaena australis*	Southern Right Whale	41110001
256	Marine mammal	Balaenopteridae	*Balaenoptera acutorostrata*	Minke Whale	41112001
261	Marine mammal	Balaenopteridae	*Balaenoptera borealis*	Sei Whale	41112002
262	Marine mammal	Balaenopteridae	*Balaenoptera edeni*	Bryde's Whale	41112003
265	Marine mammal	Balaenopteridae	*Balaenoptera musculus*	Blue Whale	41112004
268	Marine mammal	Balaenopteridae	*Balaenoptera physalus*	Fin Whale	41112005
984	Marine mammal	Balaenopteridae	*Megaptera novaeangliae*	Humpback Whale	41112006
612	Marine mammal	Delphinidae	*Delphinus delphis*	Common Dolphin	41116001
902	Marine mammal	Delphinidae	*Feresa attenuata*	Pygmy Killer Whale	41116002
934	Marine mammal	Delphinidae	*Globicephala macrorhynchus*	Short-finned Pilot Whale	41116003
935	Marine mammal	Delphinidae	*Globicephala melas*	Long-finned Pilot Whale	41116004
937	Marine mammal	Delphinidae	*Grampus griseus*	Risso's Dolphin	41116005
970	Marine mammal	Delphinidae	*Lagenodelphis hosei*	Fraser's Dolphin	41116006
832	Marine mammal	Delphinidae	*Lagenorhynchus cruciger*	Hourglass dolphin	41116007
971	Marine mammal	Delphinidae	*Lagenorhynchus obscurus*	Dusky Dolphin	41116008
61	Marine mammal	Delphinidae	*Lissodelphis peronii*	Southern Right Whale Dolphin	41116009
1002	Marine mammal	Delphinidae	*Orcinus orca*	Killer Whale	41116011
1007	Marine mammal	Delphinidae	*Peponocephala electra*	Melon-headed Whale	41116012
1044	Marine mammal	Delphinidae	*Pseudorca crassidens*	False Killer Whale	41116013
1076	Marine mammal	Delphinidae	*Sousa chinensis*	Indo-Pacific Humpback Dolphin	41116014
1080	Marine mammal	Delphinidae	*Stenella attenuata*	Spotted Dolphin	41116015
1081	Marine mammal	Delphinidae	*Stenella coeruleoalba*	Striped Dolphin	41116016
1082	Marine mammal	Delphinidae	*Stenella longirostris*	Long-snouted Spinner Dolphin	41116017
1083	Marine mammal	Delphinidae	*Steno bredanensis*	Rough-toothed Dolphin	41116018
1494	Marine mammal	Delphinidae	*Tursiops aduncus*	Indian Ocean bottlenose dolphin	41116020
1091	Marine mammal	Delphinidae	*Tursiops truncatus*	Bottlenose Dolphin	41116019
813	Marine mammal	Dugongidae	*Dugong dugon*	Dugong	41206001

Species Number	Taxa	Family name	Scientific name	Common Name	CAAB code
216	Marine mammal	Otariidae	*Arctocephalus forsteri*	New Zealand Fur-seal	41131001
253	Marine mammal	Otariidae	*Arctocephalus pusillus doriferus*	Australian Fur Seal	41131003
263	Marine mammal	Otariidae	*Arctocephalus tropicalis*	Subantarctic fur seal	41131004
1000	Marine mammal	Otariidae	*Neophoca cinerea*	Australian Sea-lion	41131005
295	Marine mammal	Phocidae	*Hydrurga leptonyx*	Leopard seal	41136001
993	Marine mammal	Phocidae	*Mirounga leonina*	Elephant seal	41136004
968	Marine mammal	Physeteridae	*Kogia breviceps*	Pygmy Sperm Whale	41119001
969	Marine mammal	Physeteridae	*Kogia simus*	Dwarf Sperm Whale	41119002
1036	Marine mammal	Physeteridae	*Physeter catodon*	Sperm Whale	41119003
269	Marine mammal	Ziphiidae	*Berardius arnuxii*	Arnoux's Beaked Whale	41120001
959	Marine mammal	Ziphiidae	*Hyperoodon planifrons*	Southern Bottlenose Whale	41120002
985	Marine mammal	Ziphiidae	*Mesoplodon bowdoini*	Andrew's Beaked Whale	41120004
986	Marine mammal	Ziphiidae	*Mesoplodon densirostris*	Blainville's Beaked Whale	41120005
987	Marine mammal	Ziphiidae	*Mesoplodon gingkodens*	Gingko Beaked Whale	41120006
988	Marine mammal	Ziphiidae	*Mesoplodon grayi*	Gray's Beaked Whale	41120007
989	Marine mammal	Ziphiidae	*Mesoplodon hectori*	Hector's Beaked Whale	41120008
990	Marine mammal	Ziphiidae	*Mesoplodon layardii*	Strap-toothed Beaked Whale	41120009
991	Marine mammal	Ziphiidae	*Mesoplodon mirus*	True's Beaked Whale	41120010
1030	Marine mammal	Ziphiidae	*Tasmacetus shepherdi*	Tasman Beaked Whale	41120011
1098	Marine mammal	Ziphiidae	*Ziphius cavirostris*	Cuvier's Beaked Whale	41120012
324	Marine reptile	Cheloniidae	*Caretta caretta*	Loggerhead	39020001
541	Marine reptile	Cheloniidae	*Chelonia mydas*	Green turtle	39020002
613	Marine reptile	Dermochelyidae	*Dermochelys coriacea*	Leathery turtle	39021001
254	Marine reptile	Hydrophiidae	*Astrotia stokesii*	Stokes' seasnake	39125009
957	Marine reptile	Hydrophiidae	*Hydrophis elegans*	Elegant seasnake	39125021
1423	Marine reptile	Hydrophiidae	*Hydrophis ornatus*	seasnake	39125028
1005	Marine reptile	Hydrophiidae	*Pelamis platurus*	yellow-bellied seasnake	39125033
1074	Teleost	Solenostomidae	*Solenostomus cyanopterus*	Blue-finned Ghost Pipefish, Robust Ghost	37281001
1075	Teleost	Solenostomidae	*Solenostomus paradoxus*	Harlequin Ghost Pipefish, Ornate Ghost Pipefish	37281002
105	Teleost	Syngnathidae	*Acentronura australe*	Southern Pygmy Pipehorse	37282034
114	Teleost	Syngnathidae	*Acentronura breviperula*	Hairy Pygmy Pipehorse	37282035

Species Number	Taxa	Family name	Scientific name	Common Name	CAAB code
287	Teleost	Syngnathidae	*Campichthys galei*	Gale's Pipefish	37282039
288	Teleost	Syngnathidae	*Campichthys tryoni*	Tryon's Pipefish	37282041
563	Teleost	Syngnathidae	*Corythoichthys amplexus*	Fijian Banded Pipefish, Brown-banded Pipefish	37282047
578	Teleost	Syngnathidae	*Corythoichthys ocellatus*	Orange-spotted Pipefish, Ocellated Pipefish	37282050
580	Teleost	Syngnathidae	*Cosmocampus howensis*	Lord Howe Pipefish	37282055
904	Teleost	Syngnathidae	*Festucalex cinctus*	Girdled Pipefish	37282061
914	Teleost	Syngnathidae	*Filicampus tigris*	Tiger Pipefish	37282064
1591	Teleost	Syngnathidae	*Halicampus boothae*	[a pipefish]	37282107
938	Teleost	Syngnathidae	*Halicampus grayi*	Mud Pipefish, Gray's Pipefish	37282030
1592	Teleost	Syngnathidae	*Halicampus macrorhynchus*	[a pipefish]	37282067
942	Teleost	Syngnathidae	*Heraldia nocturna*	Upside-down Pipefish	37282071
1548	Teleost	Syngnathidae	*Heraldia sp. 1 [in Kuiter, 2000]*	Western upsidedown pipefish	37282130
943	Teleost	Syngnathidae	*Hippichthys cyanospilos*	Blue-speckled Pipefish, Blue-spotted Pipefish	37282072
944	Teleost	Syngnathidae	*Hippichthys heptagonus*	Madura Pipefish	37282073
945	Teleost	Syngnathidae	*Hippichthys penicillus*	Beady Pipefish, Steep-nosed Pipefish	37282075
1664	Teleost	Syngnathidae	*Hippocampus abdominalis*	Big-bellied / southern potbellied seahorse	37282120
946	Teleost	Syngnathidae	*Hippocampus bleekeri*	pot bellied seahorse	37282010
947	Teleost	Syngnathidae	*Hippocampus breviceps*	Short-head Seahorse, Short-snouted Seaho	37282026
1666	Teleost	Syngnathidae	*Hippocampus kelloggi*	Kellogg's Seahorse	
1667	Teleost	Syngnathidae	*Hippocampus kuda*	Spotted Seahorse, Yellow Seahorse	
950	Teleost	Syngnathidae	*Hippocampus minotaur*	Bullneck Seahorse	37282105
951	Teleost	Syngnathidae	*Hippocampus planifrons*	Flat-face Seahorse	37282078
949	Teleost	Syngnathidae	*Hippocampus taeniopterus*	Spotted Seahorse, Yellow Seahorse	37282033
1602	Teleost	Syngnathidae	*Hippocampus tristis*	[a pipefish]	37282117
952	Teleost	Syngnathidae	*Hippocampus whitei*	white's seahorse	37282027
953	Teleost	Syngnathidae	*Histiogamphelus briggsii*	Briggs' Crested Pipefish, Briggs' Pipefish	37282011
954	Teleost	Syngnathidae	*Histiogamphelus cristatus*	Rhino Pipefish, Macleay's Crested Pipefish	37282081
960	Teleost	Syngnathidae	*Hypselognathus horridus*	Shaggy Pipefish, Prickly Pipefish	37282082
961	Teleost	Syngnathidae	*Hypselognathus rostratus*	Knife-snouted Pipefish	37282012
1699	Teleost	Syngnathidae	*Idiotropiscis australe*	Southern Pygmy Pipehorse	
966	Teleost	Syngnathidae	*Kaupus costatus*	Deep-bodied Pipefish	37282014

Species Number	Taxa	Family name	Scientific name	Common Name	CAAB code
967	Teleost	Syngnathidae	*Kimblaeus bassensis*	Trawl Pipefish, Kimbla Pipefish	37282083
978	Teleost	Syngnathidae	*Leptoichthys fistularius*	Brushtail Pipefish	37282013
979	Teleost	Syngnathidae	*Lissocampus caudalis*	Australian Smooth Pipefish, Smooth Pipefish	37282016
980	Teleost	Syngnathidae	*Lissocampus runa*	Javelin Pipefish	37282009
983	Teleost	Syngnathidae	*Maroubra perserrata*	Sawtooth Pipefish	37282085
992	Teleost	Syngnathidae	*Micrognathus andersonii*	Anderson's Pipefish, Shortnose Pipefish	37282086
994	Teleost	Syngnathidae	*Mitotichthys mollisoni*	Mollison's Pipefish	37282022
995	Teleost	Syngnathidae	*Mitotichthys semistriatus*	Half-banded Pipefish	37282015
996	Teleost	Syngnathidae	*Mitotichthys tuckeri*	Tucker's Pipefish	37282025
1001	Teleost	Syngnathidae	*Notiocampus ruber*	Red Pipefish	37282095
1010	Teleost	Syngnathidae	*Phycodurus eques*	Leafy Seadragon	37282001
1011	Teleost	Syngnathidae	*Phyllopteryx taeniolatus*	Weedy Seadragon, Common Seadragon	37282002
1061	Teleost	Syngnathidae	*Pugnaso curtirostris*	Pug-nosed Pipefish	37282021
1070	Teleost	Syngnathidae	*Solegnathus dunckeri*	Duncker's Pipehorse	37282098
1072	Teleost	Syngnathidae	*Solegnathus robustus*	Robust Spiny Pipehorse, Robust Pipehorse	37282004
1071	Teleost	Syngnathidae	*Solegnathus sp. 1 [in Kuiter, 2000]*	Pipehorse	37282099
1073	Teleost	Syngnathidae	*Solegnathus spinosissimus*	spiny pipehorse	37282029
1026	Teleost	Syngnathidae	*Stigmatopora argus*	Spotted Pipefish	37282017
1027	Teleost	Syngnathidae	*Stigmatopora nigra*	Wide-bodied Pipefish, Black Pipefish	37282018
1028	Teleost	Syngnathidae	*Stipecampus cristatus*	Ring-backed Pipefish	37282019
1029	Teleost	Syngnathidae	*Syngnathoides biaculeatus*	Double-ended Pipehorse, Alligator Pipefish	37282100
1089	Teleost	Syngnathidae	*Trachyrhamphus bicoarctatus*	Bend Stick Pipefish, Short-tailed Pipefish	37282006
1092	Teleost	Syngnathidae	*Urocampus carinirostris*	Hairy Pipefish	37282008
1093	Teleost	Syngnathidae	*Vanacampus margaritifer*	Mother-of-pearl Pipefish	37282102
1094	Teleost	Syngnathidae	*Vanacampus phillipi*	Port Phillip Pipefish	37282023
1095	Teleost	Syngnathidae	*Vanacampus poecilolaemus*	Australian Long-snout Pipefish, Long-snouted Pipefish	37282024
1096	Teleost	Syngnathidae	*Vanacampus vercoi*	Verco's Pipefish	37282103

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 SESSF Danish Seine sub-fishery were images taken during several CSIRO surveys off Eastern Bass Strait between 1994 and 2000 in depths from ~20 to 200 m.

A list of the benthic habitats for the SET Danish Seine sub-fishery. Shading denotes habitats occurring within the jurisdictional boundary of the sub-fishery that are not subject to effort from Danish Seining.

ERAEF record No.	ERAEF Habitat Number	Sub-biome	Feature	Habitat type	SGF Score	Depth (m)	Image available	Reference image location
0007	001	inner shelf	Shelf	gravel, current rippled, mixed faunal community	313	25- 100	Y	DS Image Collection
0019	002	inner shelf	Shelf	Sedimentary rock, outcrop, large sponges	691	25- 100	Y	DS Image Collection
0031	003	inner shelf	Shelf	Sedimentary rock, outcrop, mixed faunal community	693	25- 100	Y	DS Image Collection
0043	004	inner shelf	Shelf	Sedimentary rock, outcrop, large sponges	671	25- 100	Y	DS Image Collection
0055	005	inner shelf	Shelf	cobble, debris flow, large sponges	441	25- 100	Y	DS Image Collection
0067	006	inner shelf	Shelf	coarse sediments, subcrop, large sponges	251	25- 100	Y	DS Image Collection
0079	007	inner shelf	Shelf	gravel, debris flow, mixed faunal community	343	25- 100	Y	DS Image Collection
0091	009	inner shelf	Shelf	coarse sediments, wave rippled, sedentary	227	25- 100	Y	DS Image Collection
0103	010	inner shelf	Shelf	coarse sediments, current rippled, no fauna	210	25- 100	Y	DS Image Collection
0116	011	inner shelf	Shelf	coarse sediments, wave rippled, large sponges	221	25- 100	Y	DS Image Collection

ERAEF record No.	ERAEF Habitat Number	Sub-biome	Feature	Habitat type	SGF Score	Depth (m)	Image available	Reference image location
0128	012	inner shelf	Shelf	fine sediments, unrippled, large sponges	101	25- 100	Y	DS Image Collection
0140	013	inner shelf	Shelf	coarse sediments, unrippled, large sponges	201	25- 100	Y	DS Image Collection
0152	014	inner shelf	Shelf	fine sediments, wave rippled, large sponges	111	25- 100	Y	DS Image Collection
0164	016	inner shelf	Shelf	fine sediments, unrippled, mixed faunal community	103	25- 100	Y	DS Image Collection
0852	089	inner shelf	Shelf	coarse sediments, irregular, encrustors	236	25- 100	N	DS Image Collection
0864	090	inner shelf	Shelf	coarse sediments, current rippled, bioturbators	219	25- 100	N	DS Image Collection
0876	091	inner shelf	Shelf	fine sediments, irregular, large sponges	131	25- 100	N	DS Image Collection
0888	092	inner shelf	Shelf	fine sediments, irregular, small sponges	132	25- 100	N	DS Image Collection
0900	093	inner shelf	Shelf	fine sediments, unrippled, bioturbators	109	25- 100	N	DS Image Collection
0912	094	inner shelf	Shelf	fine sediments, unrippled, small sponges	102	25- 100	N	DS Image Collection
0924	095	inner shelf	Shelf	fine sediments, wave rippled, no fauna	120	25- 100	N	DS Image Collection
0937	096	inner shelf	Shelf	fine sediments, wave rippled, small sponges	122	25- 100	N	DS Image Collection
0949	097	inner shelf	Shelf	gravel, wave rippled, bioturbators	329	25- 100	Y	DS Image Collection
0961	098	inner shelf	Shelf	gravel, wave rippled, no fauna	320	25- 100	Y	DS Image Collection
0973	099	inner shelf	Shelf	Igneous rock, high outcrop, large sponges	591	25- 100	N	DS Image Collection
1998	191	inner shelf	Shelf	coarse sediments, wave rippled, small sponges	222	25- 100	N	DS Image Collection
2074	199	inner shelf	Shelf	cobble, wave rippled, low/ encrusting mixed fauna	426	25- 100	N	DS Image Collection
2087	200	inner shelf	Shelf	coarse sediments, wave rippled, encrustors	226	25- 100	N	DS Image Collection
0177	017	outer-shelf	Shelf	fine sediments, subcrop, large sponges	151	100- 200	Y	DS Image Collection
0189	018	outer-shelf	Shelf	Sedimentary rock, outcrop, encrustors	696	100- 200	Y	DS Image Collection
0202	019	outer-shelf	Shelf	coarse sediments, subcrop, large sponges	251	100- 200	Y	DS Image Collection
0214	020	outer-shelf	Shelf	cobble, outcrop, crinoids	464	100- 200	Y	DS Image Collection
0226	022	outer-shelf	Shelf	Sedimentary rock, subcrop, mixed faunal community	653	100- 200	Y	DS Image Collection
0238	023	outer-shelf	Shelf	Sedimentary rock, outcrop, large sponges	671	100- 200	Y	DS Image Collection
0250	024	outer-shelf	shelf	gravel, irregular, encrustors	336	100- 200	Y	DS Image Collection
0263	025	outer-shelf	shelf	coarse sediments, wave rippled, no fauna	220	100- 200	Y	DS Image Collection
0275	026	outer-shelf	shelf	coarse sediments, unrippled, encrustors	206	100- 200	Y	DS Image Collection
0288	027	outer-shelf	shelf	coarse sediments, current rippled, no fauna	210	100- 200	Y	DS Image Collection

ERAEF record No.	ERAEF Habitat Number	Sub-biome	Feature	Habitat type	SGF Score	Depth (m)	Image available	Reference image location
0300	028	outer-shelf	shelf	cobble, unrippled, large sponges	401	100- 200	Y	DS Image Collection
0312	029	outer-shelf	shelf	coarse sediments, irregular, large sponges	231	100- 200	Y	DS Image Collection
0324	030	outer-shelf	shelf	coarse sediments, unrippled, mixed faunal community	203	100- 200	Y	DS Image Collection
0336	032	outer-shelf	shelf	cobble, subcrop, crinoids	454	100- 200	Y	DS Image Collection
0672	065	outer-shelf	canyon	Sedimentary rock, outcrop, small sponges	672	100- 200	Y	DS Image Collection
0985	100	outer-shelf	shelf	mud, unrippled, sedentary	007	100- 200	Y	DS Image Collection
0999	101	outer-shelf	shelf	coarse sediments, subcrop, small sponges	252	100- 200	N	DS Image Collection
1011	102	outer-shelf	shelf	coarse sediments, wave rippled, encrustors	226	100- 200	N	DS Image Collection
1023	103	outer-shelf	shelf	coarse sediments, wave rippled, small sponges	222	100- 200	N	DS Image Collection
1035	104	outer-shelf	shelf	fine sediments, current rippled, bioturbators	119	100- 200	Y	DS Image Collection
1047	105	outer-shelf	shelf	fine sediments, irregular, large sponges	131	100- 200	N	DS Image Collection
1060	106	outer-shelf	shelf	fine sediments, irregular, no fauna	130	100- 200	N	DS Image Collection
1073	107	outer-shelf	shelf	fine sediments, irregular, small sponges	132	100- 200	N	DS Image Collection
1085	108	outer-shelf	shelf	fine sediments, subcrop, mixed faunal community	153	100- 200	N	DS Image Collection
1098	109	outer-shelf	shelf	fine sediments, subcrop, small sponges	152	100- 200	Y	DS Image Collection
1111	110	outer-shelf	shelf	fine sediments, unrippled, bioturbators	109	100- 200	Y	DS Image Collection
1123	111	outer-shelf	shelf	fine sediments, unrippled, large sponges	101	100- 200	Y	DS Image Collection
1136	112	outer-shelf	shelf	fine sediments, unrippled, no fauna	100	100- 200	Y	DS Image Collection
1149	113	outer-shelf	shelf	fine sediments, unrippled, small sponges	102	100- 200	Y	DS Image Collection
1162	114	outer-shelf	shelf	fine sediments, wave rippled, bioturbators	129	100- 200	Y	DS Image Collection
1174	115	outer-shelf	shelf	fine sediments, wave rippled, encrustors	126	100- 200	N	DS Image Collection
1186	116	outer-shelf	shelf	fine sediments, wave rippled, large sponges	121	100- 200	N	DS Image Collection
1199	117	outer-shelf	shelf	fine sediments, wave rippled, no fauna	120	100- 200	N	DS Image Collection
1211	118	outer-shelf	shelf	fine sediments, wave rippled, sedentary	127	100- 200	N	DS Image Collection
1223	119	outer-shelf	shelf	fine sediments, wave rippled, small sponges	122	100- 200	N	DS Image Collection
1236	120	outer-shelf	shelf	gravel, current rippled, bioturbators	319	100- 200	N	DS Image Collection
1249	121	outer-shelf	shelf	gravel, wave rippled, bioturbators	329	100- 200	Y	DS Image Collection
1261	122	outer-shelf	shelf	gravel, wave rippled, encrustors	326	100- 200	N	DS Image Collection

ERAEF record No.	ERAEF Habitat Number	Sub-biome	Feature	Habitat type	SGF Score	Depth (m)	Image available	Reference image location
1274	123	outer-shelf	shelf	gravel, wave rippled, large sponges	321	100- 200	N	DS Image Collection
1287	124	outer-shelf	shelf	gravel, wave rippled, no fauna	320	100- 200	N	DS Image Collection
1300	125	outer-shelf	shelf	mud, subcrop, small sponges	052	100- 200	Y	DS Image Collection
1312	126	outer-shelf	shelf	Sedimentary rock, subcrop, large sponges	651	100- 200	Y	DS Image Collection
1325	127	outer-shelf	shelf	Sedimentary rock, subcrop, small sponges	652	100- 200	Y	DS Image Collection
1757	166	outer-shelf	shelf-break	Bryozoan based commmunities	xx6	100- 200, 200- 700	N	DS Image Collection
1769	167	outer-shelf	shelf-break	fine sediments, irregular, bioturbators	139	100- 200, 200- 700	N	DS Image Collection
1781	168	outer-shelf	shelf-break	fine sediments, irregular, small sponges	132	100- 200, 200- 700	N	DS Image Collection
1793	169	outer-shelf	shelf-break	fine sediments, unrippled, bioturbators	109	100- 200, 200- 700	N	DS Image Collection
1805	170	outer-shelf	shelf-break	fine sediments, unrippled, no fauna	100	100- 200, 200- 700	N	DS Image Collection
1817	171	outer-shelf	shelf-break	fine sediments, unrippled, octocorals	105	100- 200, 200- 700	N	DS Image Collection
1829	172	outer-shelf	shelf-break	Igneous rock, high outcrop, no fauna	590	100- 200, 200- 700	N	DS Image Collection
1841	173	outer-shelf	shelf-break	mud, unrippled, no fauna	000	100- 200, 200- 700	N	DS Image Collection
1853	174	outer-shelf	shelf-break	mud, unrippled, sedentary	007	100- 200, 200- 700	N	DS Image Collection
1865	175	outer-shelf	shelf-break	Sedimentary rock, subcrop, crinoids	654	100- 200, 200- 700	N	DS Image Collection
1877	176	outer-shelf	shelf-break	Sedimentary rock, subcrop, small sponges		100- 200, 200- 700	N	DS Image Collection
0348	033	upper-slope	slope	Sedimentary rock, subcrop, mixed faunal community	652	200- 700	Y	DS Image Collection
0360	034	upper-slope	slope	Sedimentary rock, outcrop, encrustors		200- 700	Y	DS Image Collection
0372	035	upper-slope	slope	Sedimentary rock, outcrop, encrustors	653	200- 700	Y	DS Image Collection
0384	036	upper-slope	slope	Sedimentary rock, subcrop, encrustors	696	200- 700	Y	DS Image Collection
0396	039	upper-slope	slope	Sedimentary rock, outcrop, crinoids	666	200- 700	Y	DS Image Collection
0408	040	upper-slope	slope	fine sediments, subcrop, sedentary	656	200- 700	Y	DS Image Collection
0420	041	upper-slope	slope	fine sediments, irregular, bioturbators	684	200- 700	Y	DS Image Collection
0432	043	upper-slope	slope	coarse sediments, unrippled, low mixed encrustors	157	200- 700	Y	DS Image Collection
0444	044	upper-slope	slope, canyon	fine sediments, unrippled, bioturbators	139	200- 700	Y	DS Image Collection
0456	045	upper-slope	slope	coarse sediments, unrippled, sedentary	206	200- 700	Y	DS Image Collection
0468	046	upper-slope	slope	fine sediments, unrippled, no fauna	109	200- 700	Y	DS Image Collection
0684	066	upper-slope	canyon	Sedimentary rock, outcrop, crinoids	207	200- 700	Y	DS Image Collection

ERAEF record No.	ERAEF Habitat Number	Sub-biome	Feature	Habitat type	SGF Score	Depth (m)	Image available	Reference image location
0696	067	upper-slope	canyon, slope	Sedimentary rock, subcrop, large sponges	100	200- 700	Y	DS Image Collection
0708	069	upper-slope	canyon	cobble, outcrop, crinoids	694	200- 700	Y	DS Image Collection
0720	070	upper-slope	canyon	Sedimentary rock, subcrop, small sponges	651	200- 700	Y	DS Image Collection
0732	071	upper-slope	canyon	Sedimentary rock, outcrop, encrustors	464	200- 700	Y	DS Image Collection
0744	072	upper-slope	canyon	coarse sediments, irregular, bioturbators	652	200- 700	Y	DS Image Collection
0756	073	upper-slope	canyon	fine sediments, irregular, encrustors	676	200- 700	Y	DS Image Collection
0768	076	upper-slope	canyon, slope	coarse sediments, irregular, low mixed encrustors	239	200- 700	Y	DS Image Collection
0780	077	upper-slope	canyon, slope	fine sediments, subcrop, small sponges	136	200- 700	Y	DS Image Collection
0792	078	upper-slope	canyon	fine sediments, unrippled, sedentary	236	200- 700	Y	DS Image Collection
0804	080	upper-slope	seamount	Sedimentary rock, outcrop, encrustors	152	200- 700	Y	DS Image Collection
0816	081	upper-slope	seamount	Sedimentary rock, unrippled, no fauna	107	200- 700	Y	DS Image Collection
0840	085	upper-slope	seamount	Sedimentary rock, unrippled, encrustors	676	200- 700	Y	DS Image Collection
1337	128	upper-slope	slope	Bryozoan based communities	600	200- 700	N	DS Image Collection
1349	129	upper-slope	slope	cobble, debris flow, encrustors	606	200- 700	Y	DS Image Collection
1361	130	upper-slope	slope	cobble, debris flow, no fauna	xx6	200- 700	Y	DS Image Collection
1373	131	upper-slope	slope	cobble, debris flow, octocorals	446	200- 700	N	DS Image Collection
1385	132	upper-slope	slope	cobble, debris flow, small sponges	440	200- 700	Y	DS Image Collection
1397	133	upper-slope	slope	fine sediments, current rippled, no fauna	445	200- 700	N	DS Image Collection
1409	134	upper-slope	slope	fine sediments, subcrop, large sponges	442	200- 700	N	DS Image Collection
1421	136	upper-slope	slope	fine sediments, unrippled, encrustors	110	200- 700	Y	DS Image Collection
1433	137	upper-slope	slope	fine sediments, unrippled, small sponges	151	200- 700	N	DS Image Collection
1445	138	upper-slope	slope	gravel, debris flow, encrustors	106	200- 700	Y	DS Image Collection
1457	139	upper-slope	slope	gravel, debris flow, no fauna	102	200- 700	N	DS Image Collection
1469	140	upper-slope	slope	mud, irregular, bioturbators	346	200- 700	Y	DS Image Collection
1481	141	upper-slope	slope	mud, unrippled, bioturbators	340	200- 700	Y	DS Image Collection
1493	142	upper-slope	slope	mud, unrippled, encrustors	039	200- 700	Y	DS Image Collection
1505	143	upper-slope	slope	mud, unrippled, large sponges	009	200- 700	N	DS Image Collection
1517	144	upper-slope	slope	mud, unrippled, sedentary	006	200- 700	Y	DS Image Collection

ERAEF record No.	ERAEF Habitat Number	Sub-biome	Feature	Habitat type	SGF Score	Depth (m)	Image available	Reference image location
1529	145	upper-slope	slope	Sedimentary rock, low outcrop, large sponges	001	200- 700	N	DS Image Collection
1541	146	upper-slope	slope	Sedimentary rock, low outcrop, small sponges	007	200- 700	Y	DS Image Collection
1553	148	upper-slope	slope	Sedimentary rock, subcrop, octocorals	671	200- 700	N	DS Image Collection
0480	049	mid-slope	slope	Igneous rock, high outcrop, crinoids	672	700- 1500	Y	DS Image Collection
0492	050	mid-slope	slope	cobble, debris flow, encrustors	655	700- 1500	Y	DS Image Collection
0504	051	mid-slope	slope	cobble, outcrop, no fauna	594	700- 1500	Y	DS Image Collection
0516	052	mid-slope	slope	Sedimentary rock, outcrop, octocorals	446	700- 1500	Y	DS Image Collection
0528	053	mid-slope	slope	Igneous rock, low outcrop, sedentary	460	700- 1500	Y	DS Image Collection
0540	054	mid-slope	slope	Sedimentary rock, outcrop, crinoids	675	700- 1500	Y	DS Image Collection
0552	055	mid-slope	slope	Sedimentary rock, unrippled, sedentary	567	700- 1500	Y	DS Image Collection
0564	056	mid-slope	slope, canyons, seamounts	Sedimentary rock, outcrop, mixed faunal community	694	700- 1500	Y	DS Image Collection
0576	057	mid-slope	slope	fine sediments, subcrop, bioturbators	607	700- 1500	Y	DS Image Collection
0588	058	mid-slope	slope	cobble, unrippled, small sponges	673	700- 1500	Y	DS Image Collection
0600	059	mid-slope	slope	coarse sediments, irregular,low encrusting	150	700- 1500	Y	DS Image Collection
0612	060	mid-slope	slope	cobble, outcrop, crinoids	402	700- 1500	Y	DS Image Collection
0624	061	mid-slope	slope	fine sediments, irregular, bioturbators	236	700- 1500	Y	DS Image Collection
0636	062	mid-slope	slope	coarse sediments, unrippled, octocorals	464	700- 1500	Y	DS Image Collection
0648	063	mid-slope	slope	fine sediments, unrippled, octocorals	139	700- 1500	Y	DS Image Collection
0660	064	mid-slope	slope	Sedimentary slab and mud boulders, outcrop, crinoids	205	700- 1500	Y	DS Image Collection
0828	084	mid-slope	seamount	Sedimentary rock, outcrop, sedentary	105	700- 1500	Y	DS Image Collection
1565	150	mid-slope	slope	coarse sediments, current rippled, no fauna	464	700- 1500	N	DS Image Collection
1577	151	mid-slope	slope	coarse sediments, current rippled, octocorals	677	700- 1500	N	DS Image Collection
1589	152	mid-slope	slope	coarse sediments, current rippled, sedentary	210	700- 1500	N	DS Image Collection
1601	153	mid-slope	slope	coarse sediments, unrippled, no fauna	215	700- 1500	N	DS Image Collection
1613	154	mid-slope	slope	cobble, debris flow, crinoids	217	700- 1500	N	DS Image Collection
1625	155	mid-slope	slope	slabs/ boulders, debris flow, octocorals	200	700- 1500	Y	DS Image Collection
1637	156	mid-slope	slope	fine sediments, unrippled, no fauna	444	700- 1500	N	DS Image Collection
1649	157	mid-slope	slope	Igneous rock, high outcrop, octocorals	445	700- 1500	N	DS Image Collection

ERAEF record No.	ERAEF Habitat Number	Sub-biome	Feature	Habitat type	SGF Score	Depth (m)	Image available	Reference image location
1661	158	mid-slope	slope	mud, current rippled, bioturbators	100	700- 1500	N	DS Image Collection
1673	159	mid-slope	slope	mud, irregular, bioturbators	595	700- 1500	N	DS Image Collection
1685	160	mid-slope	slope	mud, irregular, sedentary	019	700- 1500	N	DS Image Collection
1697	161	mid-slope	slope	mud, unrippled, small sponges	039	700- 1500	N	DS Image Collection
1709	162	mid-slope	slope	Sedimentary rock, debris flow, crinoids	037	700- 1500	N	DS Image Collection
1721	163	mid-slope	slope	Sedimentary rock, high outcrop, octocorals	002	700- 1500	Y	DS Image Collection
1733	164	mid-slope	slope	Sedimentary rock, subcrop, crinoids	644	700- 1500	Y	DS Image Collection
1745	165	mid-slope	slope	Sedimentary rock, subcrop, octocorals	695	700- 1500	Y	DS Image Collection

Scoping Document S2B2. Pelagic Habitats

A list of the pelagic habitats for the SET Danish Seine sub-fishery. Shading denotes habitats occurring within the jurisdictional boundary of the subfishery that are not subject to effort from Danish Seining.

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

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 area of the Danish seine sub-fishery (indicated by x). Shaded cells indicate all communities within the province.

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	x	x	x	x	x									
Outer Shelf 110 – 250m [1,2,4]					x	x		x	x	x									
Upper Slope 250 – 565m [3,4]																			
Mid–Upper Slope 565 – 820m [3,5]																			
Mid Slope 820 – 1100m [3,5]																			
Lower slope/ Abyssal > 1100m [6]																			
Reef 0 -110m [7, 8]																			
Reef 110-250m [8]																			
Seamount 0 – 110m																			
Seamount 110- 250m																			
Seamount 250 – 565m																			
Seamount 565 – 820m																			
Seamount 820 – 1100m																			
Seamount 1100 – 3000m																			

Plateau 0 – 110m																			
Plateau 110- 250m[9]																			
Plateau 250 – 565m[9]																			
Plateau 565 – 820m																			
Plateau 820 – 1100m																			

[1] Four inner shelf communities occur in the Timor Transition (Arafura, Groote, Cape York and Gulf of Carpentaria) and three inner shelf communities occur in the Southern (Eyre, Eucla and South West Coast). At Macquarie Is: [2]inner & outer shelves, and [3]upper and midslope communities combined. At Heard/McDonald Is: [4]outer shelf and upper slope combined (100-500m), [5]mid and upper slopes combined into 3 trough and southern slope communities (500-100m), [9]plateaux equivalent to Shell and Western Banks (100-500m) and [6] 3 groups at Heard Is: Deep Shell Bank (>1000m), Southern and North East Lower slope/Abyssal, [7]Great Barrier Reef in the North Eastern Province and Transition and [8] Rowley Shoals in North Western Transition.

Scoping Document S2C2. Pelagic Communities

Pelagic communities that occur within the area of the Danish seine sub-fishery (indicated by x). Shaded cells indicate all communities that exist in the province.

Province / Pelagic community	Northeastern	Eastern	Southern	Western	Northern	Northwestern	Heard and McDonald Is[2]	Macquarie Is
Coastal pelagic 0-200 m[1]		x	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 add in rationale for each objective 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 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

Component	Core Objective	Sub-component	Example Operational Objectives	Example Indicators	Rationale
		4. Age/size/sex structure	4.1 Age/size/sex structure does not change outside acceptable bounds (e.g. more than X% from reference structure)	Biomass, numbers or relative proportion in age/size/sex classes Biomass of spawners Mean size, sex ratio	4.1
		5. Reproductive Capacity	5.1 Fecundity of the population does not change outside acceptable bounds (e.g. more than X% of reference population fecundity) 2 Recruitment to the population does not change outside acceptable bounds	Egg production of population Abundance of recruits	5.1 5.2
		6. Behaviour /Movement	6.1 Behaviour and movement patterns of the population do not change outside acceptable bounds	Presence of population across space, movement patterns within the population (e.g. attraction to bait, lights)	6.1
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

Component	Core Objective	Sub-component	Example Operational Objectives	Example Indicators	Rationale
		2. Geographic range	2.1 Geographic range of the population, in terms of size and continuity does not change outside acceptable bounds	Presence of population across space	2.1
		3. Genetic structure	3.1 Genetic diversity does not change outside acceptable bounds	Frequency of genotypes in the population, effective population size (N_e), number of spawning units	3.1
		4. Age/size/sex structure	4.1 Age/size/sex structure does not change outside acceptable bounds (e.g. more than X% from reference structure)	Biomass, numbers or relative proportion in age/size/sex classes Biomass of spawners Mean size, sex ratio	4.1
		5 Reproductive Capacity	5.1 Fecundity of the population does not change outside acceptable bounds (e.g. more than X% of reference population fecundity) Recruitment to the population does not change outside acceptable bounds	Egg production of population Abundance of recruits	5.1
		6. Behaviour /Movement	6.1 Behaviour and movement patterns of the population do not change outside acceptable bounds	Presence of population across space, movement patterns within the population (e.g. attraction to bait, lights)	6.1

Component	Core Objective	Sub-component	Example Operational Objectives	Example Indicators	Rationale
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
		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: SESSF
Sub-fishery Name: Danish seine
Date completed: May 2006

Direct impact of Fishing	Fishing Activity	Score (0/1)	Documentation of Rationale
Capture	Bait collection	0	No bait collection occurs
	Fishing	1	Capture of organisms due to gear deployment, retrieval and actual fishing.
	Incidental behaviour	0	none occurs
Direct impact without capture	Bait collection	0	No bait collection occurs
	Fishing	1	Organisms may come into contact with net; benthic species may be damaged by net moving over them.
	Incidental behaviour	0	none occurs
	Gear loss	0	none occurs
	Anchoring/ mooring	1	Not common but can occur
	Navigation/steaming	1	
Addition/ movement of biological material	Translocation of species (boat launching, reballasting)	0	Boats only visit one port.
	On board processing	0	Does not occur.
	Discarding catch	1	Discarding is common.
	Stock enhancement	0	Does not occur.
	Provisioning	0	Does not occur.
	Organic waste disposal	1	Disposal of organic wastes (food scraps, sewage) from the boats.
Addition of non-biological material	Debris	1	Rubbish thrown overboard.
	Chemical pollution	1	Oil spills, anti-fouling chemicals
	Exhaust	1	Exhaust as a result of diesel and other engines during fishing operations.
	Gear loss	0	Does not occur
	Navigation/ steaming	1	The navigation and steaming of vessels will introduce noise (engine noise and echo-sounders) and visual stimuli into the environment.
	Activity/ presence on water	1	The activity of vessels will introduce noise and visual stimuli into the environment
Disturb physical processes	Bait collection	0	Does not occur
	Fishing	1	Gear may disturb sediment on the seafloor.

Direct impact of Fishing	Fishing Activity	Score (0/1)	Documentation of Rationale
	Boat launching	0	Vessels in fishery come from designated ports.
	Anchoring/ mooring	1	Not common but can occur
	Navigation/ steaming	1	
External Hazards (specify the particular example within each activity area)	Other capture fishery methods	1	Other fisheries (trawl, non-trawl, shark) occur in the same region.
	Aquaculture	0	Does not occur in the area
	Coastal development	1	Discharge from sewage, ocean dumping
	Other extractive activities	1	Oil and gas pipelines and wells.
	Other non-extractive activities	1	Ocean disposal sites
	Other anthropogenic activities	1	Shipping, 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 use to fish during their down time. This does not include impacts on predator species of removing their prey through fishing.
	Gear loss	Direct impacts (damage or mortality), without capture on organisms due to gear that has been lost from the fishing boat. This includes damage/mortality to species when the lost gear contacts them or if species swallow the lost gear.
	Anchoring/ mooring	Direct impact (damage or mortality) that occurs and when anchoring or mooring. This includes damage/mortality due to physical contact of the anchor, chain or rope with organisms, e.g. An anchor damaging live coral.
	Navigation/ steaming	Direct impact (damage or mortality) without capture may occur while vessels are navigating or steaming. This includes collisions with marine organisms or birds.
Addition/ movement of biological material		Any activities that result in the addition or movement of biological material to the ecosystem of the fishery.
	Translocation of species (boat movements,	The translocation and introduction of species to the area of the fishery, through transportation of any life stage. This transport can occur through movement on boat hulls or in ballast water as boats move throughout the fishery or from outside areas into the fishery.

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

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

2.2.5 Bibliography (Step 5)

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

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

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

Other publications that may provided information include

- BRS Fishery Status Reports
- Strategic Plans

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

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

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 subcomponent
Step 9: Record confidence/uncertainty for the consequence scores
Step 10. Document rationale for each of the above steps
Step 11. Summary of SICA results
Step 12. Evaluation/discussion of Level 1
Step 13. Components to be examined at Level 2

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

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

2.3.2 Score spatial scale of activity (Step 2)

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

Spatial scale score of activity

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

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

2.3.3 Score temporal scale of activity (Step 3)

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

Temporal scale score of activity

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

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

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

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

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

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

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

2.3.6 Select the most appropriate operational objective (Step 6)

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

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

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

Intensity score of activity (Modified from Fletcher *et al*. 2002)

Level	Score	Description
Negligible	1	remote likelihood of detection at any spatial or temporal scale
Minor	2	occurs rarely or in few restricted locations and detectability even at these scales is rare
Moderate	3	moderate at broader spatial scale, or severe but local
Major	4	severe and occurs reasonably often at broad spatial scale
Severe	5	occasional but very severe and localized or less severe but widespread and frequent
Catastrophic	6	local to regional severity or continual and widespread

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

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

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

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

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

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

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

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

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

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

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

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

2.3.1 Level 1 (SICA) Documents L1.1 - Target Species Component - Danish Seine sub-fishery

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	4	6	population size	flathead	1.2	4	**3**	2	Fishing occurs throughout the year over an area approx 500 X 150 nm => Population size likely to be affected before major changes in other sub-components=> flathead assessed as medium risk species by SEFAG, whereas school whiting assessed as low risk => intensity major as fishing pressure has been fairly significant and protracted =>consequence moderate as flathead are considered to be fully fished, but not over-exploited, and indicators of stock status appear stable. Catches are cyclic and may be correlated with environmental conditions =>confidence high as have good data and reasonable stock assessment models
	Incidental behaviour	0									
Direct impact without capture	Bait collection	0									
	Fishing	1	4	6	Population size	flathead	1.2	3	**2**	1	Flathead may suffer injury/mortality as a result of passing through the net => intensity moderate as small fish escaping the net may occur often => consequence minor as impact expected to have minimal impact on population size or dynamics => confidence low due to lack of data
	Incidental behaviour	0									
	Gear loss	0									
	Anchoring/ mooring	1	3	4	Population size	flathead	1.2	1	**1**	2	Given that flathead coming into direct contact with anchors is very remote there is negligible intensity at any spatial or temporal scale => Therefore consequence also scored as negligible => Confidence was recorded as high because it is considered very unlikely for there to be damage or mortality to flathead associated with Anchoring/mooring.
	Navigation/ steaming	1	4	6	Population size	flathead	1.2	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	0									
	On board processing	0									

Direct impact of Fishing	Fishing Activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (from S2.1)	Intensity Score (1-6)	**Consequence Score (1-6)**	Confidence score (1-2)	Rationale
	Discarding catch	1	4	6	Population size	flathead	1.2	3	**2**	2	Discarding is not uncommon, but adding discards of any species to the water not likely to affect target species => confidence high (logic)
	Stock enhancement	0									
	Provisioning	0									
	Organic waste disposal	1	4	6	Population size	flathead	1.2	1	**1**	2	Disposal of organic waste occurs over small spatial scale => unlikely to affect target species
Addition of non-biological material	Debris	1	4	6	Population size	flathead	1.2	1	**1**	2	Addition of debris unlikely to affect target species => confidence high (logic)
	Chemical pollution	1	4	6	Reproductive output	flathead	5.1	1	**1**	2	Chemical pollution considered to only impact a small area => unlikely to have a measurable affect on target species => confidence high (logic)
	Exhaust	1	4	6	Reproductive output	flathead	5.1	1	**1**	2	Most exhaust enters the atmosphere, or immediately below the water from engines, dissolved gases and particulates not believed to be of consequence to demersal target species. Confidence high due to logical consideration
	Gear loss	0									
	Navigation/ steaming	1	4	6	Behaviour and Movement	flathead	6.1	1	**1**	2	Navigation/ steaming of fishing vessels was expected to pose greatest potential risk for the Behaviour/ movement of target species resulting in disruption to feeding => introduction of noise from navigation/ steaming considered unlikely to impact bottom-dwelling species=> Consequence was considered negligible with any impact of Navigation/ steaming unlikely to be measurable for flathead => Confidence high (logic)
	Activity/ presence on water	1	4	6	Behavior and Movement	flathead	6.1	1	**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	6	Population size	flathead	1.2	3	**2**	1	flathead are bottom-dwellers and fishing may disturb sediments => intensity moderate as disturbance of sediment may occur often => consequence minor as sediment disturbance not likely to affect population size or dynamics of flathead => confidence low because little information is available
	Boat launching	0									
	Anchoring/ mooring	1	3	4	Population size	flathead	1.2	1	**1**	2	Effects hard to envisage for the target species. Confidence high through logical constraints
	Navigation/steaming	1	4	6	Population size	flathead	1.2	1	**1**	2	Effects 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 Impacts (specify the particular example within each activity area)	Other fisheries - trawl fishery	1	6	6	Population size	flathead	1.2	4	**3**	2	SE Trawl fishery takes more flathead than the Danish Seine sub-fishery => intensity major as fishing pressure has been fairly significant and protracted =>consequence moderate as flathead are considered to be fully fished, but not over-exploited, and indicators of stock status appear stable. Catches are cyclic and may be correlated with environmental conditions =>confidence high as have good data and reasonable stock assessment models
	Aquaculture	0									
	Coastal development	1	4	6	Population size	flathead	1.2	2	**1**	2	Development not great on coasts adjacent to fishing grounds => any effects unlikely to have measurable impact on population of flathead
	Other extractive activities - oil and gas wells	1	4	6	Population size	flathead	1.2	3	**1**	2	There are numerous oil and gas wells in the area of the Danish Seine sub-fishery, but any impact on target species is expected to be negligible
	Other non extractive activities - ocean disposal	1	4	6	Population size	flathead	1.2	1	**1**	2	There are a number of ocean disposal sites in the area of the fishery, but hard to see how they could impact flathead stocks
	Other anthropogenic activities - tourism	1	4	6	Population size	flathead	1.2	1	**1**	2	Tourism in the region is not a major activity - not likely to have measurable impact on flathead stocks.

2.3.1 Level 1 (SICA) Documents L1.2 – Byproduct and Bycatch Component - Danish Seine sub-fishery

Direct impact of Fishing	Fishing Activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (from S2.1)	Intensity Score (1-6)	**Consequence Score (1-6)**	Confidence score (1-2)	Rationale
Capture	Bait collection	0									
	Fishing	1	4	6	population size	school shark	1.2	2	**2**	2	School shark chosen because it is the most depleted byproduct species. School shark is targeted by the Southern Shark fishery and is considered to be over-fished. The small amounts taken by the Danish Seine sub-fishery would only have minimal impact on school shark populations. Confidence high as catch in this fishery is known to be very low.
	Incidental behaviour	0									
Direct impact without capture	Bait collection	0									
	Fishing	1	4	6	Population size	jackass morwong	1.2	2	**2**	1	Jackass morwong chosen as it is the byproduct species with highest catch in this fishery. Jackass morwong may suffer injury/mortality as a result of passing through the net => intensity minor as jackass morwong are caught in small quantities in this fishery => consequence minor as impact expected to have minimal impact on population size or dynamics => confidence low due to lack of data
	Incidental behaviour	0									
	Gear loss	0									
	Anchoring/ mooring	1	3	4	Population size	jackass morwong	1.2	1	**1**	2	Jackass morwong chosen as it is the byproduct species with highest catch in this fishery, and is benthic species. Given that morwong coming into direct contact with anchors is very remote there is negligible intensity at any spatial or temporal scale => Therefore consequence also scored as negligible => Confidence was recorded as high because it is considered very unlikely for there to be damage or mortality to morwong associated with Anchoring/mooring.
	Navigation/ steaming	1	4	6	Population size	gummy shark	1.2	2	**1**	2	This activity is widespread, but consequence for byproduct/bycatch is negligible. Confidence constrained by logic.
Addition/ movement of biological material	Translocation of species	0									
	On board processing	0									

Direct impact of Fishing	Fishing Activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (from S2.1)	Intensity Score (1-6)	**Consequence Score (1-6)**	Confidence score (1-2)	Rationale
	Discarding catch	1	4	6	behaviour/movement	gummy shark	6.1	2	**2**	1	Discarding is common => occurs frequently =>most likely to affect behaviour /movement of species if scavengers are attracted =>gummy shark considered most likely species that could be a scavenger => intensity scored as moderate because gummy shark is widespread => consequence scored as minor as impact is likely to be minimal => Confidence scored as low due to lack of data
	Stock enhancement	0									
	Provisioning	0									
	Organic waste disposal	1	4	6	Population size	jackass morwong	1.2	1	**1**	2	Disposal of organic waste occurs over small spatial scale => unlikely to affect byproduct species => confidence high (logic)
Addition of non-biological material	Debris	1	4	6	Population size	jackass morwong	1.2	1	**1**	2	Addition of debris unlikely to affect byproduct species => confidence high (logic)
	Chemical pollution	1	4	6	Reproductive output	jackass morwong	5.1	1	**1**	2	Chemical pollution considered to only impact a small area => unlikely to have a measurable affect on byproduct species => confidence high (logic)
	Exhaust	1	4	6	Population size	jackass morwong	5.1	1	**1**	2	Most exhaust enters the atmosphere, or immediately below the water from engines, dissolved gases and particulates not believed to be of consequence to benthic species. Confidence high due to logical consideration
	Gear loss	0									
	Navigation/ steaming	1	4	6	behaviour/ movement	jackass morwong	6.1	1	**1**	2	Navigation/ steaming of fishing vessels was expected to pose greatest potential risk for the Behaviour/ movement of species resulting in disruption to feeding => introduction of noise from navigation/ steaming considered unlikely to impact bottom-dwelling species=> Consequence was considered negligible with any impact of Navigation/ steaming unlikely to be measurable for morwong => Confidence high (logic)
	Activity/ presence on water	1	4	6	behaviour/ movement	jackass morwong	6.1	1	**1**	2	Simple presence of vessels on water might change the behavior of species, but hard to envisage. High confidence by consensus and lack of scenarios.
Disturb physical processes	Bait collection	0									
	Fishing	1	4	6	Population size	jackass morwong	1.2	3	**2**	1	morwong are bottom-dwellers and fishing may disturb sediments => intensity moderate as disturbance of sediment may occur often => consequence minor as sediment disturbance not likely to affect population size or dynamics of morwong => confidence low because little information is available
	Boat launching	0									

Direct impact of Fishing	Fishing Activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (from S2.1)	Intensity Score (1-6)	**Consequence Score (1-6)**	Confidence score (1-2)	Rationale
	Anchoring/ mooring	1	3	4	Population size	jackass morwong	1.2	1	**1**	2	Effects hard to envisage for any species. Confidence high through logical constraints
	Navigation/steaming	1	4	6	Population size	jackass morwong	1.2	1	**1**	2	Effects hard to envisage for any species. Confidence high through logical constraints
External Impacts (specify the particular example within each activity area)	Other fisheries	1	4	6	Population size	gummy shark	1.2	4	**3**	2	Gummy shark is targeted by the Southern Shark fishery and is considered to be fully-fished
	Aquaculture	0	0	0	0						
	Coastal development	1	4	6	Population size	jackass morwong	1.2	2	**1**	2	Development not great on coasts adjacent to fishing grounds => any effects unlikely to have measurable impact on population of morwong
	Other extractive activities - oil and gas wells	1	4	6	Behavior and Movement	gummy shark	1.2	3	**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) => the auditory and lateral line sensory acuity of gummy shark could be affected by seismic survey => intensity scored as moderate as local effects are potentially severe => consequence scored as minor as effect on population dynamics expected to be minimal => confidence is low as effects are unknown
	Other non extractive activities	1	4	6	Population size	jackass morwong	1.2	1	**1**	2	There are a number of ocean disposal sites in the area of the fishery, but hard to see how they could impact morwong stocks
	Other anthropogenic activities	1	4	6	Population size	jackass morwong	1.2	1	**1**	2	Tourism in the region is not a major activity - not likely to have measurable impact on morwong stocks.

2.3.1 Level 1 (SICA) Documents L1.3 – TEP species Component - Danish Seine sub-fishery

Direct impact of Fishing	Fishing Activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (from S2.1)	Intensity Score (1-6)	**Consequence Score (1-6)**	Confidence score (1-2)	Rationale
Capture	Bait collection	0									
	Fishing	1	4	6	population size	spiny pipehorse	1.1	3	**4**	1	Spiny pipehorse likely to have a low population size and limited range => intensity moderate as they are known to be caught often by Danish seiners => consequence major as they are brooders rather than broadcast spawners, thus low in fecundity compared with other teleosts, and due to low population size are at risk of population decline => confidence low as there is a high level of uncertainty in regard to spiny pipehorse distribution and habitat preferences, and they are difficult to detect if caught
	Incidental behaviour	0									
Direct impact without capture	Bait collection	0									
	Fishing	1	4	6	geographic range	Australian fur seal	1.2	2	**2**	1	Fur seals are known to hassle the cod-end, and eat discards, but no reports of damage to seals from interacting with gear => consequence minor as impact expected to be minimal => confidence low due to lack of data
	Incidental behaviour	0									
	Gear loss	0									
	Anchoring/ mooring	1	3	4	Population size	White's seahorse	1.1	1	**1**	2	White's seahorse occurs in shallow inshore areas so considered most vulnerable to impact => Given that seahorses coming into direct contact with anchors is very remote there is negligible intensity at any spatial or temporal scale => Therefore consequence also scored as negligible => Confidence was recorded as high because it is considered very unlikely for there to be damage or mortality to seahorses associated with Anchoring/mooring.
	Navigation/ steaming	1	4	6	Behavior and Movement	short-tailed shearwater	6.1	2	**2**	1	Shearwaters known to follow vessels => collisions are negligible => alterations to movement patters likely to be short-term => consequence minor => confidence low due to lack of data
Addition/ movement of biological material	Translocation of species	0									
	On board processing	0									

Direct impact of Fishing	Fishing Activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (from S2.1)	Intensity Score (1-6)	**Consequence Score (1-6)**	Confidence score (1-2)	Rationale
	Discarding catch	1	4	6	Behavior and Movement	Australian fur seal	6.1	2	**3**	1	Animals modify behavior, especially to feed on discards. Moderate consequence as change in behaviour is detectable, but minimal impact on population dynamics. Confidence low due to lack of information.
	Stock enhancement	0									
	Provisioning	0									
	Organic waste disposal	1	4	6	Behavior and Movement	short-tailed shearwater	6.1	2	**2**	2	Seabirds were chosen because they were considered to be readily attracted toward fishing vessels dispensing organic waste => Intensity was scored as minor because there was remote likelihood of seabirds being adversely affected (aggregation during feeding frenzy a natural process) => Organic waste disposal in its own right was considered to have minimal consequence on seabirds, however, it was considered that disposal of organic waste is likely to increase chances of other negative interactions e.g. collision or entanglement => Confidence in the consequence score was high because organic waste disposal considered unlikely to have detectable impacts on seabirds.
Addition of non-biological material	Debris	1	4	6	Population size	seabirds	1.2	2	**2**	1	Seabirds were chosen for analysis because they were considered vulnerable to debris e.g. six pack holders =>Intensity was scored as Minor because debris – seabird interactions are considered to be rare => Consequence was considered minor on seabirds because damage/mortality due to debris from fishing vessels was considered unlikely to be measurable against background variability => Confidence was scored as low because of a lack of data on interactions between seabirds and debris originating from Danish seine fishing operations.
	Chemical pollution	1	4	6	Reproductive output	albatrosses	5.1	2	**2**	1	albatrosses considered species most vulnerable as they are long-lived top-order predators, so may accumulate high levels of chemicals in tissues => Intensity was scored as minor as most deleterious chemicals probably not from fishing vessels => Consequence was also considered minor , as although effect of chemical pollution on seabirds could be serious, it is not likely that fishing vessels are a major source of the pollution=> Confidence was considered low due to lack of data

Direct impact of Fishing	Fishing Activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (from S2.1)	Intensity Score (1-6)	**Consequence Score (1-6)**	Confidence score (1-2)	Rationale
	Exhaust	1	4	6	Population size	Little penguin	1.1	1	**1**	2	The little penguin was chosen for analysis because this species was considered vulnerable to oil slicks as a result of exhaust emissions => Intensity was scored as negligible because exhaust considered to only impact a small < 1 nm area and because little penguins are highly mobile strong avoidance was expected at the scale of 1 nm => Consequence was also considered negligible i.e. any consequence on little penguins in the SEF unlikely to be measurable => Confidence in the consequence score was considered high because localised exhaust unlikely to impact on behaviour/movement of little penguins.
	Gear loss	0									
	Navigation/ steaming	1	4	6	Behavior and Movement	seabirds	6.1	1	**1**	2	Seabirds known to follow fishing vessels, but addition of noise and visual stimuli from fishing operations unlikely to have a measurable impact => confidence high (logic)
	Activity/ presence on water	1	4	6	Behavior and Movement	seabirds	6.1	1	**1**	2	Seabirds known to follow fishing vessels, but presence of vessels on water unlikely to have a measurable impact => confidence high (logic)
Disturb physical processes	Bait collection	0		0							
	Fishing	1	4	6	Population size	spiny pipehorse	1.1	3	**2**	1	Fishing may lead to changes in turbidity, reducing the ability of the animals to find prey or attachment sites. This impact is expected to be of short duration. Confidence low due to lack of information.
	Boat launching	0									
	Anchoring/ mooring	1	3	4	Population size	spiny pipehorse	1.1	1	**1**	2	Inshore where anchoring can occur, might disrupt the sediments reintroduce organic material, decrease the cover of oxygenizing biota (seagrasses, bacterial mats), or anoxic muds that kill syngnathids. Anchoring is not common. Confidence high due to logical considerations
	Navigation/steaming	1	4	6	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 Impacts (specify the particular example within each activity area)	Other fisheries	1	6	6	Population size	spiny pipehorse	1.1	3	**4**	1	Spiny pipehorse also caught in SE trawl fishery
	Aquaculture	0									
	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	4	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	4	6	Behavior and Movement	sharks, e.g. grey nurse	6.1	1	**1**	2	There are a number of ocean disposal sites in the area of the fishery, but hard to see how they could impact shark stocks
	Other anthropogenic activities	1	4	6	Reproductive output	seabirds	4.2	3	**2**	2	tourism on islands can lead to disturbance of nesting seabirds, and reproductive capacity

2.3.1 Level 1 (SICA) Documents L1.4 Habitat Component Danish seine

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	0	0							
	Fishing	1	4	6	Habitat structure and function	coarse sediments, unrippled, mixed faunal community, outer shelf	5.1	3	**3**	1	Danish seine fishers deploy the gear over areas of 'smooth' sandy seafloor, moving to another area if sponges are encountered in high densities. Hard rocky, high relief seabed is avoided to preserve gear. However, habitat is patchy, and sediment patches which feature erect, rugose, delicate and or, inflexible fauna, will be removed or damaged as gear passes over. Assumptions that 'pumpkin' sponges survive when thrown back are unsubstantiated. This habitat type is justified by virtue of reports of Danish Seine activity out to the head of Bass Canyons at 183m. Intensity: moderate, highly localised. Consequence: moderate, regeneration of sponges may take between months to years if large or more complex. Sponges in these depths may be expected to be fairly resilient to natural disturbance, which is not the same as fishing disturbance. Confidence low due to lack of data
	Incidental behaviour	0									
Direct impact without capture	Bait collection	0	0	0							
	Fishing	1	4	6	Habitat structure and function	coarse sediments, unrippled, mixed faunal community, outer shelf	5.1	3	**3**	1	If encountered by gear, damage and or removal of large, tall, rugose, delicate, inflexible fauna, is likely to occur as gear passes over. Some Sediment habitats are at risk as they can support areas of large sponges and mixed faunal communities which are vulnerable to breakage with unnatural force. This habitat type is justified by virtue of reports of Danish Seine activity out to the head of Bass Canyons at 183m. Intensity: moderate, highly localised. Consequence: moderate, regeneration of sponges may take between months to years if large or more complex. Sponges in these depths may be expected to be fairly resilient to disturbance. Effect of fishing on habitat structure is correlated with depth. Confidence low due to lack of data
	Incidental behaviour	0									
	Gear loss	0									

Direct impact of Fishing	Fishing Activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (from S2.1)	Intensity Score (1-6)	**Consequence Score (1-6)**	Confidence score (1-2)	Rationale
	Anchoring/ mooring	1	3	4	Habitat structure and function	coarse sediments, wave rippled, large sponges, inner shelf	5.1	1	**1**	2	Inner-shelf sponge beds could be damaged by physical contact with anchor and chain during deployment, resting and retrieval. Intensity and consequence scored as negligible as anchoring/mooring is not common in this fishery, but more likely to occur on soft bottom and is considered to affect only a very small percentage of the area of the habitat. Confidence: high because it is considered very unlikely for there to be lasting damage to a large area of inner-shelf habitat caused by Anchoring/ mooring from this fishery.
	Navigation/ steaming	1	4	6	Water quality	Southern Oceanic Pelagic provinces.	1.1	1	**1**	2	Light and noise will alter the water quality of the pelagic habitat for as long as the vessel is present in an area. Intensity: negligible. Consequence: negligible, once activity ceases, no evidence of activity remains. Confidence high, and constrained by logic
Addition/ movement of biological material	Translocation of species	0									
	On board processing	0									
	Discarding catch	1	4	6	substrate quality	fine sediments, unrippled, large sponges, inner shelf	3.1	3	**2**	2	Substrate quality most likely to be impacted by discarding of catch. May result in localised accumulation of carcasses on the benthos leading to altered sediment chemistry. Intensity was scored as moderate because it was considered there was a possibility for severe localised benthic accumulation of carcasses, due to the concentration of effort in this fishery. Consequence: Minor, measurable impacts were considered to only be detectable at very localised scales, and not for long. Confidence: high, operators generally discard waste over the course of fishing operations leading to dispersal of waste.
	Stock enhancement	0	0	0							
	Provisioning	0	0	0							
	Organic waste disposal	1	4	6	Water quality	Southern Oceanic Pelagic provinces.	1.1	1	**1**	2	Discharge of organic waste likely to occur daily. Intensity: negligible over area. Consequence: negligible, volume likely to be small and quickly dispersed through the water column. Confidence: high, localised short term increases in nutrient not expected to adversely affect water column.

Direct impact of Fishing	Fishing Activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (from S2.1)	Intensity Score (1-6)	**Consequence Score (1-6)**	Confidence score (1-2)	Rationale
Addition of non-biological material	Debris	1	4	6	Water quality	Southern Oceanic Pelagic provinces.	1.1	1	**2**	1	Fishing activity occurs in a concentrated zone of the SEF. Debris possible over this scale. Debris was considered to pose greatest potential risk for Water quality in the Southern province pelagic habitat. Intensity: negligible if MARPOL rules adhered to, and because the volume of debris was considered to be small. Consequence: minor if small volume, but lost debris expected to accumulate in certain locations, and small pieces may be ingested by species. Confidence: low no observer data, therefore confidence in the consequence score was low because the volume of debris generated by the fishery is unknown.
	Chemical pollution	1	4	6	Water quality	Southern Oceanic Pelagic provinces.	1.1	1	**2**	1	Fishing activity occurs throughout the year over the entire SEF. Chemical pollution possible over this scale, posing risk to pelagic habitat water quality. Intensity: negligible, inadvertent spills. MARPOL regulations in place. Consequence: minor unless large chemical/ oil spill, then may be locally severe. Confidence: low no observer data, but most chemical related activities expected to occur in coastal waters.
	Exhaust	1	4	6	Air quality	Southern Oceanic Pelagic provinces.	2.1	1	**1**	2	Exhaust from running engines may impact the air quality of the species within Southern Oceanic Pelagic habitat (e.g. birds). Intensity: negligible, emissions dispersed quickly. Consequence: negligible due to rapid dispersal of pollutants in winds, and likely to be physically undetectable over very short time frames. Confidence high because effect of exhaust was considered to be very localised and logical consideration.
	Gear loss	0									
	Navigation/ steaming	1	4	6	Air quality	Southern Oceanic Pelagic provinces.	2.1	2	**1**	2	Light and noise impact the habitat for as long as activity occurs. Intensity, minor as localised addition of energy. Consequence: negligible, as vessel passes no evidence of activity remains. Confidence high, and constrained by logic
	Activity/ presence on water	1	4	6	Water quality		1.1	1	**1**	1	The environment will be impacted by noise and visual stimuli, and localised addition of gear to water column, birds and seals may be attracted to fishing operations. Intensity: negligible over area, unless many vessels. Consequence: negligible because it is unlikely to have persistent effect on water quality. Confidence: low, unknown impact on pelagic habitat
Disturb physical processes	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 (from S2.1)	Intensity Score (1-6)	**Consequence Score (1-6)**	Confidence score (1-2)	Rationale
	Fishing	1	4	6	substrate quality	fine sediments, unrippled, large sponges, inner shelf	3.1	3	**2**	2	Danish seine nets are deployed over sandy sediments which may support large/ tall erect sponges and other suspension feeding sessile invertebrates in patches. Seine trawling activates suspension of fine sediment layers of the seafloor, in a way that is greater than expected from wave/ current action alone. Intensity: moderate, occurs every pass of the gear over a highly concentrated zone. Consequence: minor, suspended sediments translocated by currents and settle out on filter feeding organisms smothering ability to function normally. Confidence high, however, the area fished is a highly dynamic zone, much of its fauna is adapted to mobile sediments from natural disturbance, but fishing may occur at greater frequency than these natural events.
	Boat launching	0	0	0							
	Anchoring/ mooring	1	3	4	Habitat structure and function	fine sediments, unrippled, large sponges, inner shelf	5.1	1	**1**	2	Inner-shelf sponge beds have physical structure that could be damaged by physical contact with anchor, damage to structure may disturb physical processes. Intensity and consequence: negligible. Very low frequency of anchoring, therefore considered to affect only a very small percentage of the area of the habitat. Confidence: high, because any disturbance to physical processes associated with Anchoring/mooring likely to be very small area of fishery.
	Navigation/steaming	1	4	6	Habitat structure and function	Southern Oceanic Pelagic provinces.	5.1	2	**1**	2	Mixing of the water column occurs at minor intensity and likely to be negligible with regard to influencing the structure of the water column, or the productivity. Confidence high, and constrained by logic
External Impacts (specify the particular example within each activity area)	Other fisheries SE trawl	1	6	6	Habitat structure and function	coarse sediments, wave rippled, large sponges, outer shelf	5.1	4	**5**	1	Other SE fisheries operating over the same grounds with potential to impact benthic habitats include, demersal trawl, gillnet, some dredging in shallower waters. Cumulative effects on Habitat structure and function are a concern for all habitats, but particularly those at depths >100m which may be trawled or netted, and where unclear boundaries define hard and soft habitat types. Sediment based habitats supporting large sponges are likely to be most subject to effort. Intensity: major as all methods work over these grounds. Consequence is potentially severe, given the number of methods that expend effort over this terrain type, so that habitat structure and its function may be affected over the long term. Confidence low; data required on the cumulative effects of fishing in these depths, as well as the regeneration rates of temperate benthic habitats in depths 100-200m.
	Aquaculture	0									

Direct impact of Fishing	Fishing Activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (from S2.1)	Intensity Score (1-6)	**Consequence Score (1-6)**	Confidence score (1-2)	Rationale
	Coastal development	1	4	6	Habitat structure and function	fine sediments, unrippled, large sponges, inner shelf	5.1	1	**1**	1	Development not great on coasts adjacent to fishing grounds, any effects unlikely to have measurable impact on offshore habitats. Therefore Intensity and Consequence: considered negligible. Confidence low; little data is available
	Other extractive activities - oil and gas wells	1	4	6	Habitat types	mud, unrippled, bioturbators, outer shelf	4.1	3	**2**	1	Drilling for oil and gas, may discharge new substrates in an area, putting rare habitats at risk. Locally intense, how are these advected to other areas, depends on the materials. Confidence low, unknown effects downstream.
	Other non extractive activities - ocean dumping	1	4	6	Habitat structure and function	fine sediments, unrippled, large sponges, outer shelf	5.1	1	**1**	1	There are a number of ocean disposal sites in the area of the fishery, habitats in the vicinity of dumping/ discharging may be impacted. Intensity: negligible. Consequence: negligible. Confidence low, data deficient.
	Other anthropogenic activities - tourism	1	4	6	Habitat structure and function	fine sediments, unrippled, large sponges, inner shelf	5.1	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) Documents L1.5 – Community Component - Danish Seine

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	6	Species composition	SET inner shelf	1.1	3	**2**	1	There is a clear inverse relationship between catches of the two target species of the Danish seiners. Catches have fluctuated over the years, but there is no clear trend. Flathead abundance appears to be related to environmental conditions. Changes in species composition due to fishing are probably not detectable against natural variation. Confidence low due to lack of analysis.
	Incidental behaviour	0									
Direct impact without capture	Bait collection	0									
	Fishing	1	4	6	Species composition	SET inner shelf	1.1	2	**2**	2	Direct impact without capture most likely to affect species composition of communities due to loss of habitat caused by gear => intensity minor as Danish seine gear does not cause significant damage to habitat => consequence minor as changes in community composition not detectable against natural variation
	Incidental behaviour	0									
	Gear loss	0									
	Anchoring/ mooring	1	3	4	Species composition	SET inner shelf	1.1	1	**1**	2	intensity negligible as anchoring not common => consequence negligible as it is considered unlikely that anchoring could have a measurable effect on communities => confidence high (logic)
	Navigation/ steaming	1	4	6	Species composition	SET inner shelf	1.1	1	**1**	2	intensity negligible as although navigation/steaming is a large component of operations it is unlikely to have any measurable effect on communities => consequence negligible => confidence high (logic)
Addition/ movement of biological material	Translocation of species	0									
	On board processing	0									

Direct impact of Fishing	Fishing Activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (from S2.1)	Intensity Score (1-6)	**Consequence Score (1-6)**	Confidence score (1-2)	Rationale
	Discarding catch	1	4	6	Distribution of the community	SET inner shelf	3.1	2	**2**	1	Discarding catch could affect distribution of community, for example, scavengers attracted to discarded catch => intensity moderate as discarding is common => consequence minor as localized accumulations of waste do not generally occur, so species are unlikely to become habituated to using discards as a food source => confidence low due to lack of data (SESSF Strategic Assessment Report)
	Stock enhancement	0									
	Provisioning	0									
	Organic waste disposal	1	4	6	Distribution of the community	SET inner shelf	3.1	1	**1**	2	Organic waste disposal most likely to attract scavengers thus affecting distribution of community temporarily => intensity negligible as each disposal event considered to affect only a small area => consequence negligible as effect considered unlikely to be measurable => confidence high (logic)
Addition of non-biological material	Debris	1	4	6	Species composition	SET inner shelf	1.1	1	**1**	2	intensity negligible as addition of debris is minimal => consequence negligible as it is considered unlikely that addition of debris could affect communities => confidence high (logic)
	Chemical pollution	1	4	6	Species composition	SET inner shelf	1.1	1	**1**	2	Chemical pollution most likely to affect species composition => intensity negligible as although chemical pollution could occur over a large range, each event considered to affect only a small area => consequence negligible as effect considered unlikely to be measurable => confidence high (logic)
	Exhaust	1	4	6	Distribution of the community	SET inner shelf	3.1	1	**1**	2	Exhaust emissions most likely to affect distribution of community by repelling some species temporarily, e.g. birds, => intensity negligible as exhaust considered to affect only a small area => consequence negligible as effect considered unlikely to be measurable => confidence high (logic)
	Gear loss	0									
	Navigation/ steaming	1	4	6	Distribution of the community	SET inner shelf	3.1	1	**1**	2	intensity negligible as detection of impact considered unlikely => consequence negligible as any effect on communities unlikely to be measurable => confidence high (logic)
	Activity/ presence on water	1	4	6	Distribution of the community	SET inner shelf	3.1	1	**1**	2	intensity negligible as detection of impact considered unlikely => consequence negligible as any effect on communities unlikely to be measurable => confidence high (logic)
Disturb physical processes	Bait collection	0									
	Fishing	1	4	6	Distribution of the community	SET inner shelf	3.1	1	**1**	2	Sediments could be disturbed changing distribution of species in the community. intensity negligible as detection of impact considered unlikely => consequence negligible as any effect on communities unlikely to be measurable => confidence high (logic)
	Boat launching	0									

Direct impact of Fishing	Fishing Activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (from S2.1)	Intensity Score (1-6)	**Consequence Score (1-6)**	Confidence score (1-2)	Rationale
	Anchoring/ mooring	1	3	4	Distribution of the community	SET inner shelf	3.1	1	**1**	2	intensity negligible as anchoring not common => consequence negligible as it is considered unlikely that disturbance of physical processes from anchoring could have a measurable effect on communities => confidence high (logic)
	Navigation/steaming	1	4	6	Distribution of the community	SET inner shelf	3.1	1	**1**	2	intensity negligible as detection of impact considered unlikely => consequence negligible as any effect on communities unlikely to be measurable => confidence high (logic)
External Impacts (specify the particular example within each activity area)	Other fisheries - SE trawl	1	6	6	Trophic/size structure	SET inner shelf	4.1	3	**3**	1	Several other fisheries operate in same community as Danish seine particularly the otter trawl which overall has resulted in relatively high exploitation of the community and likely to have affected trophic/size structure => intensity moderate => consequence moderate as cumulative effects should be considered => confidence low due to lack of information/analysis on cumulative effects
	Aquaculture	0									
	Coastal development	1	4	6	Bio- and geochemical cycles	SET inner shelf	5.1	1	**1**	2	Development not great on coasts adjacent to fishing grounds => any effects unlikely to have measurable impact on communities
	Other extractive activities - oil and gas exploration	1	4	6	Distribution of the community	SET inner shelf	3.1	3	**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) => most likely to affect distribution of the community as sounds from air guns used in seismic surveys thought to affect fish behaviour possibly causing them to migrate out of fishing grounds => intensity scored as moderate as local effects are potentially severe => consequence scored as minor as long-term effect on communities expected to be minimal => confidence is low as effects are unknown
	Other non extractive activities - ocean dumping	1	4	6	Distribution of the community	SET inner shelf	3.1	1	**1**	2	There are a number of ocean disposal sites in the area of the fishery, but hard to see how they could impact communities.
	Other anthropogenic activities - tourism	1	4	6	Distribution of the community	SET inner shelf	3.1	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

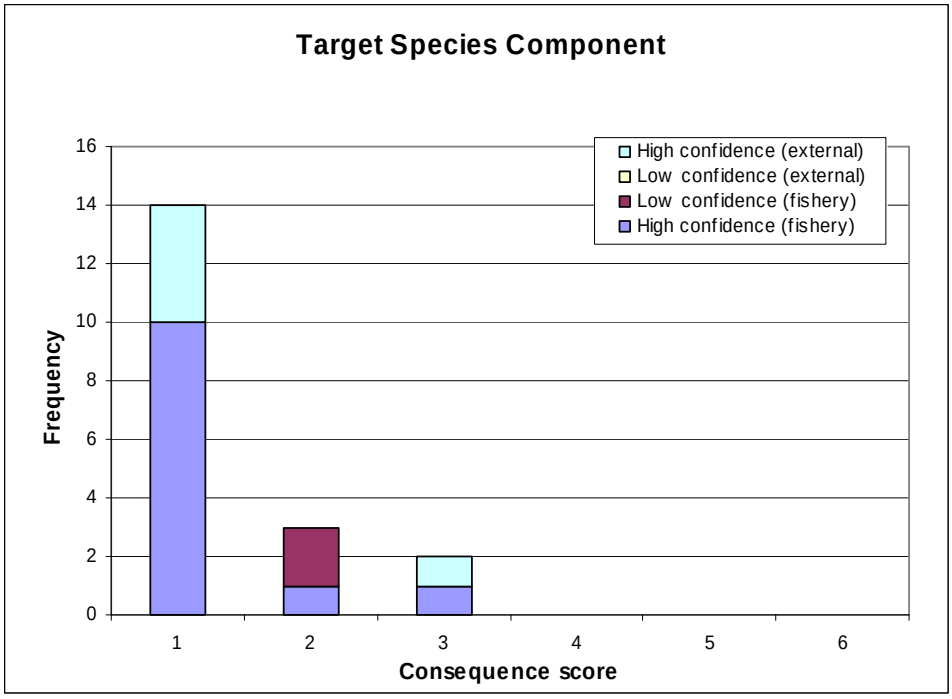
2.3.11 Summary of SICA results

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 (moderate) or above for consequence, and differentiating those that did so with high confidence (in bold).

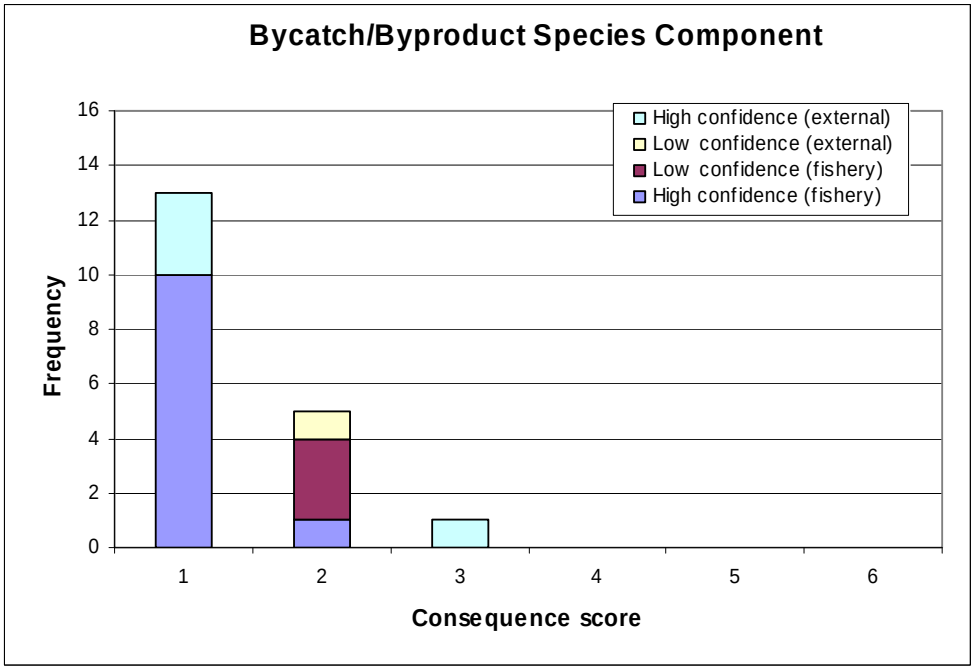
Level 1 (SICA) Document L1.6. Summary table of consequence scores for all activity/component combinations.

Direct impact	Activity	Target species	Byproduct and bycatch species	TEP species	Habitats	Communities
Capture	Bait collection	0	0	0	0	0
	Fishing	**3**	**2**	4	3	2
	Incidental behaviour	0	0	0	0	0
Direct impact without capture	Bait collection	0	0	0	0	0
	Fishing	2	2	2	3	**2**
	Incidental behaviour	0	0	0	0	0
	Gear loss	0	0	0	0	0
	Anchoring/ mooring	**1**	**1**	**1**	**1**	**1**
	Navigation/ steaming	**1**	**1**	2	**1**	**1**
Addition/ movement of biological material	Translocation of species	0	0	0	0	0
	On board processing	0	0	0	0	0
	Discarding catch	**2**	2	3	**2**	2
	Stock enhancement	0	0	0	0	0
	Provisioning	0	0	0	0	0
	Organic waste disposal	**1**	**1**	**2**	**1**	**1**
Addition of non-biological material	Debris	**1**	**1**	2	2	**1**
	Chemical pollution	**1**	**1**	2	2	**1**
	Exhaust	**1**	**1**	**1**	**1**	**1**
	Gear loss	0	0	0	0	0
	Navigation/ steaming	**1**	**1**	**1**	**1**	**1**
	Activity/ presence on water	**1**	**1**	1	1	**1**
Disturb physical processes	Bait collection	0	0	0	0	0
	Fishing	2	2	2	**2**	**1**
	Boat launching	0	0	0	0	0
	Anchoring/ mooring	**1**	**1**	**1**	**1**	**1**
	Navigation/steaming	**1**	**1**	**1**	**1**	**1**
Note: external hazards are not considered at Level 2 in the PSA analysis						
External hazards (specify the particular example within each activity area)	Other fisheries	**3**	**3**	4	5	3
	Aquaculture	0	0	0	0	0
	Coastal development	**1**	**1**	**3**	1	**1**
	Other extractive activities	**1**	2	2	2	2
	Other non extractive activities	**1**	**1**	**1**	1	**1**
	Other anthropogenic activities	**1**	**1**	**2**	**1**	**1**

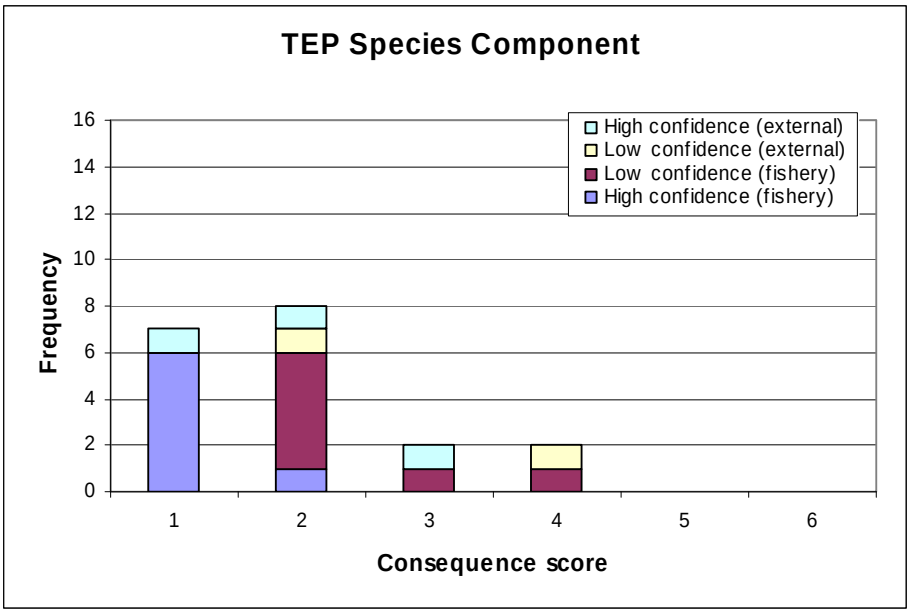
Target species: Frequency of consequence score differentiated between high and low confidence.



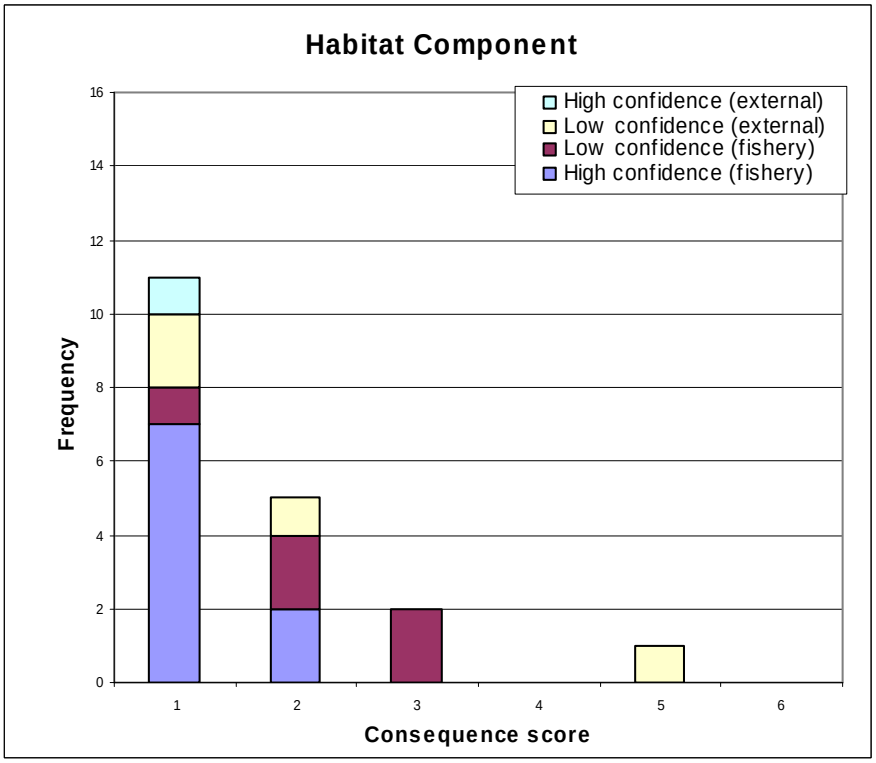
Byproduct and bycatch species: Frequency of consequence score differentiated between high and low confidence



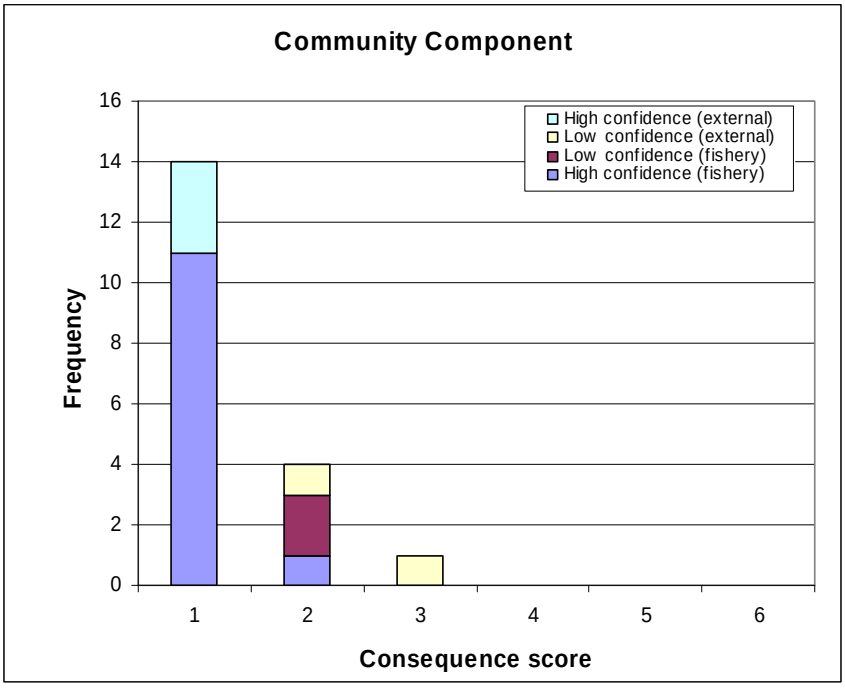
TEP species: Frequency of consequence score differentiated between high and low confidence



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

The target species, TEP species and habitat components all had consequence scores of 3 (moderate) or above for at least one activity. The hazards that led to the high consequence scores were: capture by fishing, direct impact of fishing without capture, and addition of biological material due to catch discarding.

The only activity/component combination that is assessed to potentially have a major consequence is the effect of capture by fishing on TEP species (the spiny pipehorse population). Spiny pipehorse are likely to have a low population size and a limited range, and are also low in fecundity compared to other teleosts, as they are brooders rather than broadcast spawners. They are known to be caught often in the Danish seine fishery (Bowles and Martin-Smith, 2003). However, there is a high level of uncertainty about spiny pipehorse distribution and habitat preferences, they are difficult to detect if caught, and therefore this consequence score has low confidence.

The consequence for the effect of fishing on habitats has been assessed to be moderate, but this score has low confidence due to lack of data. Danish seine fishers deploy the gear over areas of 'smooth' sandy seafloor, moving to another area if sponges are encountered in high densities. The gear is susceptible to damage if rocky, high relief surfaces are encountered, but it will remove and may damage large, tall, rugose, delicate or inflexible fauna, as gear passes over. Assumptions that 'pumpkin' sponges survive when thrown back are unsubstantiated, and regeneration of sponges may take between months to years if large or more complex.

The otter trawl component of the SESSF also operates in the area of the Danish seine fishery, and is assessed to have a significant impact on all components. The otter trawl fishery catches about 60% of the total flathead catch in the SESSF, so is likely to have an impact on flathead stocks equivalent to that of the Danish seine fishery. The otter trawl fishery is likely to have a greater impact on byproduct/bycatch species than the Danish seine fishery, as catches of the byproduct/bycatch species are greater in the trawl fishery. Otter trawl is also likely to impact habitats more severely than the Danish seine fishery, as the heavier trawl gear is more damaging to grounds than the Danish seine gear. Communities are also likely to suffer a greater impact from the otter trawl fishery than from the Danish seine fishery, because the otter trawl fishery captures a greater range of species and in greater quantity.

The byproduct/bycatch component has been assessed to only be at minor risk in this fishery. Byproduct catch levels are very low compared to catches of the target species, and the number of discard species is low compared with the otter trawl fishery in the SESSF. Assessment of low risk for this component was based on choice of school shark as the “plausible worst case” species at risk.

2.3.13 Components to be examined at Level 2

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

- Target species
- TEP species
- Habitats

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

- Byproduct/bycatch species
- Communities

2.4 Level 2 Productivity and Susceptibility Analysis (PSA)

When the risk of an activity at Level 1 (SICA) on a component is moderate or higher and no planned management interventions that would remove this risk are identified, an assessment is required at Level 2. The PSA approach is a method of assessment which allows all units within any of the ecological components to be effectively and comprehensively screened for risk. The units of analysis are the complete set of species, habitats or communities identified at the scoping stage. The PSA results in sections 2.4.2 and 2.4.3 of this report measure risk from direct impacts of fishing only, 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 noted as 'risk'). A measure of absolute risk requires some direct measure of abundance or mortality rate for the unit in question, and this information is generally lacking at Level 2.

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

Species

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

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

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

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

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

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

For species that are caught by the gear, **post capture mortality** measures the survival probability of the species. Obviously, for species that are retained, survival will be zero. Species that are discarded may or may not survive. This aspect is mainly scored using independent field 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 each ecological component (species or habitat) is scored for risk based on attributes for productivity and susceptibility, and the results are plotted as shown in Figure 13.

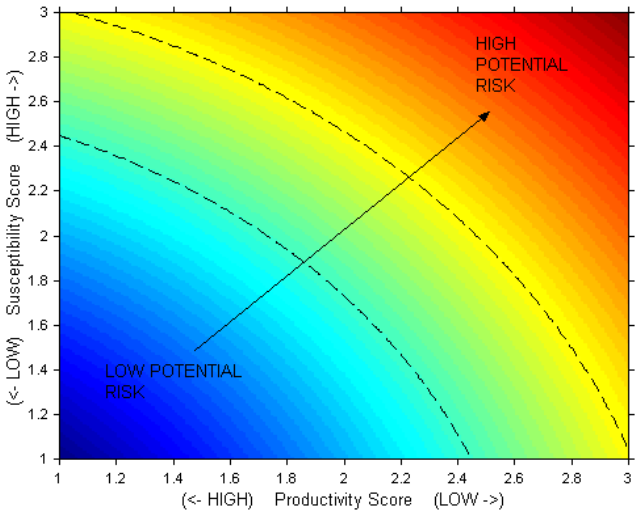


Figure 13. The axes on which risk to the ecological units is plotted. The *x*-axis includes attributes that influence the productivity of a unit, or its ability to recover after impact from fishing. The *y*-axis includes attributes that influence the susceptibility of the unit to impacts from fishing.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

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

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

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

No units were excluded from this analysis.

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

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

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

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

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

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

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

Observer data and observer expert knowledge are important sources of information in the PSA analyses, particularly for the bycatch and TEP components. The level of observer data for this fishery is regarded as high. The Integrated Scientific Monitoring Programs (ISMP) was implemented in the SESSF in 1997 to replace the Scientific Monitoring Program (1992-1996). The ISMP provides statistically rigorous port-based and at-sea monitoring, which produces important information on discards, non-commercial species and non-quota commercial species. ISMP observers collect information on all species that come aboard for both discarded and retained species. Length, weight and maturity data and biological samples (e.g. otoliths and genetic samples) are routinely collected from both discarded and retained species. Port based observers provide additional biological data and samples from the landed catch. From 2003, the ISMP also collects information on the incidence of direct and indirect interaction with TEP species.

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 *SESSF Danish trawl fishery*

ERA species ID	Scientific Name	Common Name	Average logbook catch (kg) (2001-04)	Missing > 3 attributes (Y/N)	Number of missing productivity attributes (out	Number of missing susceptibility attributes (out	Productivity (additive) 1-low risk, 3 - high risk	Susceptibility (mult) 1- low risk, 3 - high risk	2D risk value (P&S) 1.41-low risk, 4.24 - high risk	Susceptibility override used?	PSA risk category	High/Med risk category (Refer 2.4.8)	Comments
Teleost													
2765	Platycephalus caeruleopunctatus	bluespot flathead	0	N	0	0	1.43	2.33	2.74	N	Med	*Other	Justification for inclusion: This species included in the TAC but identified as tiger flathead in logbooks. Higher risk than other flathead species because this fishery targets a larger proportion of their range in the SESSF
6	Neoplatycephalus aurimaculatus	toothy flathead	0	N	0	0	1.43	1.67	2.20	N	Low		Justification for inclusion: This species included in the TAC but identified as tiger flathead in logbooks
115	Platycephalus bassensis	Sand Flathead	0	N	0	0	1.43	1.67	2.20	N	Low		Justification for inclusion: This species included in the TAC but identified as tiger flathead in logbooks
118	Platycephalus speculator	yank flathead	0	N	0	0	1.43	1.67	2.20	N	Low		Justification for inclusion: This species included in the TAC but identified as tiger flathead in logbooks

ERA species ID	Scientific Name	Common Name	Average logbook catch (kg) (2001-04)	Missing > 3 attributes (Y/N)	Number of missing productivity attributes (out	Number of missing susceptibility attributes (out	Productivity (additive) 1-low risk, 3 - high risk	Susceptibility (mult) 1- low risk, 3 - high risk	2D risk value (P&S) 1.41-low risk, 4.24 - high risk	Susceptibility override used?	PSA risk category	High/Med risk category (Refer 2.4.8)	Comments
1037	Neoplatycephalus richardsoni	Flathead	1,100,995	N	0	0	1.29	1.67	2.10	N	Low		productivity high;susceptibility medium because this fishery only targets a small proportion of their range in the SESSF. Level 3 information available : stock status stable (BRS 2004)
145	Sillago flindersi	School Whiting	462,206	N	0	0	1.14	1.67	2.02	N	Low		productivity high;susceptibility medium because this fishery only targets a small proportion of their range in the SESSF

TEP species *SESSF Danish trawl fishery*

ERA species ID	Scientific Name	Common Name	Average logbook catch (kg) (2001-04)	Missing > 3 attributes (Y/N)	Number of missing productivity attributes (out of 7)	Number of missing susceptibility attributes (out of 5)	Productivity (additive) 1- low risk, 3 - high risk	Susceptibility (mult) 1- low risk, 3 - high risk	2D risk value (P&S) 1.41- low risk, 4.24 - high risk	Susceptibility override used?	PSA risk category	High/Med risk category (Refer 2.4.8)	Comments
Chondrichthyan													
315	Carcharodon carcharias	white shark	0	N	0	0	2.86	1.05	3.04	Y	Med	Low overlap	Observer override : very few interactions. Selectivity decreased to low. If caught are released alive. PCM reduced to medium.(ERA Observer workshop, PIRVic 15-16 August 2005)
1067	Rhincodon typus	whale shark	0	N	0	0	2.71	1.15	2.95	N	Med	Widely distributed	
313	Carcharias taurus	grey nurse shark	0	N	0	0	2.71	1.10	2.93	Y	Med	Widely distributed	Observer override : very few interactions. Selectivity decreased to low. If caught are released alive. PCM reduced to medium.(ERA Observer workshop, PIRVic 15-16 August 2005)
Marine bird													

ERA species ID	Scientific Name	Common Name	Average logbook catch (kg) (2001-04)	Missing > 3 attributes (Y/N)	Number of missing productivity attributes (out of 7)	Number of missing susceptibility attributes (out of 5)	Productivity (additive) 1- low risk, 3 - high risk	Susceptibility (mult) 1- low risk, 3 - high risk	2D risk value (P&S) 1.41- low risk, 4.24 - high risk	Susceptibility override used?	PSA risk category	High/Med risk category (Refer 2.4.8)	Comments
1673	Thalassarche nov. sp.	Pacific Albatross	0	Y	4	1	2.71	1.44	3.07	Y	Med	Missing data	Observer override : Small proportion of birds seen encounter gear (2.7% in 2004), encounterability decreased to medium. Small proportion of those seen are caught or killed (0.04% in 2004), selectivity decreased to low. Koopman, M, Talman, SG, Gason ASH, Stokie TK, and Berrie SE (2005) Integrated Scientific Monitoring Program - South East Trawl Fishery Annual Report 2004. Report to AFMA project No. R03/1551. PIRVic, Queenscliff.
1580	Calonectris leucomelas	streaked shearwater	0	Y	3	1	2.57	1.44	2.95	Y	Med	Missing data	Observer override : see above
1428	Diomedea amsterdamensis	Amsterdam Albatross	0	N	1	0	2.57	1.44	2.95	Y	Med	Low attribute score	Observer override : see above
628	Diomedea antipodensis	Antipodean Albatross	0	N	1	0	2.57	1.44	2.95	Y	Med	Low attribute score	Observer override : see above

ERA species ID	Scientific Name	Common Name	Average logbook catch (kg) (2001-04)	Missing > 3 attributes (Y/N)	Number of missing productivity attributes (out of 7)	Number of missing susceptibility attributes (out of 5)	Productivity (additive) 1- low risk, 3 - high risk	Susceptibility (mult) 1- low risk, 3 - high risk	2D risk value (P&S) 1.41- low risk, 4.24 - high risk	Susceptibility override used?	PSA risk category	High/Med risk category (Refer 2.4.8)	Comments
1429	Diomedea dabbenena	Tristan Albatross	0	N	1	0	2.57	1.44	2.95	Y	Med	Low attribute score	Observer override : see above
753	Diomedea epomophora	Southern Royal Albatross	0	N	1	0	2.57	1.44	2.95	Y	Med	Low attribute score	Observer override : see above
451	Diomedea exulans	Wandering Albatross	0	N	1	0	2.57	1.44	2.95	Y	Med	Low attribute score	Observer override : see above
755	Diomedea gibsoni	Gibson's Albatross	0	N	1	0	2.57	1.44	2.95	Y	Med	Low attribute score	Observer override : see above
799	Diomedea sanfordi	Northern Royal Albatross	0	N	1	0	2.57	1.44	2.95	Y	Med	Low attribute score	Observer override : see above
912	Phalacrocorax fuscescens	Black faced cormorant	0	N	1	0	2.57	1.44	2.95	Y	Med	Low attribute score	Observer override : see above
1691	Pseudobulweria rostrata	Tahiti Petrel	0	Y	3	1	2.57	1.44	2.95	Y	Med	Missing data	Observer override : see above
1045	Pterodroma cervicalis	White-necked Petrel	0	N	3	0	2.57	1.44	2.95	Y	Med	Low attribute score	Observer override : see above

ERA species ID	Scientific Name	Common Name	Average logbook catch (kg) (2001-04)	Missing > 3 attributes (Y/N)	Number of missing productivity attributes (out of 7)	Number of missing susceptibility attributes (out of 5)	Productivity (additive) 1- low risk, 3 - high risk	Susceptibility (mult) 1- low risk, 3 - high risk	2D risk value (P&S) 1.41- low risk, 4.24 - high risk	Susceptibility override used?	PSA risk category	High/Med risk category (Refer 2.4.8)	Comments
1051	Pterodroma solandri	Providence Petrel	0	N	3	0	2.57	1.44	2.95	Y	Med	Low attribute score	Observer override : see above
1054	Puffinus bulleri	Buller's Shearwater	0	N	3	0	2.57	1.44	2.95	Y	Med	Low attribute score	Observer override : see above
1031	Thalassarche carteri	Indian Yellow-nosed Albatross	0	N	1	0	2.57	1.44	2.95	Y	Med	Low attribute score	Observer override : see above
889	Thalassarche eremita	Chatham albatross	0	N	1	0	2.57	1.44	2.95	Y	Med	Low attribute score	Observer override : see above
1084	Thalassarche impavida	Campbell Albatross	0	N	1	0	2.57	1.44	2.95	Y	Med	Low attribute score	Observer override : see above
894	Thalassarche salvini	Salvin's albatross	0	N	3	0	2.57	1.44	2.95	Y	Med	Low attribute score	Observer override : see above
1086	Thalassarche steadi	White-capped Albatross	0	N	2	0	2.57	1.44	2.95	Y	Med	Low attribute score	Observer override : see above

ERA species ID	Scientific Name	Common Name	Average logbook catch (kg) (2001-04)	Missing > 3 attributes (Y/N)	Number of missing productivity attributes (out of 7)	Number of missing susceptibility attributes (out of 5)	Productivity (additive) 1- low risk, 3 - high risk	Susceptibility (mult) 1- low risk, 3 - high risk	2D risk value (P&S) 1.41- low risk, 4.24 - high risk	Susceptibility override used?	PSA risk category	High/Med risk category (Refer 2.4.8)	Comments
325	Catharacta skua	Great Skua	0	N	1	0	2.43	1.44	2.83	Y	Med	Low attribute score	Observer override : see above
918	Fregetta grallaria	White-bellied Storm-Petrel (Tasman Sea),	0	N	3	0	2.43	1.44	2.83	Y	Med	Low attribute score	Observer override : see above
917	Fregetta tropica	Black-bellied Storm-Petrel	0	N	3	0	2.43	1.44	2.83	Y	Med	Low attribute score	Observer override : see above
314	Fulmarus glacialoides	Southern fulmar	0	N	1	1	2.43	1.44	2.83	Y	Med	Low attribute score	Observer override : see above
555	Garrodia nereis	Grey-backed storm petrel	0	Y	3	1	2.43	1.44	2.83	Y	Med	Missing data	Observer override : see above
939	Halobaena caerulea	Blue Petrel	0	N	3	0	2.43	1.44	2.83	Y	Med	Low attribute score	Observer override : see above
1052	Lugensa brevirostris	Kerguelen Petrel	0	N	3	0	2.43	1.44	2.83	Y	Med	Low attribute score	Observer override : see above
1003	Pachyptila turtur	Fairy Prion	0	N	3	0	2.43	1.44	2.83	Y	Med	Low attribute score	Observer override : see above

ERA species ID	Scientific Name	Common Name	Average logbook catch (kg) (2001-04)	Missing > 3 attributes (Y/N)	Number of missing productivity attributes (out of 7)	Number of missing susceptibility attributes (out of 5)	Productivity (additive) 1- low risk, 3 - high risk	Susceptibility (mult) 1- low risk, 3 - high risk	2D risk value (P&S) 1.41- low risk, 4.24 - high risk	Susceptibility override used?	PSA risk category	High/Med risk category (Refer 2.4.8)	Comments
1009	Phoebetria palpebrata	Light-mantled Albatross	0	N	1	0	2.43	1.44	2.83	Y	Med	Low attribute score	Observer override : see above
1042	Procellaria parkinsoni	Black Petrel	0	N	2	0	2.43	1.44	2.83	Y	Med	Low attribute score	Observer override : see above
1043	Procellaria westlandica	Westland Petrel	0	N	2	0	2.43	1.44	2.83	Y	Med	Low attribute score	Observer override : see above
1046	Pterodroma leucoptera	Gould's Petrel	0	Y	4	0	2.43	1.44	2.83	Y	Med	Missing data	Observer override : see above
1047	Pterodroma macroptera	Great-winged Petrel	0	N	2	0	2.43	1.44	2.83	Y	Med	Low attribute score	Observer override : see above
1048	Pterodroma mollis	Soft-plumaged Petrel	0	N	3	0	2.43	1.44	2.83	Y	Med	Low attribute score	Observer override : see above
1050	Pterodroma nigripennis	Black-winged Petrel	0	N	3	0	2.43	1.44	2.83	Y	Med	Low attribute score	Observer override : see above
1053	Puffinus assimilis	Little Shearwater (Tasman Sea)	0	N	3	0	2.43	1.44	2.83	Y	Med	Low attribute score	Observer override : see above

ERA species ID	Scientific Name	Common Name	Average logbook catch (kg) (2001-04)	Missing > 3 attributes (Y/N)	Number of missing productivity attributes (out of 7)	Number of missing susceptibility attributes (out of 5)	Productivity (additive) 1- low risk, 3 - high risk	Susceptibility (mult) 1- low risk, 3 - high risk	2D risk value (P&S) 1.41- low risk, 4.24 - high risk	Susceptibility override used?	PSA risk category	High/Med risk category (Refer 2.4.8)	Comments
1055	Puffinus carneipes	Flesh-footed Shearwater	0	N	1	0	2.43	1.44	2.83	Y	Med	Low attribute score	Observer override : see above
1059	Puffinus pacificus	Wedge-tailed Shearwater	0	N	1	0	2.43	1.44	2.83	Y	Med	Low attribute score	Observer override : see above
1060	Puffinus tenuirostris	Short-tailed Shearwater	0	N	1	0	2.43	1.44	2.83	Y	Med	Low attribute score	Observer override : see above
1032	Thalassarche bulleri	Buller's Albatross	0	N	1	0	2.43	1.44	2.83	Y	Med	Low attribute score	Observer override : see above
1033	Thalassarche cauta	Shy Albatross	0	N	1	0	2.43	1.44	2.83	Y	Med	Low attribute score	Observer override : see above
1035	Thalassarche chrysostoma	Grey-headed Albatross	0	N	1	0	2.43	1.44	2.83	Y	Med	Low attribute score	Observer override : see above
1085	Thalassarche melanophrys	Black-browed Albatross	0	N	1	0	2.43	1.44	2.83	Y	Med	Low attribute score	Observer override : see above

ERA species ID	Scientific Name	Common Name	Average logbook catch (kg) (2001-04)	Missing > 3 attributes (Y/N)	Number of missing productivity attributes (out of 7)	Number of missing susceptibility attributes (out of 5)	Productivity (additive) 1- low risk, 3 - high risk	Susceptibility (mult) 1- low risk, 3 - high risk	2D risk value (P&S) 1.41- low risk, 4.24 - high risk	Susceptibility override used?	PSA risk category	High/Med risk category (Refer 2.4.8)	Comments
203	Anous stolidus	Common noddy	0	N	1	0	2.29	1.44	2.70	Y	Med	Low attribute score	Observer override : see above
595	Daption capense	Cape Petrel	0	N	1	0	2.29	1.44	2.70	Y	Med	Low attribute score	Observer override : see above
975	Larus pacificus	Pacific Gull	0	N	1	0	2.29	1.44	2.70	Y	Med	Low attribute score	Observer override : see above
73	Macronectes giganteus	Southern Giant-Petrel	0	N	1	0	2.29	1.44	2.70	Y	Med	Low attribute score	Observer override : see above
981	Macronectes halli	Northern Giant-Petrel	0	N	1	0	2.29	1.44	2.70	Y	Med	Low attribute score	Observer override : see above
1549	Morus capensis	Cape gannet	0	N	1	0	2.29	1.44	2.70	Y	Med	Low attribute score	Observer override : see above
998	Morus serrator	Australasian Gannet	0	N	1	0	2.29	1.44	2.70	Y	Med	Low attribute score	Observer override : see above

ERA species ID	Scientific Name	Common Name	Average logbook catch (kg) (2001-04)	Missing > 3 attributes (Y/N)	Number of missing productivity attributes (out of 7)	Number of missing susceptibility attributes (out of 5)	Productivity (additive) 1- low risk, 3 - high risk	Susceptibility (mult) 1- low risk, 3 - high risk	2D risk value (P&S) 1.41- low risk, 4.24 - high risk	Susceptibility override used?	PSA risk category	High/Med risk category (Refer 2.4.8)	Comments
1008	Phoebetria fusca	Sooty Albatross	0	N	1	0	2.29	1.44	2.70	Y	Med	Low attribute score	Observer override : see above
1041	Procellaria aequinoctialis	White-chinned Petrel	0	N	1	0	2.29	1.44	2.70	Y	Med	Low attribute score	Observer override : see above
494	Procellaria cinerea	Grey petrel	0	N	1	0	2.29	1.44	2.70	Y	Med	Low attribute score	Observer override : see above
504	Pterodroma lessoni	White-headed petrel	0	N	1	0	2.29	1.44	2.70	Y	Med	Low attribute score	Observer override : see above
1672	Pterodroma leucoptera (subsp. Caledonica)	Gould's Petrel	0	N	1	1	2.29	1.44	2.70	Y	Med	Low attribute score	Observer override : see above
1049	Pterodroma neglecta	Kermadec Petrel (western)	0	N	2	0	2.29	1.44	2.70	Y	Med	Low attribute score	Observer override : see above
1057	Puffinus griseus	Sooty Shearwater	0	N	1	0	2.29	1.44	2.70	Y	Med	Low attribute score	Observer override : see above

ERA species ID	Scientific Name	Common Name	Average logbook catch (kg) (2001-04)	Missing > 3 attributes (Y/N)	Number of missing productivity attributes (out of 7)	Number of missing susceptibility attributes (out of 5)	Productivity (additive) 1- low risk, 3 - high risk	Susceptibility (mult) 1- low risk, 3 - high risk	2D risk value (P&S) 1.41- low risk, 4.24 - high risk	Susceptibility override used?	PSA risk category	High/Med risk category (Refer 2.4.8)	Comments
1017	Sterna bergii	Crested Tern	0	N	1	0	2.29	1.44	2.70	Y	Med	Low attribute score	Observer override : see above
1018	Sterna caspia	Caspian Tern	0	N	1	0	2.29	1.44	2.70	Y	Med	Low attribute score	Observer override : see above
1433	Sula dactylatra	Masked Booby	0	N	1	1	2.29	1.44	2.70	Y	Med	Low attribute score	Observer override : see above
1034	Thalassarche chlororhynchos	Yellow-nosed Albatross, Atlantic Yellow-	0	N	1	0	2.29	1.44	2.70	Y	Med	Low attribute score	Observer override : see above
898	Eudyptula minor	Little Penguin	0	N	1	0	2.14	1.44	2.58	Y	Low		Observer override : see above
973	Larus dominicanus	Kelp Gull	0	N	1	0	2.14	1.44	2.58	Y	Low		Observer override : see above
974	Larus novaehollandiae	Silver Gull	0	N	3	0	2.14	1.44	2.58	Y	Low		Observer override : see above
1056	Puffinus gavia	Fluttering Shearwater	0	N	2	0	2.14	1.44	2.58	Y	Low		Observer override : see above
1058	Puffinus huttoni	Hutton's Shearwater	0	N	2	0	2.14	1.44	2.58	Y	Low		Observer override : see above
1020	Sterna fuscata	Sooty tern	0	N	1	0	2.14	1.44	2.58	Y	Low		Observer override : see above
1021	Sterna hirundo	Common tern	0	N	1	0	2.14	1.44	2.58	Y	Low		Observer override : see above
1022	Sterna nilotica	Gull-billed tern	0	N	1	0	2.14	1.44	2.58	Y	Low		Observer override : see above
1023	Sterna paradisaea	Arctic tern	0	N	1	0	2.14	1.44	2.58	Y	Low		Observer override : see above

ERA species ID	Scientific Name	Common Name	Average logbook catch (kg) (2001-04)	Missing > 3 attributes (Y/N)	Number of missing productivity attributes (out of 7)	Number of missing susceptibility attributes (out of 5)	Productivity (additive) 1- low risk, 3 - high risk	Susceptibility (mult) 1- low risk, 3 - high risk	2D risk value (P&S) 1.41- low risk, 4.24 - high risk	Susceptibility override used?	PSA risk category	High/Med risk category (Refer 2.4.8)	Comments
1025	Sterna sumatrana	Black-naped tern	0	N	2	0	2.14	1.44	2.58	Y	Low		Observer override : see above
556	Oceanites oceanicus	Wilson's storm petrel (subantarctic)	0	N	1	0	2.00	1.44	2.47	Y	Low		Observer override : see above
1004	Pelagodroma marina	White-faced Storm-Petrel	0	N	1	0	2.00	1.44	2.47	Y	Low		Observer override : see above
1014	Sterna albifrons	Little tern	0	N	1	0	2.00	1.44	2.47	Y	Low		Observer override : see above
1015	Sterna anaethetus	Bridled Tern	0	N	1	0	2.00	1.44	2.47	Y	Low		Observer override : see above
1019	Sterna dougallii	Roseate tern	0	N	1	0	2.00	1.44	2.47	Y	Low		Observer override : see above
1024	Sterna striata	White-fronted Tern	0	N	1	0	2.00	1.44	2.47	Y	Low		Observer override : see above
1006	Pelecanoides urinatrix	Common Diving-Petrel	0	N	1	0	1.86	1.44	2.35	Y	Low		Observer override : see above
Marine mammal													
253	Arctocephalus pusillus doriferus	Australian Fur Seal	0	N	0	0	2.29	3.00	3.77	N	High	Spatial uncertainty	Level 3 information available : are known to interact with fishery, but total population size has increased (SETF Seal Bycatch, BRS)
902	Feresa attenuata	Pygmy Killer Whale	0	N	0	0	2.86	1.22	3.11	Y	Med	Low attribute score	Observer override : not encountered. Encounterability reduced to low.
934	Globicephala macrorhynchus	Short-finned Pilot Whale	0	N	0	0	2.86	1.22	3.11	Y	Med	Low attribute score	Observer override : not encountered. Encounterability reduced to low.

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935	Globicephala melas	Long-finned Pilot Whale	0	N	0	0	2.86	1.22	3.11	Y	Med	Low attribute score	Observer override : not encountered. Encounterability reduced to low.
937	Grampus griseus	Risso's Dolphin	0	N	0	0	2.86	1.22	3.11	Y	Med	Low attribute score	Observer override : not encountered. Encounterability reduced to low.
985	Mesoplodon bowdoini	Andrew's Beaked Whale	0	N	1	0	2.86	1.22	3.11	Y	Med	Low attribute score	Observer override : not encountered. Encounterability reduced to low.
986	Mesoplodon densirostris	Blainville's Beaked Whale	0	N	0	0	2.86	1.22	3.11	Y	Med	Low attribute score	Observer override : not encountered. Encounterability reduced to low.
987	Mesoplodon gingkodens	Gingko Beaked Whale	0	N	1	0	2.86	1.22	3.11	Y	Med	Low attribute score	Observer override : not encountered. Encounterability reduced to low.
989	Mesoplodon hectori	Hector's Beaked Whale	0	N	0	0	2.86	1.22	3.11	Y	Med	Low attribute score	Observer override : not encountered. Encounterability reduced to low.
991	Mesoplodon mirus	True's Beaked Whale	0	N	0	0	2.86	1.22	3.11	Y	Med	Low attribute score	Observer override : not encountered. Encounterability reduced to low.

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1002	Orcinus orca	Killer Whale	0	N	0	0	2.86	1.22	3.11	Y	Med	Low attribute score	Observer override : not encountered. Encounterability reduced to low.
1044	Pseudorca crassidens	False Killer Whale	0	N	1	0	2.86	1.22	3.11	Y	Med	Low attribute score	Observer override : not encountered. Encounterability reduced to low.
1494	Tursiops aduncus	Indian Ocean bottlenose dolphin	0	N	1	0	2.86	1.22	3.11	Y	Med	Low attribute score	Observer override : not encountered. Encounterability reduced to low.
1091	Tursiops truncatus	Bottlenose Dolphin	0	N	0	0	2.86	1.22	3.11	Y	Med	Low attribute score	Observer override : not encountered. Encounterability reduced to low.
256	Balaenoptera acutorostrata	Minke Whale	0	N	0	0	2.86	1.15	3.08	Y	Med	Low attribute score	Observer override : not encountered. Encounterability reduced to low.
959	Hyperoodon planifrons	Southern Bottlenose Whale	0	N	1	0	2.86	1.15	3.08	Y	Med	Low attribute score	Observer override : not encountered. Encounterability reduced to low.
988	Mesoplodon grayi	Gray's Beaked Whale	0	N	1	0	2.86	1.15	3.08	Y	Med	Low attribute score	Observer override : not encountered. Encounterability reduced to low.

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990	Mesoplodon layardii	Strap-toothed Beaked Whale	0	N	1	0	2.86	1.15	3.08	Y	Med	Low attribute score	Observer override : not encountered. Encounterability reduced to low.
1098	Ziphius cavirostris	Cuvier's Beaked Whale	0	N	0	0	2.86	1.15	3.08	Y	Med	Low attribute score	Observer override : not encountered. Encounterability reduced to low.
1439	Balaenoptera bonaerensis	Antarctic Minke Whale	0	N	1	0	2.86	1.07	3.05	Y	Med	Low attribute score	Observer override : not encountered. Encounterability reduced to low.
261	Balaenoptera borealis	Sei Whale	0	N	0	0	2.86	1.07	3.05	Y	Med	Low attribute score	Observer override : not encountered. Encounterability reduced to low.
262	Balaenoptera edeni	Bryde's Whale	0	N	0	0	2.86	1.07	3.05	Y	Med	Low attribute score	Observer override : not encountered. Encounterability reduced to low.
268	Balaenoptera physalus	Fin Whale	0	N	0	0	2.86	1.07	3.05	Y	Med	Low attribute score	Observer override : not encountered. Encounterability reduced to low.
269	Berardius arnuxii	Arnoux's Beaked Whale	0	N	0	0	2.86	1.07	3.05	Y	Med	Low attribute score	Observer override : not encountered. Encounterability reduced to low.

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968	Kogia breviceps	Pygmy Sperm Whale	0	N	0	0	2.86	1.07	3.05	Y	Med	Low attribute score	Observer override : not encountered. Encounterability reduced to low.
1036	Physeter catodon	Sperm Whale	0	N	0	0	2.86	1.07	3.05	Y	Med	Low attribute score	Observer override : not encountered. Encounterability reduced to low.
1030	Tasmacetus shepherdi	Tasman Beaked Whale	0	N	1	0	2.86	1.07	3.05	Y	Med	Low attribute score	Observer override : not encountered. Encounterability reduced to low.
813	Dugong dugon	Dugong	0	N	1	0	2.71	1.22	2.98	Y	Med	Low attribute score	Observer override : not encountered. Encounterability reduced to low.
295	Hydrurga leptonyx	Leopard seal	0	N	0	0	2.71	1.22	2.98	Y	Med	Low attribute score	Observer override : interactions unlikely to occur (Stewardson and Knuckey, BRS). Selectivity reduced to low.
969	Kogia simus	Dwarf Sperm Whale	0	N	0	0	2.71	1.22	2.98	Y	Med	Low attribute score	Observer override : not encountered. Encounterability reduced to low.
970	Lagenodelphis hosei	Fraser's Dolphin	0	N	1	0	2.71	1.22	2.98	Y	Med	Low attribute score	Observer override : not encountered. Encounterability reduced to low.

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832	Lagenorhynchus cruciger	Hourglass dolphin	0	N	1	1	2.71	1.22	2.98	Y	Med	Low attribute score	Observer override : not encountered. Encounterability reduced to low.
61	Lissodelphis peronii	Southern Right Whale Dolphin	0	N	1	0	2.71	1.22	2.98	Y	Med	Low attribute score	Observer override : not encountered. Encounterability reduced to low.
984	Megaptera novaeangliae	Humpback Whale	0	N	0	0	2.71	1.22	2.98	Y	Med	Low attribute score	Observer override : not encountered. Encounterability reduced to low.
993	Mirounga leonina	Elephant seal	0	N	0	0	2.71	1.22	2.98	Y	Med	Low attribute score	Observer override : interactions unlikely to occur (Stewardson and Knuckey, 2005). Selectivity reduced to low.
1076	Sousa chinensis	Indo-Pacific Humpback Dolphin	0	N	0	0	2.71	1.22	2.98	Y	Med	Low attribute score	Observer override : not encountered. Encounterability reduced to low.
1081	Stenella coeruleoalba	Striped Dolphin	0	N	0	0	2.71	1.22	2.98	Y	Med	Low attribute score	Observer override : not encountered. Encounterability reduced to low.
1083	Steno bredanensis	Rough-toothed Dolphin	0	N	0	0	2.71	1.22	2.98	Y	Med	Low attribute score	Observer override : not encountered. Encounterability reduced to low.

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289	Caperea marginata	Pygmy Right Whale	0	N	1	0	2.71	1.15	2.95	Y	Med	Low attribute score	Observer override : not encountered. Encounterability reduced to low.
216	Arctocephalus forsteri	New Zealand Fur-seal	0	N	0	0	2.43	1.67	2.95	N	Med	Low attribute score	
1000	Neophoca cinerea	Australian Sea-lion	0	N	0	0	2.43	1.67	2.95	N	Med	Low attribute score	
896	Eubalaena australis	Southern Right Whale	0	N	0	0	2.71	1.07	2.92	Y	Med	Low attribute score	Observer override : not encountered. Encounterability reduced to low.
1007	Peponocephala electra	Melon-headed Whale	0	N	1	0	2.57	1.22	2.85	Y	Med	Low attribute score	Observer override : not encountered. Encounterability reduced to low.
1080	Stenella attenuata	Spotted Dolphin	0	N	1	0	2.57	1.22	2.85	Y	Med	Low attribute score	Observer override : not encountered. Encounterability reduced to low.
263	Arctocephalus tropicalis	Subantarctic fur seal	0	N	0	0	2.29	1.67	2.83	N	Med	Low attribute score	

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265	Balaenoptera musculus	Blue Whale	0	N	0	0	2.57	1.07	2.79	Y	Med	Low attribute score	Observer override : not encountered. Encounterability reduced to low.
1082	Stenella longirostris	Long-snouted Spinner Dolphin	0	N	0	0	2.43	1.22	2.72	Y	Med	Low attribute score	Observer override : not encountered. Encounterability reduced to low.
612	Delphinus delphis	Common Dolphin	0	N	0	0	2.29	1.22	2.59	Y	Low		Observer override : not encountered. Encounterability reduced to low.
971	Lagenorhynchus obscurus	Dusky Dolphin	0	N	0	0	2.29	1.22	2.59	Y	Low		Observer override : not encountered. Encounterability reduced to low.
Marine reptile													
254	Astrotia stokesii	Stokes' seasnake	0	N	3	0	2.71	1.22	2.98	Y	Med	Low attribute score	Observer override : not encountered. Encounterability decreased to low.
1423	Hydrophis ornatus	seasnake	0	N	3	0	2.71	1.22	2.98	Y	Med	Low attribute score	Observer override : not encountered. Encounterability decreased to low.
1005	Pelamis platurus	yellow-bellied seasnake	0	N	3	0	2.71	1.22	2.98	Y	Med	Low attribute score	Observer override : not encountered. Encounterability decreased to low.

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613	Dermochelys coriacea	Leathery turtle	0	N	1	0	2.57	1.22	2.85	Y	Med	Low attribute score	Observer override : not encountered. Encounterability decreased to low.
324	Caretta caretta	Loggerhead	0	N	1	0	2.43	1.22	2.72	Y	Med	Low attribute score	Observer override : not encountered. Encounterability decreased to low.
541	Chelonia mydas	Green turtle	0	N	1	0	2.43	1.22	2.72	Y	Med	Low attribute score	Observer override : not encountered. Encounterability decreased to low.
957	Hydrophis elegans	Elegant seasnake	0	N	2	0	2.14	1.22	2.47	Y	Low		Observer override : not encountered. Encounterability decreased to low.
Teleost													
1667	Hippocampus kuda	Spotted Seahorse, Yellow Seahorse	0	N	0	0	1.57	2.33	2.81	N	Med	Spatial uncertainty	
1548	Heraldia sp. 1 [in Kuiter, 2000]	Western upsidedown pipefish	0	N	0	0	1.43	2.33	2.74	N	Med	Spatial uncertainty	
1666	Hippocampus kelloggi	Kellogg's Seahorse	0	N	0	0	1.43	2.33	2.74	N	Med	Spatial uncertainty	
950	Hippocampus minotaur	Bullneck Seahorse	0	N	0	0	1.43	2.33	2.74	N	Med	Low overlap	

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1699	Idiotropiscis australe	Southern Pygmy Pipehorse	0	N	0	1	1.43	2.33	2.74	Y	Med	Spatial uncertainty	Expert override : SA & WA species.(Kuiter 2000) Availability reduced to medium.
1074	Solenostomus cyanopterus	Blue-finned Ghost Pipefish, Robust Ghost	0	N	3	0	2.14	1.67	2.71	N	Med	Widely distributed	
1075	Solenostomus paradoxus	Harlequin Ghost Pipefish, Ornate Ghost Pipefish	0	N	3	0	2.14	1.44	2.58	N	Low		
1010	Phycodurus eques	Leafy Seadragon	0	N	0	0	1.57	1.67	2.29	N	Low		
1011	Phyllopteryx taeniolatus	Weedy Seadragon, Common Seadragon	0	N	0	0	1.57	1.67	2.29	N	Low		
114	Acentronura breviperula	Hairy Pygmy Pipehorse	0	N	0	0	1.43	1.67	2.20	N	Low		
914	Filicampus tigris	Tiger Pipefish	0	N	0	0	1.43	1.67	2.20	N	Low		
938	Halicampus grayi	Mud Pipefish, Gray's Pipefish	0	N	0	0	1.43	1.67	2.20	N	Low		
1592	Halicampus macrorhynchus	[a pipefish]	0	N	0	0	1.43	1.67	2.20	N	Low		
943	Hippichthys cyanospilos	Blue-speckled Pipefish, Blue-spotted Pipefish	0	N	0	0	1.43	1.67	2.20	N	Low		
944	Hippichthys heptagonus	Madura Pipefish	0	N	0	0	1.43	1.67	2.20	N	Low		
945	Hippichthys penicillus	Beady Pipefish, Steep-nosed Pipefish	0	N	0	0	1.43	1.67	2.20	N	Low		

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1664	Hippocampus abdominalis	Big-bellied / southern potbellied seahorse	0	N	0	0	1.43	1.67	2.20	N	Low		
946	Hippocampus bleekeri	pot bellied seahorse	0	N	0	0	1.43	1.67	2.20	N	Low		
1602	Hippocampus tristis	[a pipefish]	0	N	0	0	1.43	1.67	2.20	N	Low		
952	Hippocampus whitei	white's seahorse	0	N	0	0	1.43	1.67	2.20	N	Low		
960	Hypselognathus horridus	Shaggy Pipefish, Prickly Pipefish	0	N	0	0	1.43	1.67	2.20	N	Low		
961	Hypselognathus rostratus	Knife-snouted Pipefish	0	N	0	0	1.43	1.67	2.20	N	Low		
966	Kaupus costatus	Deep-bodied Pipefish	0	N	0	0	1.43	1.67	2.20	N	Low		
967	Kimblaeus bassensis	Trawl Pipefish, Kimbla Pipefish	0	N	0	0	1.43	1.67	2.20	N	Low		
978	Leptoichthys fistularius	Brushtail Pipefish	0	N	0	0	1.43	1.67	2.20	N	Low		
979	Lissocampus caudalis	Australian Smooth Pipefish, Smooth Pipefish	0	N	0	0	1.43	1.67	2.20	N	Low		
980	Lissocampus runa	Javelin Pipefish	0	N	0	0	1.43	1.67	2.20	N	Low		
992	Micrognathus andersonii	Anderson's Pipefish, Shortnose Pipefish	0	N	0	0	1.43	1.67	2.20	N	Low		
994	Mitotichthys mollisoni	Mollison's Pipefish	0	N	0	0	1.43	1.67	2.20	N	Low		
995	Mitotichthys semistriatus	Half-banded Pipefish	0	N	0	0	1.43	1.67	2.20	N	Low		

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996	Mitotichthys tuckeri	Tucker's Pipefish	0	N	0	0	1.43	1.67	2.20	N	Low		
1001	Notiocampus ruber	Red Pipefish	0	N	0	1	1.43	1.67	2.20	N	Low		
1061	Pugnaso curtirostris	Pug-nosed Pipefish	0	N	0	0	1.43	1.67	2.20	N	Low		
1070	Solegnathus dunckeri	Duncker's Pipehorse	0	N	0	0	1.43	1.67	2.20	N	Low		
1072	Solegnathus robustus	Robust Spiny Pipehorse, Robust Pipehorse	0	N	0	0	1.43	1.67	2.20	N	Low		
1071	Solegnathus sp. 1 [in Kuiter, 2000]	Pipehorse	0	N	0	0	1.43	1.67	2.20	N	Low		
1073	Solegnathus spinosissimus	spiny pipehorse	0	N	0	0	1.43	1.67	2.20	N	Low		Additional information on distribution: known to be caught in the fishery but susceptibility is medium as this fishery only covers a small proportion of spiny pipehorse range in the SESSF
1026	Stigmatopora argus	Spotted Pipefish	0	N	0	0	1.43	1.67	2.20	N	Low		
1027	Stigmatopora nigra	Wide-bodied Pipefish, Black Pipefish	0	N	0	0	1.43	1.67	2.20	N	Low		
1028	Stipecampus cristatus	Ring-backed Pipefish	0	N	0	0	1.43	1.67	2.20	N	Low		
1029	Syngnathoides biaculeatus	Double-ended Pipehorse, Alligator Pipefish	0	N	0	0	1.43	1.67	2.20	Y	Low		Expert override : tropical species (Kuiter 2000). Availability reduced to low

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1089	Trachyrhamphus bicoarctatus	Bend Stick Pipefish, Short-tailed Pipefish	0	N	0	0	1.43	1.67	2.20	N	Low		
1092	Urocampus carinirostris	Hairy Pipefish	0	N	0	0	1.43	1.67	2.20	N	Low		
1093	Vanacampus margaritifer	Mother-of-pearl Pipefish	0	N	0	0	1.43	1.67	2.20	N	Low		
1095	Vanacampus poecilolaemus	Australian Long-snout Pipefish, Long-snouted Pipefish	0	N	0	0	1.43	1.67	2.20	N	Low		
1096	Vanacampus vercoi	Verco's Pipefish	0	N	0	0	1.43	1.67	2.20	N	Low		
949	Hippocampus taeniopterus	Spotted Seahorse, Yellow Seahorse	0	N	0	0	1.57	1.44	2.13	N	Low		
983	Maroubra perserrata	Sawtooth Pipefish	0	N	0	0	1.57	1.44	2.13	N	Low		
1094	Vanacampus phillipi	Port Phillip Pipefish	0	N	0	0	1.29	1.67	2.10	N	Low		
105	Acentronura australe	Southern Pygmy Pipehorse	0	N	0	0	1.43	1.44	2.03	N	Low		
287	Campichthys galei	Gale's Pipefish	0	N	0	0	1.43	1.44	2.03	N	Low		fs
288	Campichthys tryoni	Tryon's Pipefish	0	N	0	0	1.43	1.44	2.03	N	Low		
578	Corythoichthys ocellatus	Orange-spotted Pipefish, Ocellated Pipefish	0	N	0	0	1.43	1.44	2.03	N	Low		
904	Festucalex cinctus	Girdled Pipefish	0	N	0	0	1.43	1.44	2.03	N	Low		
1591	Halicampus boothae	[a pipefish]	0	N	0	0	1.43	1.44	2.03	N	Low		
942	Heraldia nocturna	Upside-down Pipefish	0	N	0	0	1.43	1.44	2.03	N	Low		

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947	Hippocampus breviceps	Short-head Seahorse, Short-snouted Seaho	0	N	0	0	1.43	1.44	2.03	N	Low		
951	Hippocampus planifrons	Flat-face Seahorse	0	N	0	0	1.43	1.44	2.03	N	Low		
953	Histiogamphelus briggsii	Briggs' Crested Pipefish, Briggs' Pipefish	0	N	0	0	1.43	1.44	2.03	N	Low		
954	Histiogamphelus cristatus	Rhino Pipefish, Macleay's Crested Pipefish	0	N	0	0	1.43	1.44	2.03	N	Low		
563	Corythoichthys amplexus	Fijian Banded Pipefish, Brown-banded Pipefish	0	N	0	0	1.43	1.30	1.93	N	Low		
580	Cosmocampus howensis	Lord Howe Pipefish	0	N	0	0	1.43	1.22	1.88	N	Low		

Summary of Habitat PSA results

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

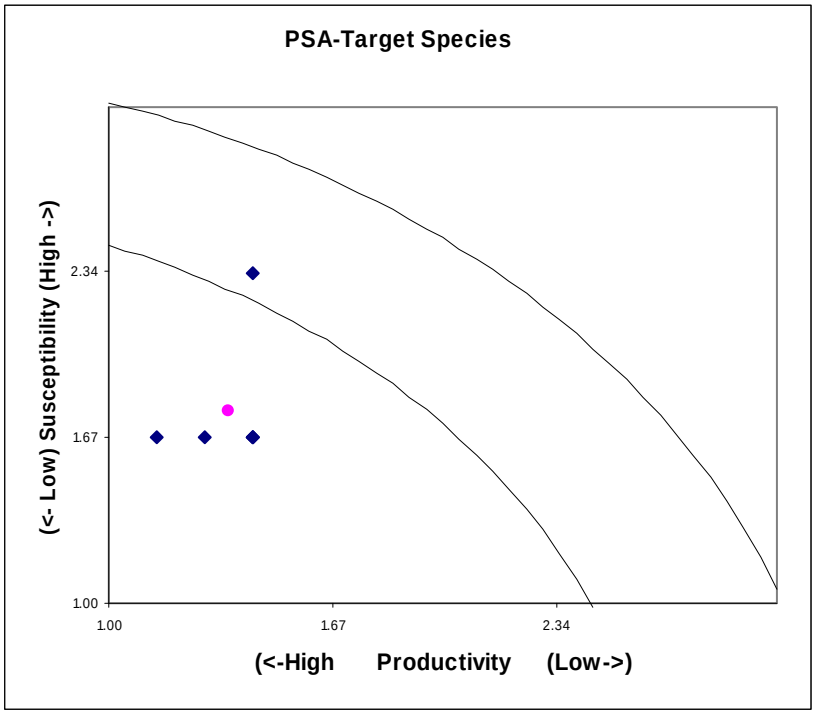
Record #	ERA habitat #	Sub-biome	Feature	Habitat Name	SGF Score	Productivity score (Average)	Susceptability score (Multiplicative)	Overall Risk Value (P&Sm)	Overall Risk Ranking (2D multiplicative)	Risk Ranking Override	Rationale for ranking override
1274	123	outer shelf	shelf	gravel, wave rippled, large sponges	321	2.50	1.98	3.19	High		
1817	171	outer shelf	shelf-break	fine sediments, unrippled, octocorals	105	2.50	1.98	3.19	High		
1853	174	outer shelf	shelf-break	mud, unrippled, sedentary	007	2.50	1.98	3.19	High		
1757	166	outer shelf	shelf-break	Bryozoan based commmunities	xx6	2.50	1.80	3.08	Med		
0312	029	outer shelf	shelf	coarse sediments, irregular, large sponges	231	2.50	1.89	3.13	Med		
0202	019	outer shelf	shelf	coarse sediments, subcrop, large sponges	251	2.50	1.71	3.03	Med		
0324	030	outer shelf	shelf	coarse sediments, unrippled, mixed faunal community	203	2.50	1.89	3.13	Med		
0214	020	outer shelf	shelf	cobble, outcrop, crinoids	464	2.50	1.71	3.03	Med	Low	not accessible
0336	032	outer shelf	shelf	cobble, subcrop, crinoids	454	2.50	1.65	3.00	Med		
0300	028	outer shelf	shelf	cobble, unrippled, large sponges	401	2.50	1.89	3.13	Med		
1047	105	outer shelf	shelf	fine sediments, irregular, large sponges	131	2.50	1.89	3.13	Med		
0177	017	outer shelf	shelf	fine sediments, subcrop, large sponges	151	2.50	1.71	3.03	Med		
1085	108	outer shelf	shelf	fine sediments, subcrop, mixed faunal community	153	2.50	1.59	2.96	Med		
1123	111	outer shelf	shelf	fine sediments, unrippled, large sponges	101	2.50	1.89	3.13	Med		
1186	116	outer shelf	shelf	fine sediments, wave rippled, large sponges	121	2.50	1.89	3.13	Med		
1211	118	outer shelf	shelf	fine sediments, wave rippled, sedentary	127	2.50	1.89	3.13	Med		
0985	100	outer shelf	shelf	mud, unrippled, sedentary	007	2.50	1.89	3.13	Med		
0238	023	outer shelf	shelf	Sedimentary rock, outcrop, large sponges	671	2.50	1.59	2.96	Med	Low	not accessible
1865	175	outer shelf	shelf-break	Sedimentary rock, subcrop, crinoids	654	2.50	1.59	2.96	Med		
1312	126	outer shelf	shelf	Sedimentary rock, subcrop, large sponges	651	2.50	1.59	2.96	Med		
0226	022	outer shelf	shelf	Sedimentary rock, subcrop, mixed faunal community	653	2.50	1.59	2.96	Med		
0116	011	inner shelf	shelf	coarse sediments, wave rippled, large sponges	221	2.00	1.89	2.75	Med		
0128	012	inner shelf	shelf	fine sediments, unrippled, large sponges	101	2.00	1.89	2.75	Med		
0164	016	inner shelf	shelf	fine sediments, unrippled, mixed faunal community	103	2.00	1.89	2.75	Med		

Record #	ERA habitat #	Sub-biome	Feature	Habitat Name	SGF Score	Productivity score (Average)	Susceptability score (Multiplicative)	Overall Risk Value (P&Sm)	Overall Risk Ranking (2D multiplicative)	Risk Ranking Override	Rationale for ranking override
0876	091	inner shelf	shelf	fine sediments, irregular, large sponges	131	2.00	1.89	2.75	Med		
0189	018	outer shelf	shelf	Sedimentary rock, outcrop, encrustors	696	1.50	1.47	2.10	Low		
0250	024	outer shelf	shelf	gravel, irregular, encrustors	336	1.50	1.80	2.34	Low		
0263	025	outer shelf	shelf	coarse sediments, wave rippled, no fauna	220	1.50	1.71	2.28	Low		
0275	026	outer shelf	shelf	coarse sediments, unrippled, encrustors	206	1.50	1.71	2.28	Low		
0288	027	outer shelf	shelf	coarse sediments, current rippled, no fauna	210	1.50	1.71	2.28	Low		
0672	065	outer shelf	canyon	Sedimentary rock, outcrop, small sponges	672	1.50	1.65	2.23	Low		
0999	101	outer shelf	shelf	coarse sediments, subcrop, small sponges	252	1.50	1.53	2.15	Low		
1011	102	outer shelf	shelf	coarse sediments, wave rippled, encrustors	226	1.50	1.71	2.28	Low		
1023	103	outer shelf	shelf	coarse sediments, wave rippled, small sponges	222	1.50	1.80	2.34	Low		
1035	104	outer shelf	shelf	fine sediments, current rippled, bioturbators	119	1.50	1.71	2.28	Low		
1060	106	outer shelf	shelf	fine sediments, irregular, no fauna	130	1.50	1.71	2.28	Low		
1073	107	outer shelf	shelf	fine sediments, irregular, small sponges	132	1.50	1.80	2.34	Low		
1098	109	outer shelf	shelf	fine sediments, subcrop, small sponges	152	1.50	1.65	2.23	Low		
1111	110	outer shelf	shelf	fine sediments, unrippled, bioturbators	109	1.50	1.71	2.28	Low		
1136	112	outer shelf	shelf	fine sediments, unrippled, no fauna	100	1.50	1.71	2.28	Low		
1149	113	outer shelf	shelf	fine sediments, unrippled, small sponges	102	1.50	1.80	2.34	Low		
1162	114	outer shelf	shelf	fine sediments, wave rippled, bioturbators	129	1.50	1.71	2.28	Low		
1174	115	outer shelf	shelf	fine sediments, wave rippled, encrustors	126	1.50	1.71	2.28	Low		
1199	117	outer shelf	shelf	fine sediments, wave rippled, no fauna	120	1.50	1.71	2.28	Low		
1223	119	outer shelf	shelf	fine sediments, wave rippled, small sponges	122	1.50	1.80	2.34	Low		
1236	120	outer shelf	shelf	gravel, current rippled, bioturbators	319	1.50	1.80	2.34	Low		
1249	121	outer shelf	shelf	gravel, wave rippled, bioturbators	329	1.50	1.80	2.34	Low		
1261	122	outer shelf	shelf	gravel, wave rippled, encrustors	326	1.50	1.80	2.34	Low		
1287	124	outer shelf	shelf	gravel, wave rippled, no fauna	320	1.50	1.80	2.34	Low		
1300	125	outer shelf	shelf	mud, subcrop, small sponges	052	1.50	1.65	2.23	Low		
1325	127	outer shelf	shelf	Sedimentary rock, subcrop, small sponges	652	1.50	1.53	2.15	Low		
1769	167	outer shelf	shelf-break	fine sediments, irregular, bioturbators	139	1.50	1.80	2.34	Low		
1781	168	outer shelf	shelf-break	fine sediments, irregular, small sponges	132	1.50	1.89	2.41	Low		

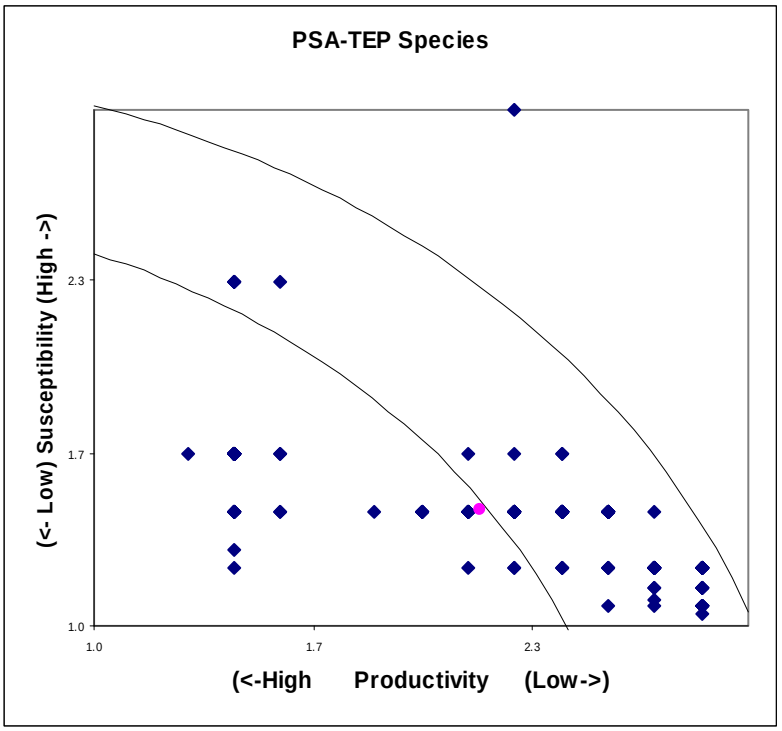
Record #	ERA habitat #	Sub-biome	Feature	Habitat Name	SGF Score	Productivity score (Average)	Susceptability score (Multiplicative)	Overall Risk Value (P&Sm)	Overall Risk Ranking (2D multiplicative)	Risk Ranking Override	Rationale for ranking override
1793	169	outer shelf	shelf-break	fine sediments, unrippled, bioturbators	109	1.50	1.80	2.34	Low		
1805	170	outer shelf	shelf-break	fine sediments, unrippled, no fauna	100	1.50	1.80	2.34	Low		
1829	172	outer shelf	shelf-break	Igneous rock, high outcrop, no fauna	590	1.50	1.41	2.06	Low		
1841	173	outer shelf	shelf-break	mud, unrippled, no fauna	000	1.50	1.80	2.34	Low		
1877	176	outer shelf	shelf-break	Sedimentary rock, subcrop, small sponges	652	1.50	1.53	2.15	Low		
0007	001	inner shelf	shelf	gravel, current rippled, mixed faunal community	313	1.50	1.98	2.48	Low	vulnerable to gear	
0019	002	inner shelf	shelf	Sedimentary rock, outcrop, large sponges	691	1.50	1.53	2.15	Low	vulnerable to gear	
0031	003	inner shelf	shelf	Sedimentary rock, outcrop, mixed faunal community	693	2.00	1.53	2.52	Low	vulnerable to gear	
0043	004	inner shelf	shelf	Sedimentary rock, outcrop, large sponges	671	2.00	1.53	2.52	Low	vulnerable to gear	
0055	005	inner shelf	shelf	cobble, debris flow, large sponges	441	1.50	1.65	2.23	Low	vulnerable to gear	
0067	006	inner shelf	shelf	coarse sediments, subcrop, large sponges	251	2.00	1.65	2.59	Low	vulnerable to gear	
0079	007	inner shelf	shelf	gravel, debris flow, mixed faunal community	343	1.50	1.65	2.23	Low	vulnerable to gear	
0091	009	inner shelf	shelf	coarse sediments, wave rippled, sedentary	227	1.50	1.89	2.41	Low	vulnerable to gear	
0103	010	inner shelf	shelf	coarse sediments, current rippled, no fauna	210	1.50	1.71	2.28	Low		
0140	013	inner shelf	shelf	coarse sediments, unrippled, large sponges	201	1.50	1.89	2.41	Low	vulnerable to gear	
0152	014	inner shelf	shelf	fine sediments, wave rippled, large sponges	111	1.50	1.89	2.41	Low	vulnerable to gear	
0852	089	inner shelf	shelf	coarse sediments, irregular, encrustors	236	1.50	1.71	2.28	Low		
0864	090	inner shelf	shelf	coarse sediments, current rippled, bioturbators	219	1.50	1.71	2.28	Low		
0888	092	inner shelf	shelf	fine sediments, irregular, small sponges	132	1.50	1.80	2.34	Low		
0900	093	inner shelf	shelf	fine sediments, unrippled, bioturbators	109	1.50	1.71	2.28	Low		
0912	094	inner shelf	shelf	fine sediments, unrippled, small sponges	102	1.50	1.80	2.34	Low		
0924	095	inner shelf	shelf	fine sediments, wave rippled, no fauna	120	1.50	1.71	2.28	Low		
0937	096	inner shelf	shelf	fine sediments, wave rippled, small sponges	122	1.50	1.80	2.34	Low		
0949	097	inner shelf	shelf	gravel, wave rippled, bioturbators	329	1.00	1.80	2.06	Low		
0961	098	inner shelf	shelf	gravel, wave rippled, no fauna	320	1.00	1.80	2.06	Low		
0973	099	inner shelf	shelf	Igneous rock, high outcrop, large sponges	591	2.00	1.47	2.48	Low	vulnerable to gear	
1998	191	inner shelf	shelf	coarse sediments, wave rippled, small sponges	222	1.50	1.80	2.34	Low		
2074	199	inner shelf	shelf	cobble, wave rippled, low/ encrusting mixed fauna	426	1.50	1.80	2.34	Low		
2087	200	inner shelf	shelf	coarse sediments, wave rippled, encrustors	226	1.50	1.80	2.34	Low		

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

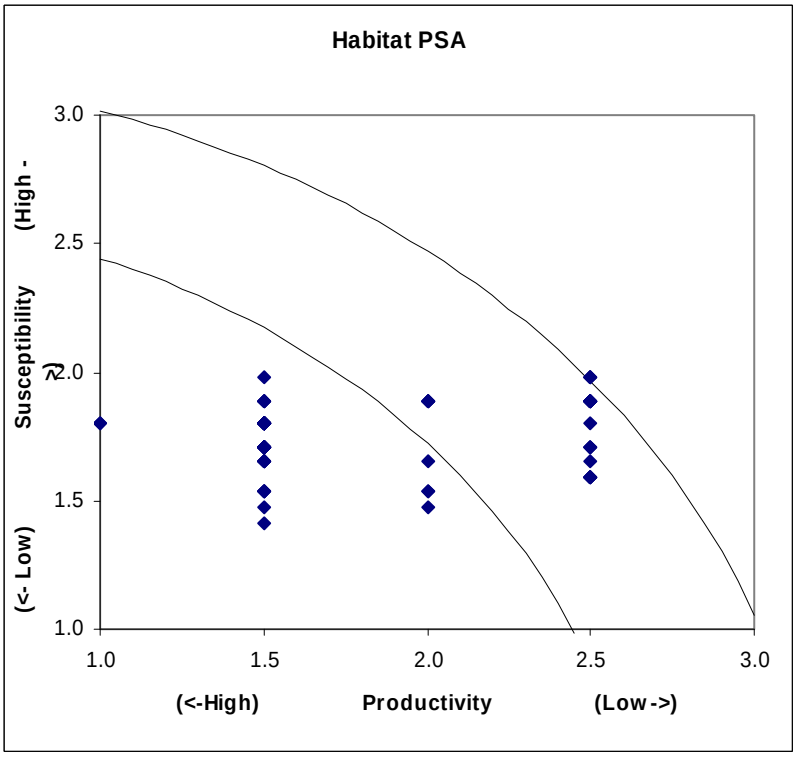
The average productivity and susceptibility scores for each unit of analysis (e.g. for each species) are then used to place the individual units of analysis on 2D plots (as below). The relative position of the units on the plot will determine relative risk at the unit level as per PSA plot below. The 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), 1/3rd will be between 3.18 and 2.64 (medium risk), and 1/3rd will be lower than 2.64 (low risk).



PSA plot for target species



PSA plot for TEP species



PSA plot for habitats

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)**.

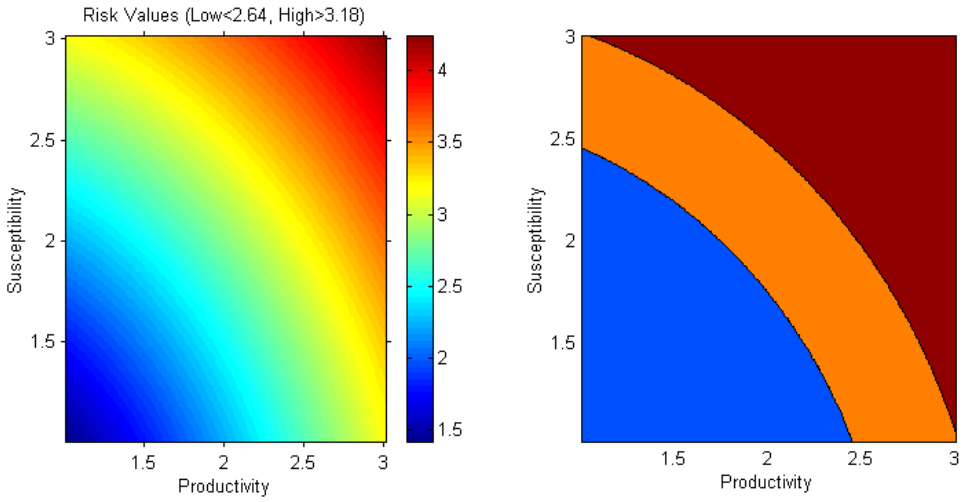


Figure 17. Overall risk values in the PSA plot. Left panel. Colour map of the distribution of the euclidean overall risk values. Right panel. The PSA plot contoured to show the low risk (blue), medium risk (orange) and high risk (red) values.

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 to an individual unit will depend on the level of impact as well its productivity and susceptibility.

2.4.5 Uncertainty analysis ranking of overall risk (Step 5)

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

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

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

Availability of information

The ability to score each species based on information on each attribute varied between the attributes (as per summary below). With regard to the productivity attributes, trophic level was missing in 46% of species (this was almost exclusively marine birds), and so the most conservative score was used, while information on maximum size could be found or calculated for all units. The current method of scoring the susceptibility attributes provides a value for each attribute for each species – some of these are based on good information, whereas others are merely sensible default values.

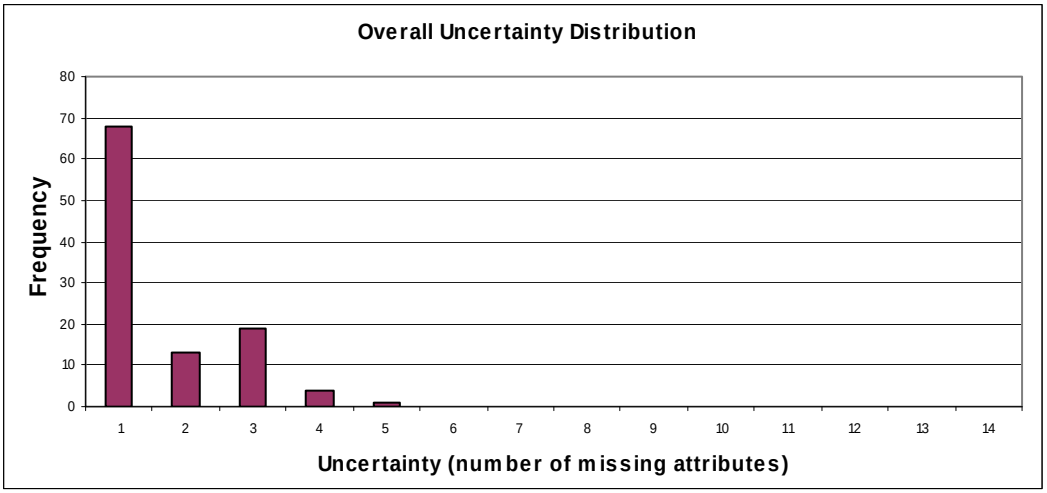
Summary of the success of obtaining information on the set of productivity and susceptibility attributes for the species. Where information on an attribute was missing the highest score was used in the PSA.

Results from PSA workbook ranking worksheet (species only).

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	182	171	195	204	204	204	109
n species scores with attribute unknown, (conservative score used)	22	33	9	0	0	0	95
% unknown information	11	17	5	0	0	0	46
Susceptibility Attributes	Availability	Encounterability		Selectivity	PCM		
		Bathymetry overlap	Habitat				
Total species scores for attribute	204	202	196	204	204		
n species scores with attribute unknown, (conservative score used)	0	2	8	0	0		
% unknown information	0	1	4	0	0		

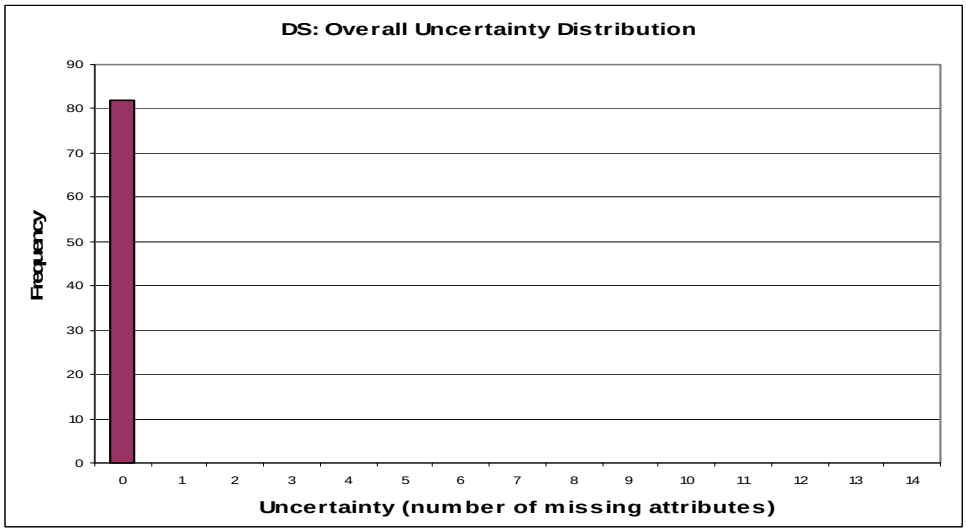
Each species considered in the analysis had information for an average of 6.21, (89%) productivity attributes and 4 (100%) susceptibility attributes. This meant that, on average, conservative scores were used for less than 7% of the attributes for each species. Species had missing information for between 0 and 4 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. Only attributes that could be ranked were utilized and therefore there are no missing attributes. It is important to note that habitat attributes relating to fauna specify taxa specific generalizations not species specific metrics.



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

Correlation between attributes

In situations where attributes are strongly correlated only one of them should be included in the final PSA (Stobutzki *et al*., 2001).

Species component: Few of the attributes selected for productivity and susceptibility were strongly correlated (as per correlation matrix below for Productivity and susceptibility). The strongest productivity attribute correlation was between maximum

size and size at maturity, while the strongest susceptibility correlation was between availability and selectivity (a negative correlation). This correlation analysis suggests that each attribute was "measuring" a different aspect of the species' characteristics and all attributes were suitable for inclusion in the PSA.

	Age at maturity	Max age	Fecundity	Max size	Min size at maturity	Reproductive strategy	Trophic level
Age at maturity	X						
Max age	0.66	X					
Fecundity	0.53	0.75	X				
Max size	0.30	0.47	0.42	X			
Min size at maturity	0.40	0.64	0.59	0.86	X		
Reproductive strategy	0.50	0.75	0.95	0.44	0.62	X	
Trophic level	0.49	0.81	0.71	0.37	0.57	0.76	X

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.

	Availability	Encounterability	Selectivity	Post-capture mortality
Availability	X			
Encounterability	0.01	X		
Selectivity	-0.79	0.18	X	
Post-capture mortality	0.08	0.07	0.11	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.

Habitat Component: The attributes selected for productivity and susceptibility were not correlated (as per correlation matrix below for productivity and susceptibility). There was a negative correlation between the productivity attributes Regeneration of Fauna and Natural disturbance. The susceptibility correlation could not be calculated between the Availability and any other aspect, because there was no variation in the Availability score. There was also a negative correlation between the attributes used to calculate Encounterability and Selectivity. All attributes were included in the PSA.

Productivity Correlation Matrix	Regeneration of fauna	Natural disturbance
Regeneration of fauna	X	
Natural disturbance	-0.03	X

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.

Susceptibility Correlation Matrix	Availability score	Encounterability score (average)	Selectivity score (average)
Availability score	X		
Encounterability score (average)	-	X	
Selectivity score (average)	-	-0.35	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.

Productivity and susceptibility risk values for Species

The average productivity score for all species was 2.16 ± 0.11 (mean ± SD of scores calculated using n-1 attributes) and the mean susceptibility score was 1.46 (as per summary of average productivity and susceptibility scores as below). Individual scores are shown in section 2.4.2. The small variation in the average of the boot-strapped values (using n-1 attributes), indicates the productivity and susceptibility scores are robust to elimination of a single attribute. Information for a single attribute does not have a disproportionately large effect on the productivity and susceptibility scores. Information was missing for an average of 0.88 attributes out of 12 possible for each species.

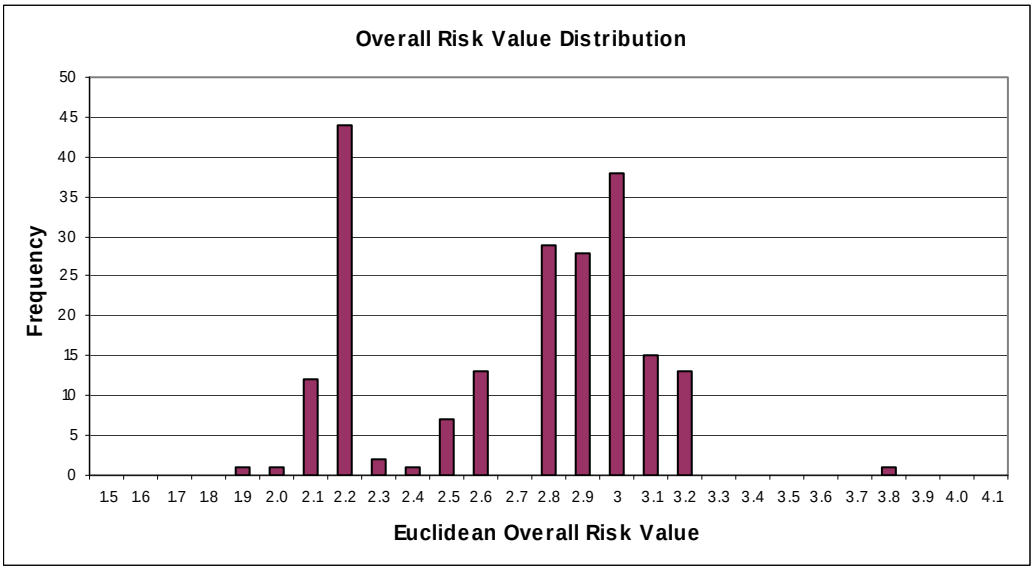
Productivity and susceptibility risk values for habitat units.

The average productivity score for all 82 habitats was 1.79 ± 0.45 (mean ± SD of scores calculated using n-1 attributes) and the mean susceptibility score was 1.75 ± 0.13 (as per summary of average productivity and susceptibility scores as below). Individual scores are shown in section 2.4.3 Summary of PSA results. The large variation in the average of the boot-strapped values (using n-1 attributes), indicates the productivity and susceptibility scores are sensitive to elimination of a single attribute. Information for a single attribute has a disproportionately large effect, particularly on the productivity scores.

Overall Risk Values for Species

The overall risk values (Euclidean distance on the PSA plot) could fall between 1 and 4.24 (scores of 1&1 and 3&3 for both productivity and susceptibility respectively). The mean observed overall risk score was 2.65, with a range of 1.88 – 3.77**.**

The actual values for each species are shown in section 2.4.2: Summary of PSA results. A total of 1 species, (0.5%)] was classed as high risk, 123 (60%) were in the medium risk category, and 81 (40%) in the low risk category**.**

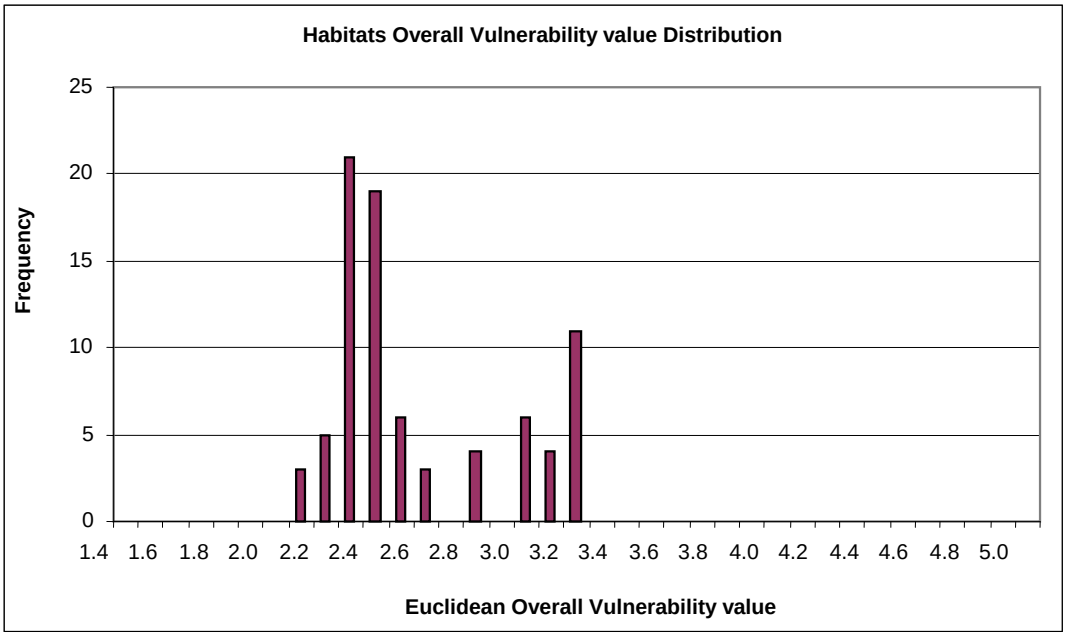


Frequency distribution of the overall risk values generated for the 205 species in Danish seine PSA.

Overall Risk Values for Habitats

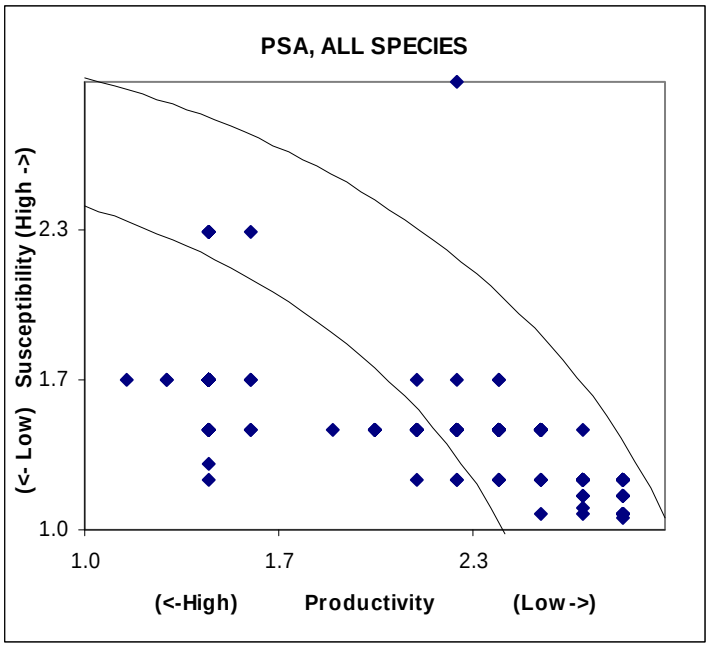
The overall risk values (Euclidean distance on the PSA plot) could fall between 1 and 4.24 (scores of 1&1 and 3&3 for both productivity and susceptibility respectively). The mean observed overall risk score was 3.01, with a range of 2.18- 3.97**.**

The actual values for each species are shown in section 2.4.3 Summary of PSA results. A total of 3 units, (4%) were classed as high risk, 20 units, (24%) were in the medium risk category, and 59 (72%) as low risk**.**



Frequency distribution of the overall risk values generated for the 82 habitat types in the Danish Seine PSA.

The distribution of the overall risk values of all (target and TEP) species is shown on the PSA plot below. The species are distributed in the lower parts of the plot, indicating that few of these species are potentially impacted severely in the Danish seine fishery.



PSA plot for all target and TEP species in the Danish seine fishery. Species in the upper right of the plot are at highest risk.

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

All attributes are treated equally in the PSA, but information on some attributes may be of low quality.

2.4.6 Evaluation of the PSA results (Step 6)

Species Components:

The PSA analysis of the Danish seine component of the South East Trawl fishery was presented to a SETMAC meeting in Melbourne on 22 November 2005. The PSA methodology has since been reviewed and revised. The following results reflect the revised methodology (as at 8 May 2006).

Overall

The byproduct/discard species component was screened out at Level 1, so these species are not considered in the PSA analysis. A total of six target species and 199 TEP species were considered. For most species there was little missing data. The average number of missing attributes was 0.88 out of a possible 12. Of the 204 species assessed at Level 2, expert over rides were used on 133 species. Of the 1 species assessed to be at high risk, 0 had more than 3 missing attributes.

Summary of average productivity, susceptibility and overall risk scores

Component	Measure	
All species	Number of species	204
	Average of productivity total	2.16
	Average of susceptibility total	1.46
	Average of overall risk value	2.65
	Average number of missing attributes	0.88
Target species	Number of species	6
	Average of productivity total	1.36
	Average of susceptibility total	1.78
	Average of overall risk value	2.24
	Average number of missing attributes	0.0
TEP species	Number of species	198
	Average of productivity total	2.18
	Average of susceptibility total	1.45
	Average of overall risk value	2.66
	Average number of missing attributes	0.91

PSA risk categories for each species component**.**

Risk category	High	Medium	Low	Total
Target species	0	1	5	6
TEP species	1	121	76	198
Total	1	122	81	204

PSA risk categories for each taxon.

Risk category	High	Medium	Low	Total
Chondrichthyan	0	3	0	3
Invertebrate	0	0	0	0
Marine bird	0	60	17	77
Marine mammal	1	46	2	49
Marine reptile	0	6	1	7
Teleost	0	7	61	68
Total	1	122	81	204

Target species

No target species are classified as high risk, 1 as medium risk, and 5 as low risk. Most flathead species and school whiting have a low risk score in this analysis because their productivity is high (therefore scores low) due to their low ages at maturity and maximum ages, and their susceptibility is medium because this fishery only targets a small proportion of their range in the SESSF. The exception is bluespot flathead which has a medium risk score because a higher proportion of its range in the SESSF is targeted by the Danish seine fishery.

TEP species

One TEP species was classified as high risk, 122 as medium risk and 81 as low risk. Vulnerabilities for TEP species were lowered considerably by use of observer information, provided in the ISMP report and at an ERAEF workshop held at Queenscliff in August 2005.

All seabirds were assigned a low selectivity, as observer data show that although many birds are observed, only a small percentage of these come into contact with the gear, and of these very few die. Of the 77 marine birds in the analysis, 60 were classified as potential medium risk and 17 as low.

Of the 49 marine mammals, one was classified as high risk, 46 as medium risk, and two as low risk. The Australian fur seal is at high potential risk due to its low productivity and high susceptibility. Observer reports show that seals are encountered in the fishery, and do come into contact with the gear. Overall it appears that the total Australian fur seal population has increased in recent years (Stewardson and Knuckey 2005).

Dolphins were assigned a low encounterability, as observers report that although dolphins are seen occasionally bow riding, they do not interact with the gear. Whales were also assigned a low encounterability, as they are not reported as seen by observers. Risk scores were reduced for the larger whale species, due to their being assigned a low selectivity because of their large size.

The three TEP shark species were classified as medium risk as observers report very few interactions as most of these species are inshore. Those that are caught are generally released alive.

For the seven species of marine reptiles, six were classified as medium risk, and one as low risk. Sea snakes were medium risk due to lack of data. Turtles were assigned a low encounterability as observers reported that they are not seen in this fishery – their risk category was medium.

Of the 68 syngnathids, none were classified as high risk, seven were classified as medium risk, and the rest were low risk as they had little or no overlap with the area of the fishery. The spiny pipehorse is a species that is known to be caught in this fishery (Bowles and Martin-Smith, 2003), but it scores as low risk because the Danish seine fishery only covers a small proportion of its range in the SESSF (2%).

Habitat Component:

The PSA analysis of the Danish seine component of the South East Trawl fishery was presented to a SETMAC meeting in Melbourne on 22 November 2005. The PSA methodology has since been reviewed and revised. The following results reflect the revised methodology (as at 8 May 2006).

Overall

A total of 82 habitat types were considered. Eleven attributes were scored for all habitats. Risk ranking categories have been adjusted following the PSA based on stakeholder feedback and expert opinion. The resulting PSA risk rankings (H, M or L), including overrides, are considered in the following discussion. Overrides are made according to the rationales discussed in the evaluation and are included in the Summary of PSA Results (2.4.3 Level 2 PSA) which lists all habitats assessed in the PSA. Overrides are a category adjustment only, the Productivity and Susceptibility scores could not be adjusted further to automatically over ride overall risk values.

Summary of average productivity, susceptibility and overall risk scores.

Component	Measure	
All habitats	Number of habitats	82
	Average of productivity total	1.79
	Average of susceptibility total	1.75
	Average of overall risk value (2D)	2.52
	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	3	0	0	3
Medium	0	4	18	0	0	22
Low	0	24	33	0	0	57
Total	Not in fishery	28	54	No effort	No effort	82

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	3	0	0	3
Medium	0	4	16	0	0	20
Low	0	24	35	0	0	59
Total	Not in fishery	28	54	No effort	No effort	82

Only habitats of the inner and outer shelf were scored. On the outer shelf, three scored at high risk, 16 at medium and 35 at low risk. No inner shelf habitats were classified as high risk; 4 were scored as medium risk, and 24 as low risk.

Discussion

The moderately broad operating depth range of the sub-fishery (inner and outer shelf), together with the detailed data available to define habitats, results in many different habitat types (82) being identified and assessed. However, 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 or geomorphology or dominant fauna, and therefore attracting similar PSA scores and the same risk rankings. For example, one general type will group together the habitats of a depth zone characterized by similar substratum and geomorphology but different large fauna (sponges, crinoids, octocorals or mixed communities).

The distribution of risk values for SET Danish Seine is 3 (4%) high, 20 (24%) medium and 59 (72%) low. High risk habitat types were identified only on the outer shelf; medium risk habitats also included types on the inner shelf.

Factors contributing to the low number of habitats with high risk scoring (3) included the relatively low overall level of disturbance of Danish Seine fishing; effort restricted to the continental shelf where productivity is relatively high (compared to the continental slope used by other offshore SET sub-fisheries); and concentration of Danish Seine effort in eastern Bass Strait where there are large areas of relatively invulnerable habitat (dynamic, naturally disturbed sediment plains with little emergent fauna) and substantial areas protected by State and Commonwealth MPAs. At high risk are:

- Two types of soft bottom, and one harder bottom habitat (gravel) characterized by large, erect or delicate epifauna (sedentary fauna, octocorals and large sponges) located in outer shelf depths.

Factors contributing to the number of habitats scored at medium risk (20) are largely the same as for high risk types. However, two additional classes of habitat types appear here. Firstly, inner shelf habitats with relatively high productivity but supporting large, erect or delicate epifauna on soft bottom types which are accessible by Danish Seine gear. Secondly, outer shelf hard bottom types supporting large, erect or delicate epifauna some of which are likely to be accessible to Danish Seine gear, e.g. low relief, sub-cropping soft sandstone supporting predominantly sponge communities and less commonly, patches of stalked crinoids.

There were 59 habitat types scored at low risk. These are outer shelf habitats characterized by low and encrusting types of fauna, and inner shelf types characterized by large, erect fauna in depths where there is relatively high benthic productivity (compared to the slope) based on a faster regeneration time of fauna, and adaptation of fauna to a greater degree of natural disturbance. There is a risk of false negatives in this category stemming from low productivity risk scores which are being driven by the assumption of high benthic production in <60m. Generalizations about the ability of structural fauna to recover from impact are made for high-level taxa (e.g. sponges) and don't take into account the characteristics of individual species, or the ecosystem services they provide at fine scales. However, 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.

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

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

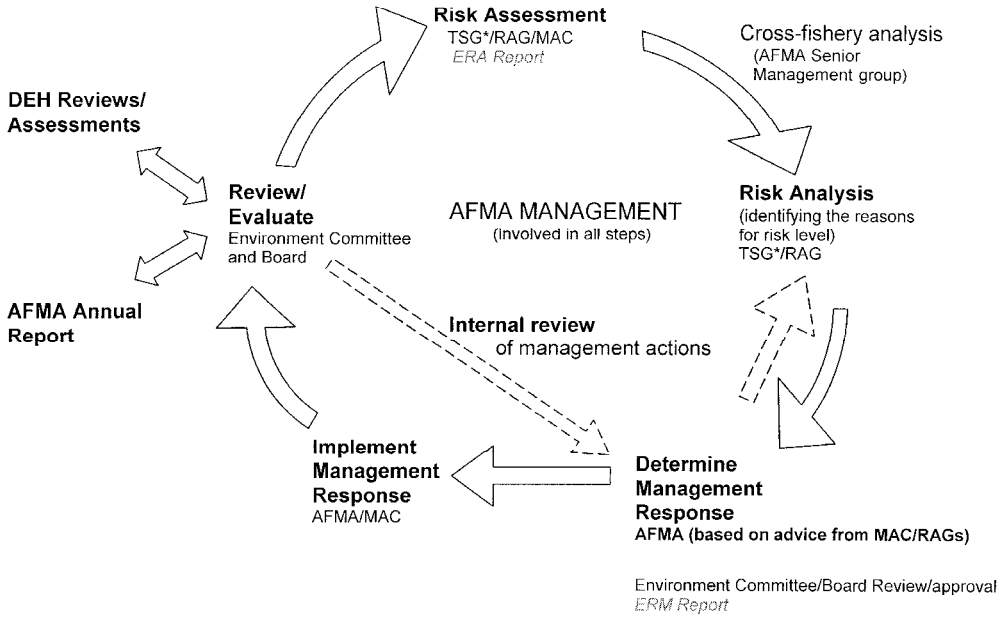
For example, if in a Level 2 analysis of habitat types, two of seven habitat types were determined to have risk from the sub-fishery, only those two habitat types would be considered at Level 3.

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

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

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

Figure x: Ecological Risk Management Framework



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

2.4.8 High/Medium risk categorisation (Step 8)

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

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

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

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

Categorisation results - High risk species

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

Of the 1 species classified as high risk in the SESSF Danish trawl fishery, 1 had spatial uncertainty (Category 4).

High risk Category	Description	Total
Category 1	High risk - Missing data for more that 3 attributes	0
Category 2A	High risk - Widely distributed outside fishery	0
Category 2B	High risk - Low overlap inside fishery	0
Category 3	High risk - One (susceptibility) attribute scored low	0
Category 4	High risk - Spatial uncertainty	1
Category5	High risk -other	0
	Total High	1

It is important to stress that this categorisation 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

Both tiger flathead and school whiting have been assessed at Level 3 in recent years. A quantitative tiger flathead assessment was presented to SESSFRAG in 2005 (Punt *et al*, unpublished) and showed the stock to be at or close to target biomass levels, though with recent catches in excess of longer term sustainable levels. School whiting was last assessed in 2004 (Cui *et al*, unpublished) and, although not able to be assessed relative to unfished levels, was found to have been stable since 1991. Both tiger flathead and school whiting are managed under the new SESSF harvest strategy framework. These results are consistent with the level 2 assessments presented in this report, suggesting that stocks are fully exploited and not at immediate risk of overfishing. The most recently published stock assessment information for these species may be found in Tuck (2006).

3. General discussion and research implications

The Danish seine fishery operates primarily out of a single port (Lakes Entrance) and fishes mainly within Bass Strait and out to the shelf break in eastern Bass Strait. It targets primarily tiger flathead and school whiting (both also caught in the otter trawl fishery). While the fishing method involves use of mobile ground gear, it uses lighter gear than otter trawl and is effectively restricted to fishing soft sediment bottom.

3.1 Level 1

The SICA analysis identified three components at potential risk from the fishery – the target species, TEP species, and habitats. These have all been assessed further at Level 2 using the PSA analysis. The only hazards identified to be of concern at Level 1 were direct and indirect impacts of fishing, and addition of biological material due to discarding of catch. Only TEP species were considered to be potentially at major risk from the fishery (risk score 4), and no hazards were identified as severe (risk score 5).

The evaluation of the by-product/by-catch component at Level 1 identified some uncertainty about whether the choice of a different “worst case” species might have resulted in a higher risk score (school shark was chosen). The choice of school shark was confirmed through the stakeholder review, but it is suggested that the next full risk assessment undertaken for this sub-fishery consider whether any other of the two dozen or so chondrichthyan species taken by the fishery might be at higher risk from capture by Danish seine.

3.2 Level 2

The Level 1 analyses suggested that target and TEP species were at moderate or major risk from fishing. However the Level 2 analysis for these components only identified one TEP species at potential high risk from Danish seine. The Level 1 analysis also found a moderate level of risk to habitats from the fishery. The Level 2 analysis identified 3 habitat types as potentially at high risk.

3.2.1 Species at risk

Of the list of species rated as high risk from the PSA analyses, the authors consider that one species (Australian fur seal) requires further evaluation or management response. This expert judgment is based on taxonomy/identification, distribution, stock structure, movements, conservation status and overlap with this/other fisheries as discussed below.

The only TEP species judged to be at high potential risk from the Danish seine fishery was the Australian fur seal. This was based on its generally low productivity, its considerable overlap in range with the fishery, and the fact that observer data confirm that interactions occur with the fishery. However further consideration of this result suggests that this species may be a false positive for high risk. The populations of

Australian fur seals are known to be increasing rapidly in recent years, suggesting that whatever the mortality levels from the fishery, they do not exceed the recovery capacity of the species. However it is important to note that the Australian fur seal (as with all marine mammals) remains a protected species, requiring efforts to minimize accidental mortality from all methods of fishing.

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

Only three of the 82 habitats assessed were also found to be at high risk from Danish Seine fishing, but we note that other vulnerable habitat types exist in the area currently used for fishing.

Habitats at risk

The Level 2 habitat PSA analyses highlighted few habitat types likely to be at high risk from Danish Seine fishing. These are soft grounds supporting large, erect and fragile epifauna of various types on the outer shelf. A range of outer shelf hard bottom types supporting large, erect or delicate epifauna score as medium risk – and it is possible that these may be accessible to Danish Seine gear as knowledge of their distributions improves and better navigational technology is employed, e.g. the low relief, sub-cropping soft sandstones off Point Hicks that support sponge communities. Because these provide structured habitats for a variety of shelf fishes (including commercial species), and because they are scarce in this part of the fishery, a better knowledge of their fine scale distributions will be useful for future assessments – especially if there is a shift in effort by the Danish Seine fishery or if it expands.

Inner shelf habitats supporting the same types of large, erect or delicate epifauna are scored at low risk based on an assumed relatively high production (faster regeneration time of fauna and adaptation of fauna to a greater degree of natural disturbance), the high concentration of Danish Seine effort in eastern Bass Strait where there are large areas of relatively invulnerable habitat (dynamic, naturally disturbed sediment plains with little emergent fauna) and because substantial areas are protected by State and Commonwealth MPAs. However, the comments above for medium risk habitats apply here if new information shows a change or expansion in fishing effort, or if new biological knowledge shows that these habitats are important in some way that was previously unrecognized, e.g. 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.

The best options available for managing (the users of) benthic habitats assessed as high risk are likely to involve regulating access through long-term or permanent spatial closures. These can be gear-specific to acknowledge the highly different levels of risk from different gears, but also need to take account of cumulative effects of different sub-fisheries. For example, the habitats used by the Danish Seine subfishery, or by the species it targets, are also used for otter trawling and mesh netting. Long term or permanent spatial closures acknowledge that habitat protection requires a different response than short term regulation of access, such as seasonal closures to protect spawning stocks.

Initially, the information required for an informed management response includes knowledge of what habitats exist, how much of each type there is, and where they are found. So that goals can be clearly defined, it is also necessary to know whether a habitat is essential to maintaining a part of the fishery ecosystem (is important for commercial species), or has important biodiversity values. The Level 2 analysis provides an evaluation of what habitats exist at a relevant level of detail for risk assessment, some coarse scale information on the “how much” and “where”, and some insights into their value to the fishery and to biodiversity values. However the issue of “how much” and “where” requires further analysis (and over time, further data collection).

Some additional information to that used in the risk assessment does exist, or can be inferred from adjacent SET areas, and would enable a preliminary examination of management options. Primarily this is finer scale information on habitat distribution (how much and where), but information on the role of habitat for ecosystem function (e.g. providing refuge for commercial species) is available in some cases. However, the Danish Seine fishery is itself relatively 'compact', and, unless it expands, spatial management issues relate more to the other sub-fisheries that overlap with it.

Any consideration of spatial management for habitat protection should also involve an analysis of the extent to which it would or would not help mitigate impacts on high risk species. A key element of this is to examine the ecosystem services provided by complex fishery habitat to commercial species and their prey.

3.2.3 Communities at risk

Communities not evaluated as methods not complete.

3.3 Key Uncertainties / Recommendations for Research and Monitoring

The by-product/by-catch component was eliminated at Level 1 as being of concern, based on the likely impact of the Danish seine fishery on school shark. While this analysis and conclusion was supported through the stakeholder review process, it is conceivable that school shark is not the by-product or by-catch species most at risk from this fishery. A number of other chondrichthyan species are taken by the fishery, and the next risk assessment undertaken for this sub-fishery might consider this broader group of species in more detail.

In assessing risk to habitats, we generally 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.

Specific recommendations arising from this assessment include:

- Consider undertaking a Level 2 risk assessment for by-product/by-catch species at the next round of risk assessments.
- Map (to the extent that data allow) spatial distributions of the high risk habitats, to identify possible candidate areas for fishery closures, taking into account protection afforded by proposed MPAs in the south-east region and also the overlap of fishing effort with other fishing methods such as demersal otter trawl and gillnet.
- Further research and data collection to determine habitat distribution on the outer shelf is required.

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Glossary of Terms

Assemblage	A subset of the species in the community that can be easily recognized and studied. For example, the set of sharks and rays in a community is the Chondrichthyan 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
28-09-2006	Collated comments forwarded by AFMA	*2.4.6 Evaluation of PSA Results* Target species (page 19) The justification for the "low" rating for flathead and school whiting being partly due to the Danish seine sector only targeting a small proportion of the range of these species in the SESSF appears to disregard the fact that this sector takes a substantial share of the overall flathead catch in the SESSF and almost the entire school whiting catch. Given the added uncertainty with stock structure with both these species it would appear that a "medium" rating would be more appropriate and precautionary; The justification for rating of all bar one syngnathid species as "low" is unclear, given the noted catch of species such as spiny pipehorses in the fishery. It is unclear how the range of this species can be determined as 2% in the Danish seine sector given the above noted need for more targeted monitoring of syngnathid interactions in the SETF. These and other syngnathid species should be rated "high" risk as with the otter trawl sector until further monitoring information is obtained confirming interactions.	The ratings are not 'justified' in the text (because they have not been decided upon by anyone), it is just explained why they have come out as they are with the method we are using. The method is fairly coarse and will not work correctly in every case. The risk rankings calculated by the PSA are not intended to be a definitive ranking of all species. If more information is available then it should certainly be used when considering any individual species. The PSA is semi-quantitative and is not capable of incorporating all information that may be available for some species. The results from the PSA are produced from an automated process, they are not careful considerations of each species, taking all information into account (this is the next step). Where a species has been assessed at Level 3 clearly that assessment will take precedence over the results from the semi-quantitative PSA. In the case of flathead and school whiting extra information is known which would be used post-PSA. The availability of spiny pipehorse as 2 % means that 2% of spiny pipehorse range within SESSF overlaps with Danish seine

Date	Format received	Comment from stakeholder	Action/explanation
			fishing effort. This would be a different value if we used area of Danish seine fishery rather than area of SESSF – unfortunately that is not officially defined. This is certainly an issue that needs to be revisited. It also depends on reliability of species range data – which is another issue!
		2.4.6 Evaluation of PSA Results Habitat component It's unclear what the last 2 paragraphs (pages 21 and 22) are stating. It appears to be putting an argument for ranking inner shelf habitats also as "high" risk on the basis of similar fauna types, susceptibility to Danish seine fishing and lack of information. Need to clarify what the "expert-overrides" noted in the last sentence are in the context of the preceding text.	
28-09-2006	BRS comment on manuscript	Executive summary : "Fur seal populations in southern Australia are currently increasing quite rapidly" This is a judgement.	Change text and add reference.
		Executive summary : "the Danish seine fishery scores as a low risk fishery." The PSA ranking is relative. Assuming the whole fishery is low risk, comes not from the Level 2 but from assumptions about the scale and intensity of the activities?	The risk to units for fisheries are scored with regard to a score distribution for all fisheries, not individually – so if all units score medium-low in the PSA, then it is reasonable to say that this is a low risk fishery overall.
		PSA species summary : It is hard to imagine a whale shark is more susceptible than a grey nurse to this gear..	Grey nurse and white shark had observer overrides – whale shark should have too.
		PSA species summary It is unclear how all seabirds can have exactly the same susceptibility to a fishery?	This is because all birds had the same observer overrides.

Date	Format received	Comment from stakeholder	Action/explanation
		PSA species summary Several of these productivity values do not match those used in other fisheries for these birds, eg SBT. They should be checked.	Individual authors have sometimes added information where it was missing and this not available to all authors. Will get back to database, but not on the time schedule for these report delivery. PSAs will not be rerun for this delivery.
		PSA species summary This seems high for a dugong, does their distribution overlap with where the fishery occurs?	Availability, encounterability : low Selectivity, PCM : high Productivity is low (i.e. scores high) for this species.
		PSA species summary Are all turtles and seasnakes equally susceptible?	Yes, in this analysis they all score the same for all aspects of susceptibility
		Evaluation of PSA results (incorporation of observer information) The process for incorporating this information needs to be documented somewhere to demonstrate consistency	This is documented in the accompanying methodology document.

Appendix B: PSA results summary of stakeholder discussions

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

The PSA results were discussed at the SETMAC meeting in Melbourne on 22 November 2005. No changes were made as a result of these discussions.

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

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	**2. Geographic range** Possible detectable change in geographic range but minimal impact on population range and none on	**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
	variability for this population.	dynamics, change in 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	**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,	**5. Reproductive capacity** Change in reproductive capacity adversely affecting long-term recruitment dynamics. Time to recovery up to 5	**5. Reproductive capacity** Change in reproductive capacity adversely affecting long-term recruitment dynamics. Time to	**5. Reproductive capacity** Change in reproductive capacity adversely affecting long-term recruitment dynamics. Time to recovery > 100 generations free from

Sub-component	Score/level					
	1 Negligible	2 Minor	3 Moderate	4 Major	5 Severe	6 Intolerable
	population.		long-term recruitment dynamics not adversely damaged.	generations free from impact.	recovery up to 10 generations free from impact.	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	**3. Genetic structure** Moderate change in genetic structure. 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 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
			population size or number of spawning units up to 5%.	10%.		
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	**6. Behaviour/ movement** Possible detectable change in behaviour/ movement but minimal impact on	**6. Behaviour/ movement** Detectable change in behaviour/ movement with the potential for some impact on	**6. Behaviour/ movement** Change in behaviour/ movement, impact adversely affecting population dynamics.	**6. Behaviour/ movement** Change in behaviour/ movement. Impact adversely affecting population dynamics.

Sub-component	Score/level					
	1 Negligible	2 Minor	3 Moderate	4 Major	5 Severe	6 Intolerable
		behaviour/ movement on the scale of hours.	population dynamics. Time to return to original behaviour/ movement on the scale of days to weeks	population dynamics. Time to return to original behaviour/ movement on the scale of weeks to months	Time to return to original behaviour/ movement on the scale of months to years.	Time to return to 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	**2. Water quality** Detectable impact on water quality. Time to recover from local impact on the scale of days to weeks, at	**2. Water quality** Moderate impact on water quality. Time to recover from local impact on the scale of weeks to months, at	**2. Water quality** Time to recover from local impact on the scale of months to years, at larger spatial scales recovery time	**2. Water quality** Impact on water quality with 50 - 90% of the habitat affected or removed by the activity which may	**2. Water quality** The dynamics of the entire habitat is in danger of being changed in a major way, or > 90% of

Sub-component	Score/level					
	1 Negligible	2 Minor	3 Moderate	4 Major	5 Severe	6 Intolerable
	pre-disturbed state on the scale of hours.	larger spatial scales recovery time of hours to days.	larger spatial scales recovery time of days to weeks.	of weeks to months.	seriously endanger its long-term survival and result in changes to ecosystem function. Recovery period measured in years to decades.	habitat destroyed.
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	**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

Sub-component	Score/level					
	1 Negligible	2 Minor	3 Moderate	4 Major	5 Severe	6 Intolerable
				timeframes.		the scale of decades 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	3. Distribution of	3. Distribution of	3. Distribution of	3. Distribution of the	3. Distribution of the	3. Distribution of the

Sub-component	Score/level					
	1 Negligible	2 Minor	3 Moderate	4 Major	5 Severe	6 Intolerable
community	the community Interactions which affect the distribution of communities unlikely to be detectable against natural variation.	the community Possible detectable change in geographic range of communities but minimal impact on community dynamics change in geographic range up to 5 % of original.	the community Detectable change in geographic range of communities with some impact on community dynamics Change in geographic range up to 10 % of original.	community 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.	community 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.	community 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	5. Bio- and geochemical cycles Only minor changes	5. Bio- and geochemical cycles Changes in relative	5. Bio- and geochemical cycles Changes in relative	5. Bio- and geochemical cycles Changes in relative	5. Bio- and geochemical cycles Ecosystem function

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