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Australian Government
Australian Fisheries Management Authority

Ecological Risk Assessment for Effects of Fishing

REPORT FOR THE SEA CUCUMBER SUB-FISHERY OF THE CORAL SEA FISHERY

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

Furlani, D., Dowdney, J., Bulman, C., Sporcic, M. and Fuller, M. (2007) Ecological Risk Assessment for the Effects of Fishing: Report for the Sea Cucumber Sub-fishery of the Coral Sea Fishery. Report for the Australian Fisheries Management Authority, Canberra.

Notes to this document:

This fishery ERA report document contains figures and tables with numbers that correspond to the full methodology document for the ERAEF method:

> (Hobday, A. J., A. Smith, H. Webb, R. Daley, S. Wayte, C. Bulman, J. Dowdney, A. Williams, M. Sporcic, J. Dambacher, M. Fuller, T. Walker. (2007) Ecological Risk Assessment for the Effects of Fishing: Methodology. Report R04/1072 for the Australian Fisheries Management Authority, Canberra)

Thus, table and figure numbers within the fishery ERA report document are not sequential as not all are relevant to the fishery ERA report results.

Additional details on the rationale and the background to the methods development are contained in the ERAEF Final Report:

> Smith, A., A. Hobday, H. Webb, R. Daley, S. Wayte, C. Bulman, J. Dowdney, A. Williams, M. Sporcic, J. Dambacher, M. Fuller, D. Furlani, T. Walker. (2007) Ecological Risk Assessment for the Effects of Fishing: Final Report R04/1072 for the Australian Fisheries Management Authority, Canberra.

Executive Summary

This assessment of the ecological impacts of the Coral Sea Fishery: Sea Cucumber Sub-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.

For the Coral Sea Fishery, the ERAEF was limited to Level 1 analysis only.

This assessment of the Coral Sea Fishery: Sea Cucumber Sub-fishery includes the following:

- Scoping
- Level 1 results for Target, TEP, Habitat and Community components
- No Level 2 analyses have been undertaken at this stage.

Fishery Description

Gear:	Hand collection while diving
Area:	Sandy Cape, Fraser Island to Cape York, east of Great Barrier Reef Marine park outer boundary through to the edge of the Australian Fishing Zone (AFZ)
Depth range:	0-30 m depth
Fleet size:	2 operators
Effort:	Effort falling annually (e.g. 2004 effort <10% of 2000 effort). Confidentiality agreements prohibit disclosure of detailed data.
Landings:	Confidentiality agreements prohibit disclosure of landing details
Discard rate:	No discarding
Main target species:	Amberfish, blackfish, greenfish, lollyfish, sand fish and surf red fish
Management:	No Management Plan, MAC or RAG; but a Statement of Management Arrangements 2004/05 is in place. Catch limits apply for 5 species, and "Move on provisions" are in place.
Observer program:	No observer coverage

Ecological Units Assessed

Target species:	8
By-product species:	0
Discard Species:	0
TEP species:	109
Habitats:	44 (42 benthic, 2 overlying pelagic)
Communities:	4 (2 demersal, 2 overlying pelagic)

Level 1 Results

One ecological component was eliminated at Scoping for the Sea Cucumber sub-fishery. The Bycatch-Byproduct component was eliminated – there is no bycatch in the Hand collection sub-fisheries. (There was at least one risk score of 3 – moderate – or above for each of the other components).

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

- Fishing (direct impact of capture on Target species and Community)
- Translocation of species (impact on Target, TEP, Habitat and Communities)

One of the hazards eliminated was direct impacts from fishing. The translocation of species hazard is scored as very uncertain. It is a low probability but potentially high consequence hazard.

No risks were rated as major or above (risk score 4 or higher).

Significant external hazards included:

- other fisheries in the region (impact on Target and Communities), and
- other anthropogenic activities (tourism impact on Habitats).

Level 2 Results

Species

No Coral Sea Fishery Sea Cucumber species were assessed at Level 2 using the PSA analysis.

Habitats

No Coral Sea Fishery Sea Cucumber habitats were assessed at Level 2 using the habitat PSA analysis.

Communities

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

Summary

In the Coral Sea Fishery: Sea Cucumber sub-fishery, black teatfish are classified as overfished (Bureau of Rural Sciences 2004) and catches of most other sea cucumber species are declining. There is currently no recovery plan for the stock, although a reduction in the annual catch limit was introduced in 2002 and "Move-on provisions" apply.

Two issues emerged from the ERAEF Level 1 analysis for the Coral Sea Fishery Sea Cucumber sub-fishery:

- concerns about exploitation levels of several target species; and
- concerns about translocation of species from inshore areas via hull and anchor fouling to offshore areas, impacting species, habitats and communities.

Operator-initiated measures identified during the ERAEF process (such as a voluntary 3-year reef-rotational system, a Memorandum of Understanding (MoU)for fishing exclusion on 5 specified reefs, and the initiative to establish permanent moorings in high use areas), have the potential to address some ERAEF concerns.

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.

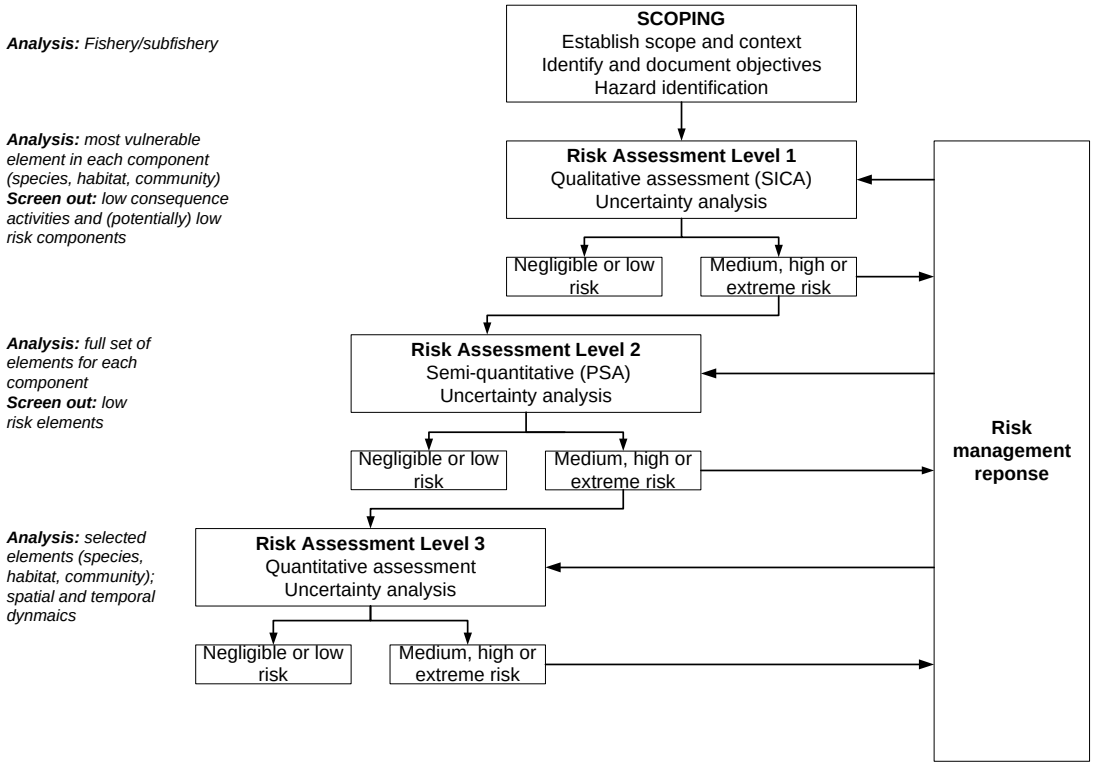


Figure 1. Overview of ERAEF showing focus of analysis for each level at the left in italics.

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 Environment Protection and Biodiversity Conservation (EPBC) legislation. The five *components* are:

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

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

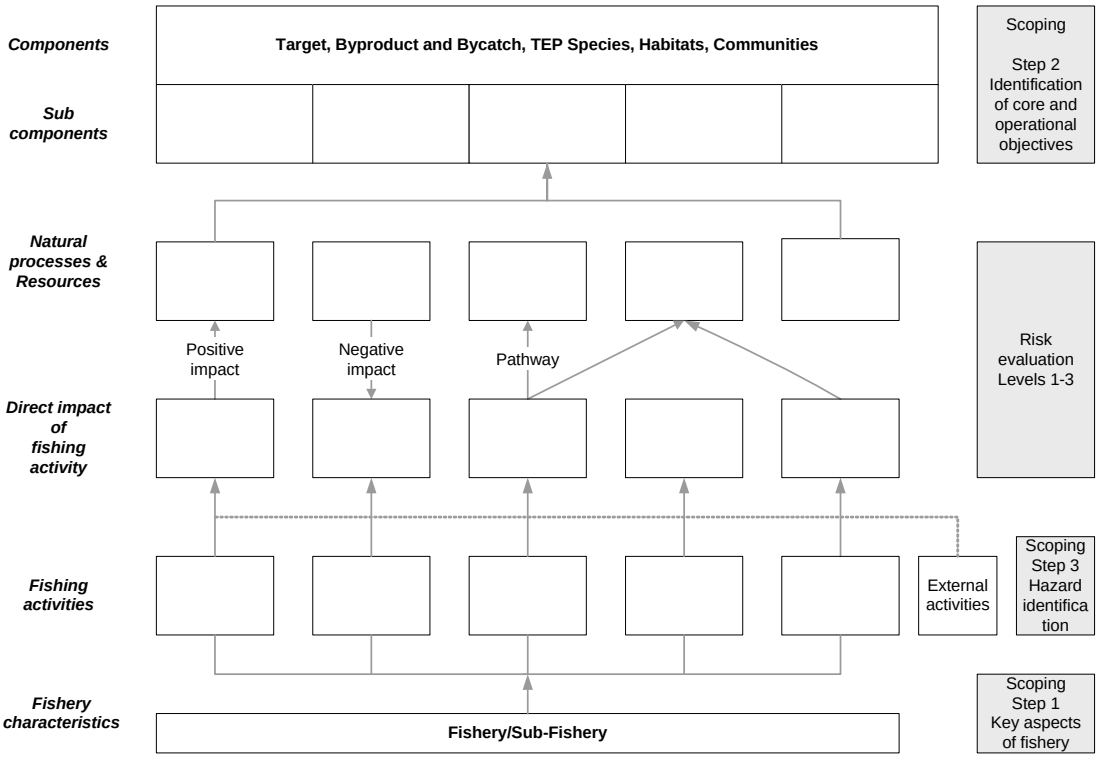


Figure 2. Generic conceptual model used in ERAEF.

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

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

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

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

ERAEF stakeholder engagement process

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

Scoping

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

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

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

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

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

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

Level 2. PSA (Productivity Susceptibility Analysis)

Level 1 assessment for the Coral Sea Fishery: Sea Cucumber Sub-fishery has been completed as required for the ERAEF Stage 2 process. **No Level 2 analysis has been conducted for the Coral Sea Fishery: Sea Cucumber Sub-fishery.** Information regarding Level 2 analysis is included to provide a full understanding of the ERAEF process.

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 categorised as low, medium and high on the set [<5, 5-500, >500], estimates for species with no data can still be made. Estimated fecundity of a species such as a broadcast-spawning fish with unknown fecundity, is still likely greater than the cutoff for the high fecundity categorisation (>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 moderate 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 Australian Fisheries Management Authority (AFMA) for a range of management purposes, including to address the requirements of the Environment Protection and Biodiversity Conservation Act (EPBC Act) as evaluated by Department of the Environment and Heritage (DEH).

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 Sea Cucumber sub-fishery of the Coral Sea Fishery (CSF).

2.1 stakeholder engagement

2.1 Summary Document SD1. Summary of stakeholder involvement for fishery

CSF Sea Cucumber sub-fishery

Fishery ERA report stage	Type of stakeholder interaction	Date of stakeholder interaction	Composition of stakeholder group (names or roles)	Summary of outcome
Scoping	Phone calls & emails; requests for data. Requests for fishers contact details Preliminary scoping and SICA documents sent to AFMA for distribution to fishers	18/10-18/11/2005 18/11/2005	Justine Johnston- AFMA Philip Domaschenz- AFMA. AFMA data section-Fisher contact details provided following Level 1 (SICA) stakeholder meeting 2/12/2005.	Data often uncertain or lacking. Instructed by AFMA to move to Level 1
Scoping	Information meeting with stakeholders and initial review by fisher representatives	30/11/2005	Documents distributed to fishers. Tim Smith- AFMA Justine Johnston- AFMA Philip Domaschenz- AFMA CSF stakeholder representatives Andy Dustan- Tourism Ross Daley- CSIRO Dianne Furlani- CSIRO	Limitations of CSF logbook data discussed; Feedback on species lists and hazards provided; Identified data which had not yet been provided.
Scoping	Phone calls/emails for information	1/12/2005	AFMA Sea cucumber operators	Feedback returned and incorporated into species documents and SICAs Information incorporated into scoping documents and hazard ID's
Level 1 (SICA)	Information meeting with stakeholders and initial review by fisher representatives	30/11/2005	Documents distributed to fishers. Tim Smith- AFMA Justine Johnston- AFMA Philip Domaschenz- AFMA CSF stakeholder representatives Andy Dustan- Tourism Ross Daley- CSIRO Dianne Furlani- CSIRO	Limitations of CSF logbook data discussed; Feedback on species lists and hazards provided; Identified data which had not yet been provided. Debated the scenarios, and explanation of the consequence scoring. Identified areas to be further investigated.

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)	Follow-up Workshop	6/4/2006	Postponed by AFMA	
Level 1 (SICA)	Attend Stakeholder meeting 2006	27/4/2006	AFMA, DEH, QDPIF, DAFF, CSIRO, and CSF operators	Discussion of CSF future research intentions, Ministerial Directives to be met, trap trial outcomes and future trial, issues of discarding, mitigating measures already in place and those being considered.
Level 1 (SICA)	Workshop Rescheduled	28/4/2006	Documents distributed to fishers. Dave Johnson- AFMA Justine Johnston- AFMA Philip Domaschenz- AFMA Tim Smith- AFMA CSF stakeholder representatives DEH representative Tony Smith- CSIRO Dianne Furlani- CSIRO	Feedback on species lists and hazards provided. Debated the scenarios, and explanation of consequence scoring. Considered mitigating measures. Incorporate stakeholder/ AFMA changes as required to reach agreed that Level 1 is acceptable
Level 2 (PSA)	Not produced for CSF during ERA Stage 2 process.			
ERAEF reporting	AFMA comments received Stakeholder and AFMA comments received	6/06/2006 21/06/2006 14/07/2006 28/09/2006		Comments addressed. Final draft submitted Comments addressed and detailed in Appendix A. Final report submitted.

2.2 Scoping

The aim in the Scoping stage is to develop a profile of the fishery being assessed. This provides information needed to complete Levels 1 and 2 and at stakeholder meetings. The focus of analysis is the fishery, which may be divided into sub-fisheries on the basis of fishing method and/or spatial coverage. Scoping involves six steps:

Step 1 Documenting the general fishery characteristics
Step 2 Generating "unit of analysis" lists (species, habitat types, communities)
Step 3 Selection of objectives
Step 4 Hazard identification
Step 5 Bibliography
Step 6 Decision rules to move to Level 1

2.2.1 General Fishery Characteristics (Step 1).

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

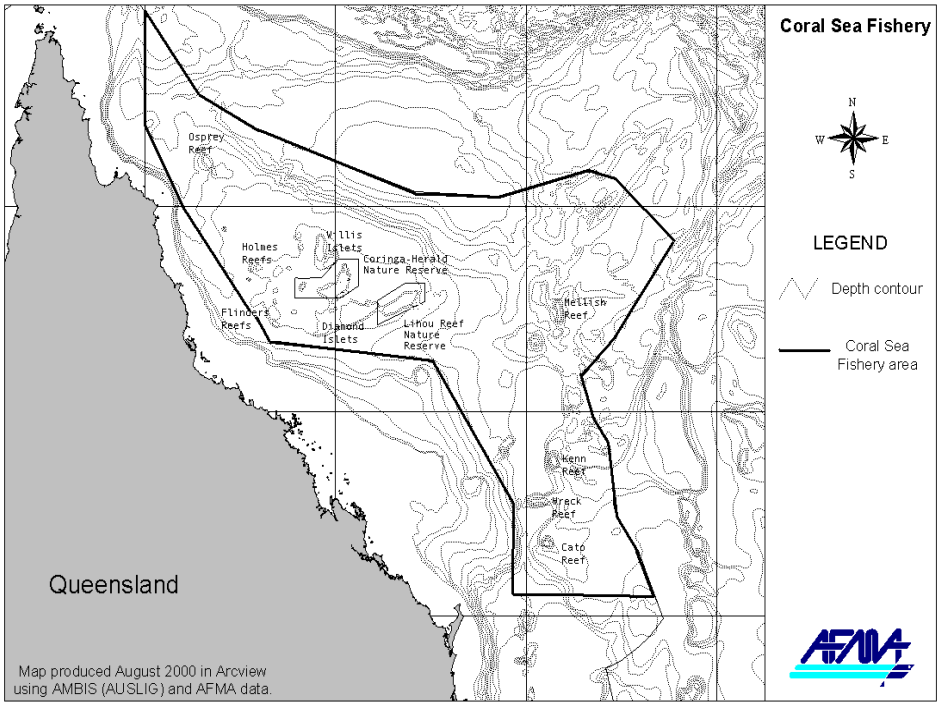
Scoping Document S1 General Fishery Characteristics

Fishery Name: Coral Sea Fishery (CSF)– Hand Collection sub-fisheries
Date of assessment: May 2006
Assessor: Dianne Furlani

NB. All 3 hand collection sub-fisheries (aquarium, lobster and trochus, and sea cucumber) of the Coral Sea Fishery are included in the following *General Fishery Characteristics* table.

General Fishery Characteristics	
Fishery Name	Coral Sea Fishery- Hand Collection sectors
Sub-fisheries	*Identify sub-fisheries on the basis of fishing method/area.* The 3 Hand Collection sectors are single fishery sectors: **Aquarium** **Lobster and Trochus** **Sea cucumber**
Sub-fisheries assessed	*The sub-fisheries to be assessed on the basis of fishing method/area in this report.* All 3 sectors employing Hand Collection are assessed in the ERAEF process.
Start date/history	*Provide an indication of the length of time the fishery has been operating.* Small-scale hand collection fisheries existed prior to their integration into the Coral Sea Fishery. These operated previously within the East Coast Deepwater Crustacean Trawl Fishery (ECDTF). No additional access has been granted since 1997. Prior to 2000, fishing permits were non-transferable; all permits were

	transferable by July 2002, subject to performance criteria. Increased value and effort has resulted with Gross value of production (GVP) for the CSF, all sectors combined, risen from $626,700 in 2001/02, to $1,201,200 in 2002/03 *(BRS, "Fishery status report" 2004).* Sea cucumber hand collection has continued since 1997. AFMA has been conducting talks with the Queensland Government proposing that management for the hand collection sector in Commonwealth waters will be transferred to the Queensland Fisheries Service (*AFMA At a glance, 2005*). Industry stakeholders are unanimous in their view to not support progression of this agreement (*CSF Stakeholders Meeting 2005).* An Aquarium collection trip was recently completed with observer coverage (March 2006). The report from this trip has not been finalised and has not been considered in this ERAEF. No observer data has previously been collected for any of the 3 Hand Collection sectors. Negotiations are presently underway to consider expansion of the Aquarium collection to include invertebrate and "living rock" collection, similar to the GBR aquarium fishery.
Geographic extent of fishery	*The geographic extent of the managed area of the fishery. Maps of the managed area and distribution of fishing effort should be included in the detailed description below, or appended to the end of this table.* Waters from Sandy Cape, Fraser Island to Cape York, generally east of the Great Barrier Reef Marine Park outer boundary through to the edge of the Australian Fishing Zone (10 to 100 nautical miles seaward of the Great Barrier Reef). This fishery excludes the areas of the Coringa-Herald and Lihou Reef National Nature Reserves. See map at the end of the table. Sub-continental shelf and abyssal plains with scattered reef systems dominate the CSF. The Coral Sea Reef system comprises 6 main habitats: outer reef slope, reef crest, back reef, leeward slope or lagoon, pinnacle, and inter-reef channels. The richest areas for fish diversity are the exposed outer slopes of 5-20 m depth and large bomboras and pinnacle reefs (*Allen 1988*).



Pg 15 AFMA "Environmental Assessment Report- Coral Sea Fishery" (July 2003).

Regions or Zones within the fishery	*Any regions or zones used within the fishery for management purposes and the reason for these zones if known* All one zone.
Fishing season	*What time of year does fishing in each sub-fishery occur?* Fishing may occur at all times of year in each of the Hand Collection sectors.
Target species and stock status	*Species targeted and where known stock status.* Overall, the status of the CSF is uncertain as most stocks have not been assessed but, with the exception of the Sea cucumber sector, all sectors are considered underdeveloped (*DEH Assessment of the Coral Sea Fishery 2004*). **Aquarium:** broad range of finfish including tropical snappers (*Lethrinidae, Lutjanidae*) and emperors (*Lutjanidae*), several species of cod, damselfish, butterflyfish, angelfish, wrasse, anemone fish, surgeonfish, blennies and gobies (*AFMA Statement of Management Arrangements June 2004).* Operator comments at the *CSF workshop, Nov 2005* indicated that specimens targeted include large specimens for supply to the public aquariums worldwide, as well as collection of smaller specimens for private aquaria, and that target species will often be determined by customer demand. Little information exists about specific target species as catch data is reported at genus or family level only, and effort data has not been provided (QFS catch data). As such, detailed lists have been supplied by the operators and used to create the species listings. These species include invertebrate and "living rock" species which are not presently collected from the CSF, but are collected from the GBR area and are being investigated for collection within the CSF also. With AFMA approval, the CSF risk assessments for this sub-fishery have been completed using this expanded listing (as discussed at April 2006 Stakeholders meeting).

<table>
<tr><td></td><td>Lobster and Trochus: Panulirus ornatus & P. versicolor, and Trochus niloticus Trochus catches are for both flesh and shell, depending on demand.

Sea cucumber: Catches include amberfish, blackfish, greenfish, lollyfish, sand fish and surf red fish. Sea Cucumber are particularly susceptible to overfishing due to their shallow habitat and sedentary nature. Information inferred from other fisheries reports a “boom and bust” cycle in almost all regional sea cucumber fisheries (Stutterd and Williams 2003). Within the CSF sea cucumber sector, black teatfish is assessed as Overfished. A 2002 preliminary assessment for the 5 target species showed a decline in the proportional catches of both the black and the white teatfishes and the prickly redfish. The overfished status has not been revised and will be reviewed in 2007. Also, see comments in Target Species issues and interactions section.</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.

Aquarium operators collect bait (mackerel and trevally) for provisioning to attract aquarium specimens. No bait collection is involved in Lobster and Trochus, or Sea Cucumber fishing.</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.

In 2004, 7 fishing concessions were regranted within the 3 Hand Collection sectors:
2 Aquarium
3 Lobster and Trochus
2 Sea cucumber</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

Aquarium NA

Lobster and Trochus (Order Archeogastropoda)
<table>
<tr><th>Common name</th><th>Annual Landed limits</th></tr>
<tr><td>All trochus species</td><td>30 tonnes</td></tr>
<tr><td>All lobster species</td><td>30 tonnes</td></tr>
</table>

Sea Cucumber- order Aspidochirotida
<table>
<tr><th>Common name</th><th>Species</th><th>Annual landed limits</th></tr>
<tr><td>White teatfish</td><td>Holothuria nobilis (was whitmaei)</td><td>2 tonnes</td></tr>
<tr><td>Black teatfish</td><td>Holothuria whitmaei (was nobilis)</td><td>500kgs</td></tr>
<tr><td>Prickly redfish</td><td>Thelenota ananas</td><td>10 tonnes</td></tr>
<tr><td>Sandfish</td><td>Holothuria scabra</td><td>5 tonnes</td></tr>
<tr><td>Surf redfish</td><td>Actinipyga mauritiana</td><td>5 tonnes</td></tr>
<tr><td>Sp’s combined</td><td></td><td>75 tonnes</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

No data summaries exist for the CSF. As less than 5 boats are involved,</td></tr>
</table>

	confidentiality agreements prohibit presentation of detailed data for these 3 Hand Collection sectors. **Aquarium-** no detailed effort data is available. Date is collected by Queensland Fisheries Service, but has not been made available for this assessment. **Lobster and Trochus-** effort expended in this sector since 2000 has been highly variable (ranging from >400 to <50 total diver hrs/year). Trochus effort was limited to the 2001 calendar year. Trochus effort and catch is dependant on the market value, and may rise if the market demand rises in the future. **Sea cucumber-** logbook data reports effort to have fallen significantly, from a high of >2,000 hr for 2000 to a low of <200 hrs for the 2004 calendar years. The number of dives/year has almost halved annually.
Current and recent fishery catch trends by method	*The most recent estimate of catch levels in the fishery by fishing method (sub-fishery) (total and/or by target species). Summary of the recent catch trends in the fishery by fishing method (sub-fishery). In table form* For the combined CSF, catches have steadily increased from a 40 tonne catch in 1998/99 to 150 tonnes catch in 2001/02 (*AFMA "Environmental Assessment Report, CSF", July 2003*). 166.4 t was reported as the combined commercial harvest for 2002/03 (*DEH Assessment of the Coral Sea Fishery 2004*). No data summaries exist for the CSF sectors. As less than 5 boats are involved, confidentiality agreements prohibit presentation of detailed data for these Hand Collection sectors. **Aquarium-** Aquarium catches are not include in Commonwealth logbook data records, but instead are recorded through the Queensland Fisheries Service. Queensland data has estimated catches of 60,000 specimens for 2003 *(Caton and McLoughlin 2004).* In terms of catch weight, a ~50% increase has been recorded in catches between 2000 and 2004 calendar years, and remained steady during the current year (QFS catch data). For **Lobster and Trochus**, information from CS01 logbook records indicate that catches have been highly variable, from <200 to >2,000 kgs/year over the calendar years 2000 to 2004. Trochus catches were limited to the 2001 calendar year **Sea cucumber-** catches declined from around 50 t in 2000 to 30 t in 2001 and declined further in 2002 *(Caton and McLoughlin 2004).* Catches for the 2002 to 2004 calendar years have recorded a dramatic decrease on these figures.
Current and recent value of fishery ($)	*Note current and recent value trends by sub-fishery.* GVP figures for the combined CSF has risen steadily from ~$150,000 in 1998/99 (*Environmental Assessment Report CSF July 2003*) to $626,700 in 2001/02, and reported as $1,201,200 in 2002/03 *(BRS Fishery status report 2004).* GVP for 2003/4 and 2004/5 are reported at around $850,000 and $1,100,000 respectively. (*DAFF Oct. 2005*) **Aquarium** –Stakeholders recently advised that the Australian aquarium trade has experienced a major downturn in demand, and has reached borderline profitability (*CSF Stakeholders Meeting 2005).* **Lobster and Trochus –**stakeholders advise that no real market exists for trochus *(CSF Stakeholders Meeting 2005).*

Relationship with other fisheries	*Commercial and recreational, state, national and international fisheries List other fisheries operating in the same region any interactions* Species in common with the CSF and the other fisheries operating in the area are: SET and Gillnet, Hook and Trap fisheries (coral trout, snapper, emperors, other reef fish species), Torres Strait Fisheries (sea cucumber, lobster and trochus), and State fisheries (target aquarium species). It is unknown if any of these resources are shared. Limited recreational fishing may also compete for resources. Also see comments in **Target Species issues and interactions** section**.**
Gear	
Fishing gear and methods	*Description of the methods and gear in the fishery, average number days at sea per trip.* Reports indicate an average trip within the 3 hand collection sectors to be around 3 days duration (*FAR Oct. 2005*). **Aquarium:** Generally 3-4 days at sea per trip (*FAR 2004/05*). Hand collection using diving equipment (freedive, hookah or scuba), barbless hook and line, or scoop net, with targeted fish herded into barrier nets by way of cast, scoop and seine nets, or hand held rods. Barrier nets have lead-line bottom and float line on top. Restrictions on net sizes are as follows: Scoop nets: • no more than 2 metres in any direction, • maximum mesh size of 25 millimetres • handle/shaft length of less than 2.5 metres. Cast nets: • no more than 6 metres in diameter, • maximum mesh size of 28 millimetres Seine nets: • no more than 16 metres in length, and drop of less than 3 metres • maximum mesh size of 25 millimetres, measured diagonally between the inner edge of the mesh knots with mesh twine pulled taut. **Lobster and Trochus,** and **Sea cucumber** sectors: no gears used; hand collection only, with or without the use of diving equipment (i.e. freedive, hookah or scuba).
Fishing gear restrictions	Noted in previous section (**Fishing gear and methods**) for Aquarium sub-fishery only – there is no gear usage in Lobster and Trochus or Sea Cucumber sub-fisheries.
Selectivity of gear and fishing methods	*Description of the selectivity of the sub-fishery methods* Hand Collection is a highly selective method for the target species alone. Gear is only used in the Aquarium sector. Gear restrictions noted above.
Spatial gear zone set	*Description where gear set i.e. continental shelf, shelf break, continental slope (range nautical miles from shore)*

	Aquarium gear is set on rubble areas and reef fronts, as opposed to coral areas, principally to avoid damage to collection nets.
Depth range gear set	*Depth range gear set at in metres* Gear only used in the **Aquarium** sector, and would be limited to safe diving depths (<30m). This depth may increase in the future as a result of further diver training presently being considered.
How gear set	*Description how set, pelagic in water column, benthic set (weighted) on seabed* **Aquarium** gear set and operated by hand. Fish are herded into barrier nets. Barrier nets are generally 6m in length, have a lead-line bottom and a float line on top. Generally, one fish is targeted at a time i.e. very selective.
Area of gear impact per set or shot	*Description of area impacted by gear per set (square metres)* Aquarium barrier nets generally 6m in length with a lead-line bottom. Both mother-boat and tender boats anchor. Gear impact is negligible for L&T and SC, and tender boats do not anchor, but drift from the mother boat.
Capacity of gear	*Description number hooks per set, net size weight per trawl shot* **Aquarium** net-size described in "Fishing gear and methods". Lob**ster and Trochus**, and **Sea Cucumber** sub-fisheries do not use any gear.
Effort per annum all boats	*Description effort per annum of all boats in fishery by shots or sets and hooks, d for all boats* Confidentiality agreements prohibit presentation of detailed data for these individual sectors. From CS01 logbook data, effort for the Lobster and Trochus and Sea Cucumber sectors (no aquarium data available through CS01), all boats combined, has been reported for individual calendar years as:

	2000	**2001**	**2002**	**2003**	**2004**
Hrs	2850	1134	451	597	159
Dives	1019	416	282	204	86

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** NA
Issues	
Species lists by component	*Species list by component (including target, by-catch/by-product and TEP), habitat and community tables (Scoping Document S1.2).* No discard or byproduct occurs in these sectors. **Aquarium** predominantly damselfish (Pomacentridae), butterflyfish (Chaetontodae), angelfish (Pomacanthidae), wrasse (Labridae), anemone fish (*Amphipron* spp, *Premnas* spp) and gobies (Gobidiidae), with an increasing target of sharks and rays, and the potential to take molluscs, crustacean, and 'other' invertebrates in the future. Mackerel and trevally are also taken for bait. See document S2A for full species listing. CS01 logbook records of species taken in the Lobster & Trochus, and Sea Cucumber sectors include: **Lobster and Trochus-**

species_name	common_name

	Panulirus spp (ornatus), not P. cygnus	Tropical rock lobsters
	Panulirus versicolor	Painted rock lobster
	Trochus niloticus	Trochus

Sea cucumber-

species_name	common_name
Thelenota anax	Amberfish
Holothuria nobilis (was whitmaei)	White teatfish
Holothuria whitmaei (was nobilis)	Black teatfish
Holothuria fuscopunctata	Elephant's trunk fish
Actinopyga miliaris	Blackfish
Holothuria atra	Lolly fish
Thelenota ananas	Prickly redfish
Actinopyga mauritiana	Surf redfish

Target species issues

List any issues, including biological information such as spawning season and spawning location, major uncertainties about biology or management, interactions etc

Aquarium

All species captured are target – i.e. there is no bycatch or discard for this sub-fishery. We have been informed that catch data for QFS is recorded at genus or family level only (QFS catch data). See document S2A for full species listing as provided from operators, and agreed at April Stakeholder meeting 2006.

Lobster and Trochus

species_name	common_name
Panulirus spp (ornatus), not P. cygnus	Tropical rock lobsters
Panulirus versicolor	Painted rock lobster
Trochus niloticus	Trochus

Trochus niloticus reach market size within 2-3 years (Castell *et al* 1996) and maturity at 2 years (shell width 50-90 mm) (Sant 1995); synchronous spawners within 1-2 days of full moon, reportedly from March to July (Caton and McLoughlin 2004) or October to May (Castell 1997); larval dispersal time is short (~2 days) and populations are thus isolated (Sant 1995);may live to 12 years (160 mm shell width) (Nash 1985). (*AFMA Draft assessment report, Torres Strait Trochus Fishery, October 2005*). Due to their accessibility to harvesting, trochus are considered vulnerable to overfishing (*DEH Assessment of the Coral Sea Fishery 2004*)

Sea cucumber

species_name	common_name
Thelenota anax	Amberfish
Holothuria nobilis (was whitmaei)	White teatfish
Holothuria whitmaei (was nobilis)	Black teatfish
Holothuria fuscopunctata	Elephant's trunk fish
Actinopyga miliaris	Blackfish
Holothuria atra	Lolly fish
Thelenota ananas	Prickly redfish
Actinopyga mauritiana	Surf redfish

Operators at the *CSF workshop, Nov 2005* indicated that larger sea cucumbers are

	usually targeted as less effort is required to clean the catch, and the market value is greater. The sea cucumber fishery in the Torres Strait gives an example of the risk of these animals. The Torres Strait Protected Zone Joint Authority states that…"Sea cucumbers have been subjected to excessive levels of fishing effort during the early 1990's and 1995 in particular. It is a high value species occurring in relatively shallow waters and as a result is vulnerable to over-harvesting. Following concerns of serious resource depletion and overexploitation of sandfish stocks on Warrior Reef, four fishery independent surveys were commissioned to assess the level of reduction in sandfish abundance in 1995/1996, 1998, 2000 and 2002. The collection of sandfish, which was harvested primarily for export, has been prohibited since early 1998 following recommendations from CSIRO researchers undertaking the surveys that the remaining stock on Warrior Reef was approximately 80% less than in November 1995. In 1995, the status of sandfish stocks were considered overexploited, therefore the subsequent reduction indicated a serious depletion". http://www.pzja.gov.au/fisheries/sea_cucumber.htm
Byproduct and bycatch issues and interactions	*List any issues, as for the target species above* There is no by-catch action plan for this fishery. Specific by-catch mitigation measures are in place for each sector. Due to the highly specified method used in the Hand Collection sector, no significant impact on ecological communities is expected and little incidence of by-catch or by-product.
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.* AFMA has recently gained funding for an Ecological Based Fisheries Management (EBFM) Project aimed at enhanced data collection for the 2004/5 and 2005/6 financial years. "The final report should provide data collection, handling and associated reporting in Commonwealth fisheries in areas where adequate information does not currently exist (for example interactions with protected species and other high risk species)." (*CSF Stakeholders Meeting 2005*). A list of TEP species is provided with this document. At present, there are no recorded interactions with listed threatened or protected species. Although low level interactions are expected to occur, the Statement of Management Arrangements provides measures to ensure all reasonable steps are taken to reduce impact on these species. Hand collection is highly selective and the opportunities for interaction with protected species are limited (*DEH Assessment of the Coral Sea Fishery 2004*). Fishing Activity Reports have reported that no wildlife interactions have occurred (FAR 2004/05). Interaction with TEP species in the hand collection sectors is expected to be negligible. Night lighting of boats may also impact birds, but impact would be expected to be minimal (*CSF workshop, Nov 2005*).
Habitat issues and interactions	*List any issues for any of the habitat units identified in* ***Scoping Document S1.2****. This should include reference to any protected, threatened or listed habitats*

	There is an absence of information on which to base habitat issues and interactions. The Coral Sea Reef system comprises 6 main habitats: outer reef slope, reef crest, back reef, leeward slope or lagoon, pinnacle, and inter-reef channels. Coringa-Herald and Lihou Reef National Nature Reserves are closed to fishing due to their high conservation value. Typically reefs are isolated shallow platforms dropping off steeply into deep water, with exposed outer slope and intertidal zone of consolidated limestone (Allen 1998). Operators within the CSF describe the habitat as patchy, steep, with few banks present. There are a small number of reefs only (5-10 square miles in size) which are steep sided with large rocky outcrops/bombies rising high up on the reef sides (*CSF Workshop, Nov. 2005*). Generally, mother-boats anchor on sand and tender boats drift, but tenders in the Aquarium sub-fishery do also anchor, generally on the reefs.
Community issues and interactions	*List any issues for any of the community units identified in **Scoping Document S1.2**.* "Move on provision" employed to limit localised depletion. A voluntary 3-year rotational zoning system is presently being considered between the Hand Collection sector and Tourism operators. There is an absence of information on which to base non-target, habitat and wildlife interactions. There are no listed threatened ecological communities in the CSF area (*DEH Assessment of the Coral Sea Fishery 2004*)
Discarding	*Summary of discarding practices by sub-fishery, including by-catch, juveniles of target species, high-grading, processing at sea.* Due to the Hand Collection method of fishing, little incidence of species discarding should occur. Discarding of offal waste (e.g. guts, etc) after processing does occur for the L&T and SC sub-fisheries.
Management: planned and those implemented	
Management Objectives	*The management objectives from the most recent management plan* Rather than a Management Plan, a Statement of Management Arrangements 2004/05 is in place for this fishery. In November 2004, the fishery was accredited as meeting the EPBC Act requirements. The CSF does not have a formal MAC or RAG process to discuss fishery-specific research priority setting or call for research proposals. Great Barrier Reef zoning changes may re-direct more attention (illegal and recreational).
Fishery management plan	*Is there a fisheries management plan, is it in the planning stage or implemented what are the key features?* No Management Plan exists for any sector of the Coral Sea Fishery.
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.* Single jurisdiction fishing trips apply to all CSF sectors. No additional access has been granted since 1997. Prior to 2000, fishing permits were non-transferable; all

	permits were transferable by July 2002, subject to performance criteria. **Aquarium**: Operator limit and minimum of 5 fishing days per year. Chemicals and explosives use is prohibited. Maximum total net size/diameter, mesh size, handle/shaft length, and net length. Operator limit of 8 persons taking fish from nominated permit holders' boat A maximum of 2 tender boats permitted. Combined precautionary trigger of 200 days combined fishing limit (specified number of days fished per year combined with restriction on the number of persons fishing from the specified permit boat). **Lobster and Trochus**: Operator limit and minimum of 5 fishing days per year. Only hand collection permitted, with/without diving equipment. AFMA proforma must be submitted within 21 days of each fishing trip. Integrated computer vessel monitoring system (ICVMS) must be used. No more than 7 persons (crew and divers) may work from the nominated permit holders' boat. A maximum of 2 tender boats permitted. A "move on provision" provides precautionary limits- no more that 3 tonnes of lobster tail or 5 tonnes of trochus may be taken from the one reef. Once this total has been reached, collection may not continue within a 15 nautical mile anchorage. **Sea cucumber**: No minimum number of fishing days. Only hand collection permitted, with/without diving equipment. AFMA proforma must be submitted within 21 days of each fishing trip. Integrated computer vessel monitoring system (ICVMS) must be used. Prior reporting and landing notification is required. No more than 7 persons may work from the nominated permit holders' boat. A maximum of 2 tender boats permitted. A "move on provision" of no more that 5 tonnes of sea cucumber (all catch species combined). Once this total has been reached, collection may not continue within a 15 nautical mile anchorage.
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.* Taking or carrying of tuna and tuna-like species is excluded in all sectors. **Aquarium**: No output controls. **Lobster and Trochus**: Minimum tail length size limit for lobster Size range set for trochus Initial stock assessment is yet to be undertaken to determine TAC **Sea cucumber**: Catch limit arrangements exist for 5 species based on landed weight, and TACs for all take in this sector. Minimum size limit guidelines exist.
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*

<table>
<tr><td></td><td>
TEDs. Primarily focused on target species as other species are addressed below.

“Taking or carrying tuna like species” restrictions apply to all CSF sectors. Within the Hand Collection sectors, gear is only used in the Aquarium sector, and reported under “Fishing gear and methods”.

Aquarium: translocation mitigation policy of no fish to be returned to the water once caught

Species size limits are as follows:
Lobster and Trochus:
<table>
<tr><th>Common name</th><th>Size limit</th></tr>
<tr><td>All trochus species</td><td>80-125 mm range</td></tr>
<tr><td>All lobster species</td><td>125 mm minimum tail length</td></tr>
</table>
Sea cucumber: guidelines implemented by voluntary agreement
<table>
<tr><th>Common name</th><th>Species</th><th>Minimum size limit</th></tr>
<tr><td>White teatfish</td><td>Holothuria nobilis</td><td>32 cm</td></tr>
<tr><td>Black teatfish</td><td>Holothuria whitmaei / fuscogilva</td><td>25 cm</td></tr>
<tr><td>Prickly redfish</td><td>Thelenota ananas</td><td>30 cm</td></tr>
<tr><td>Sandfish</td><td>Holothuria scabra</td><td>16 cm</td></tr>
<tr><td>Lollyfish</td><td>Holothuria atra</td><td>15 cm</td></tr>
<tr><td>All other species</td><td></td><td>15 cm</td></tr>
</table>
</td></tr>
<tr><td>Regulations</td><td>
Regulations regarding species (by-catch and by-product, TEP), habitat, and community; MARPOL and pollution; rules regarding activities at sea such as discarding offal and/or processing at sea.

Restrictions to “Taking or carrying tuna like species” apply to all CSF sectors. Effectively this excludes taking of billfish (Istiophoridae, Xiphiidae), pomfrets or ray’s bream (Scombridae, Bramidae), but allows the catch of mackerels (Scomberomorus, Scomber, Acanthocybium, Grammatorcynus, Rastrelliger).

All operators are aware of MARPOL requirements. Only 1 vessel in the CSF is not covered (by vessel size or weight) within these regulations.

“Move on provisions” apply to Lobster and Trochus, & Sea cucumber sectors.
</td></tr>
<tr><td>Initiatives and strategies</td><td>
BAPs; TEDs; industry codes of conduct, MPAs, Reserves

Coringa-Herald and Lihou Reef National Nature Reserves closed to fishing for all CSF sectors due to their high conservation value.
</td></tr>
<tr><td>Enabling processes</td><td>
Monitoring (logbooks, observer data, scientific surveys); assessment (stock assessments); performance indicators (decision rules, processes, compliance; education; consultation process

Aquarium must complete Individual trip reports; Queensland state catch and effort logbook “Aquarium Fish Trip Logbook AQ03”.

Lobster and Trochus must complete Individual trip reports, CS01 (Coral Sea Line, Trawl & Collection Daily Logbook) and SESS2 (Catch Disposal Record).

Sea Cucumber must complete Individual trip reports, CS01 and CS2A (Catch Disposal Record), as well as prior reporting and landing notification.
</td></tr>
</table>

	Failure to meet performance criteria will result in permits not being renewed.
Other initiatives or agreements	*State, national or international conventions or agreements that impact on the management of the fishery/sub-fishery being evaluated.* Industry have initiated spatial management discussions for the **Sea cucumber** sector, involving a spatial rotation plan. QDPIF is developing a program for reviewing all available paperwork relevant to Sea cucumbers (*CSF Stakeholders Meeting 2005*). Considerable problems exist with Illegal, Unregulated and Unreported (IUU) fishing for teatfish in the Torres Strait (*CSF Stakeholders Meeting 2005*). A proposal has recently been presented involving a voluntary exclusion of hook fishing on a number of reefs, with a Memorandum of Understanding (MOU) to accommodate tourism practices. This MOU is expected to encompass 5 reefs. Aquarium collection operators have expressed they may also be willing to be part of this MOU (*CSF Stakeholders Meeting 2005*). Concern has been expressed over the increase in dive tourism in the CSF and the lack of apparent management. AFMA have agreed to seek clarification on the issue (*CSF Stakeholders Meeting 2005).*
Data	
Logbook data	*Verified logbook data; data summaries describe programme* There are no data summaries available for the CSF. Raw logbook data has been provided but, with the 5-boat ruling and constraints of confidentiality, can only be used in general terms. The aquarium sub-fishery logbook data is collected through Queensland Fishery Services, and provided to AFMA in paper copy only.
Observer data	*Observer programme describe parameters as below* No observer program is in operation for the CSF Hand collection sector.
Other data	*Studies, surveys* No other data is available.

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]

Total Ecological Units Assessed for CSF Sea Cucumber sub-fishery

Target species:	8
By-product species:	0
Discard Species:	0
TEP species:	109
Habitats:	44 (42 benthic, 2 overlying pelagic)
Communities:	4 (2 demersal, 2 overlying pelagic)

Scoping Document S2A Species

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

Target species *[CSF Sea Cucumber]*
This list was obtained by reviewing all available fishery literature, including AFMA logbook records, and through discussions with stakeholders.

Sp Code	CAAB	Family	Species name	Common name	Role	Source
AMB	25417004	Holothuridae	*Thelenota anax*	Amberfish	Target	CS01 logbook
CUB	25416006	Holothuridae	*Holothuria nobilis*	White teatfish	Target	CS01 logbook
CUW	25416033	Holothuridae	*Holothuria whitmaei*	Black teatfish	Target	CS01 logbook

CUC	25417007	Holothuridae	*Stichopus horrens*	Curry Fish - Beche-de-mer	Target	CS01 logbook
CUD	25416001	Holothuridae	*Actinopyga echinites*	Deepwater redfish	Target	CS01 logbook
CUE	25416032	Holothuridae	*Holothuria fuscopunctata*	Elephant's trunk fish	Target	CS01 logbook
CUF	25416009	Holothuridae	*Actinopyga lecanora*	Stonefish - Beche-de-mer	Target	CS01 logbook
CUG	25417001	Holothuridae	*Stichopus chloronotus*	Greenfish	Target	CS01 logbook
CUK	25416007	Holothuridae	*Actinopyga miliaris*	Blackfish	Target	CS01 logbook
CUL	25416003	Holothuridae	*Holothuria atra*	Lolly fish	Target	CS01 logbook
CUP	25417003	Holothuridae	*Thelenota ananas*	Prickly redfish	Target	CS01 logbook
CUR	25416002	Holothuridae	*Actinopyga mauritiana*	Surf redfish	Target	CS01 logbook
CUS	25416004	Holothuridae	*Holothuria scabra*	Sand fish	Target	CS01 logbook

Byproduct species *[CSF Sea Cucumber]*

Byproduct refers to any part of the catch which is kept or sold by the fisher but which is not a target species.

NB. No byproduct occurs in the CSF Sea Cucumber sub-fishery.

Discard species *[CSF Sea Cucumber]*

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.

NB. No discard occurs in the CSF Sea Cucumber sub-fishery.

TEP species [*CSF Sea Cucumber*]
TEP species are those species listed as Threatened, Endangered or Protected under the EPBC Act.

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

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

Taxa name	Common name	Scientific name	CAAB	Fishery
Chondrichthyan	Whale Shark	*Rhincodon typus*	37014001	CSF
Marine Bird	Streaked Shearwater	*Calonectris leucomelas*	40041002	CSF
Marine Bird	Lesser Frigatebird, Least Frigatebird	*Fregata ariel*	40050002	CSF
Marine Bird	Great Frigatebird, Greater Frigatebird	*Fregata minor*	40050003	CSF
Marine Bird	White-bellied Storm-Petrel (Australasian)	*Fregetta grallaria*	40042001	CSF
Marine Bird	Southern Giant-Petrel	*Macronectes giganteus*	40041007	CSF
Marine Bird	Red-tailed Tropicbird	*Phaethon rubricauda*	40045002	CSF
Marine Bird	Herald Petrel	*Pterodroma heraldica*	99999999	CSF
Marine Bird	Kermadec Petrel (western)	*Pterodroma neglecta*	40041033	CSF
Marine Bird	Wedge-tailed Shearwater	*Puffinus pacificus*	40041045	CSF
Marine Bird	Crested Tern	*Sterna bergii*	40128025	CSF
Marine Bird	Sooty Tern	*Sterna fuscata*	40128028	CSF
Marine Bird	Black-naped Tern	*Sterna sumatrana*	40128034	CSF
Marine Bird	Masked Booby	*Sula dactylatra*	40047004	CSF
Marine Bird	Brown Booby	*Sula leucogaster*	40047005	CSF
Marine Bird	Red-footed Booby	*Sula sula*	40047006	CSF
Marine Bird	Black Noddy	*Anous minutus*	40128001	CSF
Marine Bird	Common Noddy	*Anous stolidus*	40128002	CSF
Marine mammal	Common Dolphin	*Delphinus delphis*	41116001	CSF

Marine mammal	Pygmy Killer Whale	*Feresa attenuata*	41116002	CSF
Marine mammal	Short-finned Pilot Whale	*Globicephala macrorhynchus*	41116003	CSF
Marine mammal	Risso's Dolphin, Grampus	*Grampus griseus*	41116005	CSF
Marine mammal	Longman's Beaked Whale	*Indopacetus pacificus*	41120003	CSF
Marine mammal	Pygmy Sperm Whale	*Kogia breviceps*	41119001	CSF
Marine mammal	Dwarf Sperm Whale	*Kogia simus*	41119002	CSF
Marine mammal	Fraser's Dolphin, Sarawak Dolphin	*Lagenodelphis hosei*	41116006	CSF
Marine mammal	Humpback Whale	*Megaptera novaeangliae*	41112006	CSF
Marine mammal	Blainville's Beaked/Dense-beaked Whale	*Mesoplodon densirostris*	41120005	CSF
Marine mammal	Gingko-toothed/Ginko Beaked Whale	*Mesoplodon gingkodens*	41120006	CSF
Marine mammal	Strap-toothed/ Layard's Beaked Whale	*Mesoplodon layardii*	41120009	CSF
Marine mammal	Killer Whale, Orca	*Orcinus orca*	41116011	CSF
Marine mammal	Melon-headed Whale	*Peponocephala electra*	41116012	CSF
Marine mammal	Sperm Whale	*Physeter catodon*	41119003	CSF
Marine mammal	False Killer Whale	*Pseudorca crassidens*	41116013	CSF
Marine mammal	Spotted/Pantropical Spotted Dolphin	*Stenella attenuata*	41116015	CSF
Marine mammal	Striped Dolphin, Euphrosyne Dolphin	*Stenella coeruleoalba*	41116016	CSF
Marine mammal	Long-snouted Spinner Dolphin	*Stenella longirostris*	41116017	CSF
Marine mammal	Rough-toothed Dolphin	*Steno bredanensis*	41116018	CSF
Marine mammal	Bottlenose Dolphin	*Tursiops truncatus*	41116019	CSF
Marine mammal	Cuvier's Beaked/ Goose-beaked Whale	*Ziphius cavirostris*	41120012	CSF
Marine mammal	Sei Whale	*Balaenoptera borealis*	41112002	CSF
Marine mammal	Bryde's Whale	*Balaenoptera edeni*	41112003	CSF
Marine mammal	Blue Whale	*Balaenoptera musculus*	41112004	CSF
Marine reptile	Green Turtle	*Chelonia mydas*	39020002	CSF
Marine reptile	Estuarine/Salt-water Crocodile	*Crocodylus porosus*	39140002	CSF
Marine reptile	Leathery Turtle, Leatherback Turtle	*Dermochelys coriacea*	39021001	CSF
Marine reptile	Spectacled Seasnake	*Disteira kingii*	39125010	CSF
Marine reptile	Olive-headed Seasnake	*Disteira major*	39125011	CSF
Marine reptile	Turtle-headed Seasnake	*Emydocephalus annulatus*	39125012	CSF
Marine reptile	Beaked Seasnake	*Enhydrina schistosa*	39125013	CSF
Marine reptile	Elegant Seasnake	*Hydrophis elegans*	39125021	CSF

Marine reptile	Slender Seasnake	*Hydrophis gracilis*	39125023	CSF
Marine reptile	small-headed seasnake	*Hydrophis mcdowelli*	39125025	CSF
Marine reptile	Black-banded Robust Seasnake	*Hydrophis melanosoma*	39125027	CSF
Marine reptile	a seasnake	*Hydrophis ornatus*	39125028	CSF
Marine reptile	Spine-bellied Seasnake	*Lapemis hardwickii*	39125031	CSF
Marine reptile	a sea krait	*Laticauda colubrina*	39124001	CSF
Marine reptile	a sea krait	*Laticauda laticaudata*	39124002	CSF
Marine reptile	Flatback Turtle	*Natator depressus*	39020005	CSF
Marine reptile	Yellow-bellied Seasnake	*Pelamis platurus*	39125033	CSF
Marine reptile	Horned Seasnake	*Acalyptophis peronii*	39125001	CSF
Marine reptile	Dubois' Seasnake	*Aipysurus duboisii*	39125003	CSF
Marine reptile	Spine-tailed Seasnake	*Aipysurus eydouxii*	39125004	CSF
Marine reptile	Olive Seasnake	*Aipysurus laevis*	39125007	CSF
Marine reptile	Stokes' Seasnake	*Astrotia stokesii*	39125009	CSF
Teleost	Davao Pughead Pipefish	*Bulbonaricus davaoensis*	37282038	CSF
Teleost	Short-bodied Pipefish	*Choeroichthys brachysoma*	37282042	CSF
Teleost	Sculptured Pipefish	*Choeroichthys sculptus*	37282045	CSF
Teleost	Pig-snouted Pipefish	*Choeroichthys suillus*	37282046	CSF
Teleost	Fijian Banded/Brown-banded Pipefish	*Corythoichthys amplexus*	37282047	CSF
Teleost	Yellow-banded/Network Pipefish	*Corythoichthys conspicillatus*	37282032	CSF
Teleost	Australian Messmate/Banded Pipefish	*Corythoichthys intestinalis*	37282049	CSF
Teleost	Orange-spotted/Ocellated Pipefish	*Corythoichthys ocellatus*	37282050	CSF
Teleost	Schultz's Pipefish	*Corythoichthys schultzi*	37282052	CSF
Teleost	Maxweber's Pipefish	*Cosmocampus maxweberi*	37282056	CSF
Teleost	Cleaner/Janss' Pipefish	*Doryrhamphus janssi*	37282059	CSF
Teleost	Flagtail/Negros Pipefish	*Doryrhamphus malus*	37282060	CSF
Teleost	Indian/ Blue-stripe Pipefish	*Doryrhamphus melanopleura*	37282058	CSF
Teleost	Ringed Pipefish	*Dunckerocampus dactyliophorus*	37282057	CSF
Teleost	Girdled Pipefish	*Festucalex cinctus*	37282061	CSF
Teleost	Brock's Pipefish	*Halicampus brocki*	37282065	CSF
Teleost	Red-hair/Duncker's Pipefish	*Halicampus dunckeri*	37282066	CSF
Teleost	Mud/Gray's Pipefish	*Halicampus grayi*	37282030	CSF

Teleost	Whiskered/Ornate Pipefish	*Halicampus macrorhynchus*	37282067	CSF
Teleost	Spiny-snout Pipefish	*Halicampus spinirostris*	37282070	CSF
Teleost	Ribboned Seadragon/ Pipefish	*Haliichthys taeniophorus*	37282007	CSF
Teleost	Blue-speckled/Blue-spotted Pipefish	*Hippichthys cyanospilos*	37282072	CSF
Teleost	Madura/Reticulated Freshwater Pipefish	*Hippichthys heptagonus*	37282073	CSF
Teleost	Beady/Steep-nosed Pipefish	*Hippichthys penicillus*	37282075	CSF
Teleost	Spiny Seahorse	*Hippocampus jugumus*	99999999	CSF
Teleost	Flat-face Seahorse	*Hippocampus planifrons*	37282078	CSF
Teleost	Hedgehog Seahorse	*Hippocampus spinosissimus*	99999999	CSF
Teleost	Spotted/Yellow Seahorse	*Hippocampus taeniopterus*	99999999	CSF
Teleost	Zebra Seahorse	*Hippocampus zebra*	37282080	CSF
Teleost	Anderson's/Shortnose Pipefish	*Micrognathus andersonii*	37282086	CSF
Teleost	Thorn-tailed Pipefish	*Micrognathus pygmaeus*	37282087	CSF
Teleost	Short-tailed/ River Pipefish	*Microphis brachyurus*	37282090	CSF
Teleost	Pale-blotched/Spined Pipefish	*Phoxocampus diacanthus*	37282096	CSF
Teleost	Soft-coral Pipefish	*Siokunichthys breviceps*	37282097	CSF
Teleost	Duncker's Pipehorse	*Solegnathus dunckeri*	37282098	CSF
Teleost	Pipehorse	*Solegnathus sp. 1 [in Kuiter, 2000]*	37282099	CSF
Teleost	Spiny/Australian Spiny Pipehorse	*Solegnathus spinosissimus*	37282029	CSF
Teleost	Blue-finned/Robust Ghost Pipefish	*Solenostomus cyanopterus*	37281001	CSF
Teleost	Harlequin Ghost/Ornate Ghost Pipefish	*Solenostomus paradoxus*	37281002	CSF
Teleost	Double-ended/Alligator Pipefish	*Syngnathoides biaculeatus*	37282100	CSF
Teleost	Bend Stick/Short-tailed Pipefish	*Trachyrhamphus bicoarctatus*	37282006	CSF
Teleost	Long-nosed/Straight Stick Pipefish	*Trachyrhamphus longirostris*	37282101	CSF
Teleost	Hairy Pygmy Pipehorse	*Acentronura breviperula*	37282035	CSF

Scoping Document S2 B1. 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 Coral Sea sub-fisheries were largely derived from geophysical and fishery data using Scoping method 2, as few seabed image data were available. Data were available only for the NE seamount chain from a deep sea biodiversity survey undertaken in 2003 (NORFANZ: Williams *et al*., 2006).

A list of derived Benthic habitats using Scoping method 2, for the Hand Collection Sector of the Coral Sea Fishery (Aquarium, Sea cucumber, and Lobster and Trochus sub-fisheries). This scoping method provides an overly inclusive list as a precautionary measure in the absence of habitat image data. All habitats in this list have been identified from video, and applied to this region based on depth zone and geomorphic feature. Norfanz data considered representative of the NE seamount chain. Obvious anomaly is the inclusion of sponges as the dominant faunal taxa in tropical waters, however, this term is likely to interchangeable with 'corals' in warmer waters. Blue denotes habitats occurring within the jurisdictional boundary of the fishery that are not subject to effort from Aquarium, Sea Cucumber, and Lobster and Trochus collection methods.

ERAEF record No.	ERAEF Habitat Number	Sub-biome	Feature	Habitat type	SGF Score	Depth (m)	Image available	Reference image location
2995	012	inner shelf	shelf	fine sediments, unrippled, large sponges	101	25- 100	Y	SE Image Collection
3004	094	inner shelf	shelf	fine sediments, unrippled, small sponges	102	25- 100	Y	Norfanz Image Collection
2998	016	inner shelf	shelf	fine sediments, unrippled, mixed faunal community	103	25- 100	Y	SE Image Collection
3003	093	inner shelf	shelf	fine sediments, unrippled, bioturbators	109	25- 100	N	SE Image Collection
3068	229	inner shelf	Canyon	fine sediments, current rippled, no fauna	110	25-100	Y	WA Image Collection
2997	014	inner shelf	shelf	fine sediments, wave rippled, large sponges	111	25- 100	Y	SE Image Collection
3005	095	inner shelf	shelf	fine sediments, wave rippled, no fauna	120	25- 100	N	SE Image Collection
3006	096	inner shelf	shelf	fine sediments, wave rippled, small sponges	122	25- 100	N	SE Image Collection
3012	201	inner shelf	shelf	fine sediments, wave rippled, encrustors	126	25- 100	N	SE Image Collection

3001	091	inner shelf	shelf	fine sediments, irregular, large sponges	131	25- 100	N	SE Image Collection
3002	092	inner shelf	shelf	fine sediments, irregular, small sponges	132	25- 100	N	SE Image Collection
2996	013	inner shelf	shelf	coarse sediments, unrippled, large sponges	201	25- 100	Y	SE Image Collection
3218	205	inner shelf	Shelf	Coarse sediments, current swept, mixed low epifauna	206	25-100	Y	WA Image Collection
3165	234	inner shelf	Shelf	Coarse sediments, unrippled, solitary epifauna	207	25-100	Y	WA Image Collection
2993	010	inner shelf	shelf	coarse sediments, current rippled, no fauna	210	25- 100	Y	SE Image Collection
3000	090	inner shelf	shelf	coarse sediments, current rippled, bioturbators	219	25- 100	N	SE Image Collection
2994	011	inner shelf	shelf	coarse sediments, wave rippled, large sponges	221	25- 100	Y	SE Image Collection
3151	191	inner shelf	shelf	coarse sediments, wave rippled, small sponges	222	25- 100	N	SE Image Collection
3011	200	inner shelf	shelf	coarse sediments, wave rippled, encrustors	226	25- 100	N	SE Image Collection
2992	009	inner shelf	shelf	coarse sediments, wave rippled, sedentary	227	25- 100	Y	SE Image Collection
2999	089	inner shelf	shelf	coarse sediments, irregular, encrustors	236	25- 100	N	SE Image Collection
2990	006	inner shelf	shelf	coarse sediments, subcrop, large sponges	251	25- 100	Y	SE Image Collection
3177	282	inner shelf	shelf	Coarse sediments, subcrop, mixed faunal community	253	25- 100	Y	Norfanz Image Collection
2985	001	inner shelf	shelf	gravel, current rippled, mixed faunal community	313	25- 100	Y	SE Image Collection
3008	098	inner shelf	shelf	gravel, wave rippled, no fauna	320	25- 100	Y	SE Image Collection
3007	097	inner shelf	shelf	gravel, wave rippled, bioturbators	329	25- 100	Y	SE Image Collection
3227	242	inner shelf	Shelf	Gravel, irregular, no fauna	330	25-100	Y	WA Image Collection
2991	007	inner shelf	shelf	gravel, debris flow, mixed faunal community	343	25- 100	Y	SE Image Collection
3158	199	inner shelf	shelf	cobble, wave rippled, low/ encrusting mixed fauna	426	25- 100	N	SE Image Collection
2989	005	inner shelf	shelf	cobble, debris flow, large sponges	441	25- 100	Y	SE Image Collection
3009	099	inner shelf	shelf	Igneous rock, high outcrop, large sponges	591	25- 100	N	SE Image Collection
2988	004	inner shelf	shelf	Sedimentary rock, outcrop, large sponges	671	25- 100	Y	SE Image Collection
2986	002	inner shelf	shelf	Sedimentary rock, outcrop, large sponges	691	25- 100	Y	SE Image Collection
2987	003	inner shelf	shelf	Sedimentary rock, outcrop, mixed faunal community	693	25- 100	Y	SE Image Collection
3237	271	inner shelf	Shelf	Rock/ biogenic matrix, high outcrop, large sponges	719	25-100	Y	WA Image Collection
3018	272	inner shelf	Shelf	Rock/ biogenic matrix, Wave rippled, No fauna	720	25-100	Y	WA Image Collection
3019	273	inner shelf	Shelf	Rock/ biogenic matrix,subcrop, large sponges	751	25-100	3	WA Image Collection
3020	274	inner shelf	Shelf	Rock/ biogenic matrix, subcrop, small encrustors	756	25-100	Y	WA Image Collection
3021	275	inner shelf	Shelf	Rock/ biogenic matrix, low outcrop, mixed faunal community	763	25-100	Y	WA Image Collection
3022	276	inner shelf	Shelf	Rock/ biogenic matrix, low outcrop, octocorals	765	25-100	Y	WA Image Collection
3023	277	inner shelf	Shelf	Rock/ biogenic matrix, low outcrop, mixed faunal community	773	25-100	Y	WA Image Collection
3024	278	inner shelf	Shelf	Rock/ biogenic matrix, high outcrop, mixed faunal	793	25-100	Y	WA Image Collection

				community				
3026	283	inner shelf	shelf	Bryozoan communities	XX6	25- 100	Y	Norfanz Image Collection
3135	173	outer shelf	shelf-break	mud, unrippled, no fauna	000	100- 200, 200- 700	N	SE Image Collection
3065	219	outer shelf	Shelf	mud, unrippled, small or large sponges	001	100- 200	Y	WA Image Collection
3139	177	outer shelf	shelf	mud, unrippled, low encrusting sponges	002	100- 200	N	SE Image Collection
3159	220	outer shelf	Shelf	Mud, flat, octocorals	005	100- 200	Y	WA Image Collection
3101	100	outer shelf	shelf	mud, unrippled, sedentary	007	100- 200	Y	SE Image Collection
3136	174	outer shelf	shelf-break	mud, unrippled, sedentary	007	100- 200, 200- 700	N	SE Image Collection
3140	178	outer shelf	shelf	mud, unrippled, bioturbators	009	100- 200	N	SE Image Collection
3025	279	outer shelf	Shelf	mud, current rippled, no fauna	010	100- 200	Y	WA Image Collection
3067	223	outer shelf	Shelf	mud, current rippled, bioturbators	019	100- 200	Y	WA Image Collection
3161	224	outer shelf	Shelf	mud, wave rippled, no fauna	020	100- 200	Y	WA Image Collection
3162	225	outer shelf	Shelf	Mud, irregular, bioturbators	039	100- 200	Y	WA Image Collection
3141	179	outer shelf	shelf	mud, subcrop, erect sponges	051	100- 200	N	SE Image Collection
3126	125	outer shelf	shelf	mud, subcrop, small sponges	052	100- 200	Y	SE Image Collection
3163	226	outer shelf	Shelf	Mud, subcrop, mixed faunal community	053	100- 200	Y	WA Image Collection
3142	180	outer shelf	shelf	mud, subcrop, low encrusting mixed fauna	056	100- 200	N	SE Image Collection
3113	112	outer shelf	shelf	fine sediments, unrippled, no fauna	100	100- 200	Y	SE Image Collection
3132	170	outer shelf	shelf-break	fine sediments, unrippled, no fauna	100	100- 200, 200- 700	N	SE Image Collection
3112	111	outer shelf	shelf	fine sediments, unrippled, large sponges	101	100- 200	Y	SE Image Collection
3114	113	outer shelf	shelf	Fine sediments, unrippled, small sponges	102	100- 200	Y	Norfanz Image Collection
3133	171	outer shelf	shelf-break	fine sediments, unrippled, octocorals	105	100- 200, 200- 700	N	SE Image Collection
3143	181	outer shelf	shelf	fine sediments, unrippled, encrustors	106	100- 200	N	SE Image Collection
3111	110	outer shelf	shelf	fine sediments, unrippled, bioturbators	109	100- 200	Y	SE Image Collection
3131	169	outer shelf	shelf-break	fine sediments, unrippled, bioturbators	109	100- 200, 200- 700	N	SE Image Collection
3144	183	outer shelf	shelf	fine sediments, current rippled, no fauna	110	100- 200	N	SE Image Collection
3145	184	outer shelf	shelf	fine sediments, current rippled, low/ encrusting sponges	112	100- 200	N	SE Image Collection
3105	104	outer shelf	shelf	fine sediments, current rippled, bioturbators	119	100- 200	Y	SE Image Collection
3118	117	outer shelf	shelf	fine sediments, wave rippled, no fauna	120	100- 200	N	SE Image Collection
3117	116	outer shelf	shelf	fine sediments, wave rippled, large sponges	121	100- 200	N	SE Image Collection
3120	119	outer shelf	shelf	fine sediments, wave rippled, small sponges	122	100- 200	N	SE Image Collection

3116	115	outer shelf	shelf	fine sediments, wave rippled, encrustors	126	100- 200	N	SE Image Collection
3119	118	outer shelf	shelf	fine sediments, wave rippled, sedentary	127	100- 200	N	SE Image Collection
3115	114	outer shelf	shelf	fine sediments, wave rippled, bioturbators	129	100- 200	Y	SE Image Collection
3107	106	outer shelf	shelf	fine sediments, irregular, no fauna	130	100- 200	N	SE Image Collection
3106	105	outer shelf	shelf	fine sediments, irregular, large sponges	131	100- 200	N	SE Image Collection
3108	107	outer shelf	shelf	fine sediments, irregular, small sponges	132	100- 200	N	SE Image Collection
3130	168	outer shelf	shelf-break	fine sediments, irregular, small sponges	132	100- 200, 200- 700	N	SE Image Collection
3146	185	outer shelf	shelf	fine sediments, irregular, low encrusting mixed fauna	136	100- 200	N	SE Image Collection
3129	167	outer shelf	shelf-break	fine sediments, irregular, bioturbators	139	100- 200, 200- 700	N	SE Image Collection
3147	187	outer shelf	shelf	fine sediments, irregular, bioturbators	139	100- 200	N	SE Image Collection
3148	188	outer shelf	shelf	fine sediments, rubble banks, low encrusting sponges	142	100- 200	N	SE Image Collection
3086	017	outer shelf	shelf	fine sediments, subcrop, large sponges	151	100- 200	Y	SE Image Collection
3110	109	outer shelf	shelf	fine sediments, subcrop, small sponges	152	100- 200	Y	SE Image Collection
3109	108	outer shelf	shelf	fine sediments, subcrop, mixed faunal community	153	100- 200	N	SE Image Collection
3149	189	outer shelf	shelf	fine sediments, subcrop, mixed low fauna	156	100- 200	N	SE Image Collection
3150	190	outer shelf	shelf	coarse sediments, unrippled, no fauna	200	100- 200	N	SE Image Collection
3098	030	outer shelf	shelf	coarse sediments, unrippled, mixed faunal community	203	100- 200	Y	SE Image Collection
3070	233	outer shelf	Shelf	Coarse sediments, unrippled, octocoral/ and bryozoans??	205	100- 200	Y	WA Image Collection
3094	026	outer shelf	shelf	coarse sediments, unrippled, encrustors	206	100- 200	Y	SE Image Collection
3095	027	outer shelf	shelf	coarse sediments, current rippled, no fauna	210	100- 200	Y	SE Image Collection
3093	025	outer shelf	shelf	coarse sediments, wave rippled, no fauna	220	100- 200	Y	SE Image Collection
3104	103	outer shelf	shelf	coarse sediments, wave rippled, small sponges	222	100- 200	N	SE Image Collection
3103	102	outer shelf	shelf	coarse sediments, wave rippled, encrustors	226	100- 200	N	SE Image Collection
3097	029	outer shelf	shelf	coarse sediments, irregular, large sponges	231	100- 200	Y	SE Image Collection
3088	019	outer shelf	shelf	coarse sediments, subcrop, large sponges	251	100- 200	Y	SE Image Collection
3102	101	outer shelf	shelf	coarse sediments, subcrop, small sponges	252	100- 200	N	SE Image Collection
3010	192	outer shelf	shelf	gravel/ pebble, current rippled, large sponges	311	100- 200	N	SE Image Collection
3152	193	outer shelf	shelf	gravel/ pebble, current rippled, mixed low fauna	316	100- 200	N	SE Image Collection
3121	120	outer shelf	shelf	gravel, current rippled, bioturbators	319	100- 200	N	SE Image Collection
3125	124	outer shelf	shelf	gravel, wave rippled, no fauna	320	100- 200	N	SE Image Collection
3124	123	outer shelf	shelf	gravel, wave rippled, large sponges	321	100- 200	N	SE Image Collection
3153	194	outer shelf	shelf	gravel/ pebble, wave rippled, low encrusting sponges	322	100- 200	N	SE Image Collection

3123	122	outer shelf	shelf	gravel, wave rippled, encrustors	326	100- 200	N	SE Image Collection
3154	195	outer shelf	shelf	gravel, wave rippled, encrustors	326	100- 200	N	SE Image Collection
3122	121	outer shelf	shelf	gravel, wave rippled, bioturbators	329	100- 200	Y	SE Image Collection
3092	024	outer shelf	shelf	gravel, irregular, encrustors	336	100- 200	Y	SE Image Collection
3155	196	outer shelf	shelf	gravel, wave rippled, encrustors	346	100- 200	N	SE Image Collection
3096	028	outer shelf	shelf	cobble, unrippled, large sponges	401	100- 200	Y	SE Image Collection
3156	197	outer shelf	shelf	cobble, unrippled, low/ encrusting mixed fauna	406	100- 200	N	SE Image Collection
3157	198	outer shelf	shelf	cobble, current rippled, low/ encrusting mixed fauna	416	100- 200	N	SE Image Collection
3099	032	outer shelf	shelf	cobble, subcrop, crinoids	454	100- 200	Y	SE Image Collection
3089	020	outer shelf	shelf	cobble, outcrop, crinoids	464	100- 200	Y	SE Image Collection
3073	246	outer shelf	Shelf	cobble/boulder (slab), outcrop, mixed low encrustors	466	100- 200	Y	WA Image Collection
3134	172	outer shelf	shelf-break	Igneous rock, high outcrop, no fauna	590	100- 200, 200- 700	N	SE Image Collection
3127	126	outer shelf	shelf	Sedimentary rock, subcrop, large sponges	651	100- 200	Y	SE Image Collection
3128	127	outer shelf	shelf	Sedimentary rock, subcrop, small sponges	652	100- 200	Y	SE Image Collection
3138	176	outer shelf	shelf-break	Sedimentary rock, subcrop, small sponges	652	100- 200, 200- 700	N	SE Image Collection
3090	022	outer shelf	shelf	Sedimentary rock, subcrop, mixed faunal community	653	100- 200	Y	SE Image Collection
3137	175	outer shelf	shelf-break	Sedimentary rock, subcrop, crinoids	654	100- 200, 200- 700	N	SE Image Collection
3078	254	outer shelf	Shelf	Sedimentary rock (?), low outcrop, large erect sponges	661	100- 201	Y	WA Image Collection
3167	255	outer shelf	Shelf	Sedimentary rock (?) low outcrop, mixed faunal community	663	100- 200	Y	WA Image Collection
3091	023	outer shelf	shelf	Sedimentary rock, outcrop, large sponges	671	100- 200	Y	SE Image Collection
3100	065	outer shelf	canyon	Sedimentary rock, outcrop, small sponges	672	100- 200	Y	SE Image Collection
3231	258	outer shelf	Shelf	Sedimentary rock (?), low outcrop, mixed faunal community	673	100- 200	Y	WA Image Collection
3169	259	outer shelf	Shelf	Rock (sedimentary?), outcrop (low, holes and cracks etc), encrustors	676	100- 200	Y	WA Image Collection
3170	260	outer shelf	Shelf	Rock (sedimentary?), outcrop, solitary	677	100- 200	Y	WA Image Collection
3175	280	outer shelf	Shelf	Rock (sedimentary?), high outcrop, solitary	681	100- 201	Y	WA Image Collection
3079	263	outer shelf	Shelf	Rock (sedimentary?), high outcrop, ?small sponges	682	100- 200	Y	WA Image Collection
3234	266	outer shelf	Shelf	Rock (sedimentary?),, high outcrop, large sponges	691	100- 200	Y	WA Image Collection
3235	268	outer shelf	Shelf	Sedimentary rock (?), high outcrop, mixed faunal community	693	100- 200	Y	WA Image Collection
3087	018	outer shelf	shelf	Sedimentary rock, outcrop, encrustors	696	100- 200	Y	SE Image Collection
3176	281	outer shelf	Shelf	Rock/ biogenic matrix, low outcrop, mixed faunal community	763	100-200	Y	WA Image Collection
3064	166	outer shelf	shelf-break	Bryozoan based communities	XX6	100- 200	Y	Norfanz Image Collection

3013	202	upper slope	Slope	mud, unrippled, no fauna	000	200- 700	Y	WA Image Collection
3213	143	upper slope	slope	mud, unrippled, large sponges	001	200- 700	N	SE Image Collection
3212	142	upper slope	slope	mud, unrippled, encrustors	006	200- 700	Y	SE Image Collection
3214	144	upper slope	slope	mud, unrippled, sedentary	007	200- 700	Y	SE Image Collection
3211	141	upper slope	slope	mud, unrippled, bioturbators	009	200- 700	Y	SE Image Collection
3210	140	upper slope	slope	mud, irregular, bioturbators	039	200- 700	Y	SE Image Collection
3188	046	upper slope	slope	fine sediments, unrippled, no fauna	100	200- 700	Y	SE Image Collection
3164	227	upper slope	Slope	Fine sediments, unrippled, sponges	101	200- 700	Y	WA Image Collection
3207	137	upper slope	slope	Fine sediments, unrippled, small sponges	102	200- 700	Y	Norfanz Image Collection
3206	136	upper slope	slope	fine sediments, unrippled, encrustors	106	200- 700	Y	SE Image Collection
3198	078	upper slope	slope, canyon	fine sediments, unrippled, sedentary	107	200- 700	Y	SE Image Collection
3186	044	upper slope	slope, canyon	fine sediments, unrippled, bioturbators	109	200- 700	Y	SE Image Collection
3204	133	upper slope	slope	fine sediments, current rippled, no fauna	110	200- 700	N	SE Image Collection
3195	073	upper slope	canyon	fine sediments, irregular, encrustors	136	200- 700	Y	SE Image Collection
3069	231	upper slope	Slope	Fine sediments, irregular, glass sponge (stalked)	137	200- 700	Y	WA Image Collection
3184	041	upper slope	slope	fine sediments, irregular, bioturbators	139	200- 700	Y	SE Image Collection
3205	134	upper slope	slope	fine sediments, subcrop, large sponges	151	200- 700	N	SE Image Collection
3197	077	upper slope	canyon, slope	fine sediments, subcrop, small sponges	152	200- 700	Y	SE Image Collection
3183	040	upper slope	slope	fine sediments, subcrop, sedentary	157	200- 700	Y	SE Image Collection
3027	284	upper slope	slope	Coarse sediments, unrippled, large sponges	201	200- 700	Y	Norfanz Image Collection
3238	285	upper slope	slope	Coarse sediments, unrippled, octocorals	205	200- 700	Y	Norfanz Image Collection
3185	043	upper slope	slope	coarse sediments, unrippled, low mixed encrustors	206	200- 700	Y	SE Image Collection
3187	045	upper slope	slope	coarse sediments, unrippled, sedentary	207	200- 700	Y	SE Image Collection
3016	235	upper slope	Slope	Coarse sediments, rippled, no fauna	210	200- 700	Y	WA Image Collection
3221	236	upper slope	Slope	Coarse sand, rippled, solitary epifauna	217	200- 700	Y	WA Image Collection
3222	237	upper slope	Slope	Coarse sand, wave rippled, bryozoan turf	226	200- 700	Y	WA Image Collection
3223	238	upper slope	Slope	Coarse sediments, irregular, octocorals	235	200- 700	Y	WA Image Collection
3196	076	upper slope	canyon, slope	coarse sediments, irregular, low mixed encrustors	236	200- 700	Y	SE Image Collection
3194	072	upper slope	canyon, slope	coarse sediments, irregular, bioturbators	239	200- 700	Y	SE Image Collection
3224	239	upper slope	Slope	Coarse sediments, subcrop, large (?) sponges	251	200- 700	Y	WA Image Collection
3225	240	upper slope	Slope	Sedimentary, subcrop, octocorals	255	200- 700	Y	WA Image Collection
3226	241	upper slope	Slope	Coarse sediments, subcrop, low encrusting community (ascidians)	256	200- 700	Y	WA Image Collection

3209	139	upper slope	slope	gravel, debris flow, no fauna	340	200- 700	N	SE Image Collection
3208	138	upper slope	slope	gravel, debris flow, encrustors	346	200- 700	Y	SE Image Collection
3201	130	upper slope	slope	cobble, debris flow, no fauna	440	200- 700	Y	SE Image Collection
3203	132	upper slope	slope	cobble, debris flow, small sponges	442	200- 700	Y	SE Image Collection
3202	131	upper slope	slope	cobble, debris flow, octocorals	445	200- 700	N	SE Image Collection
3200	129	upper slope	slope	cobble, debris flow, encrustors	446	200- 700	Y	SE Image Collection
3239	286	upper slope	slope	Cobble/ boulder, debris, sedentary	447	200- 700	Y	Norfanz Image Collection
3191	069	upper slope	canyon	cobble, outcrop, crinoids	464	200- 700	Y	SE Image Collection
3166	247	upper slope	slope	Boulders, low outcrop, no fauna	470	200- 700	Y	Norfanz Image Collection
3240	287	upper slope	slope	slabs and boulders, low outcrop, octocorals	475	200- 700	Y	Norfanz Image Collection
3241	288	upper slope	slope	Igneous Rock (?), low outcrop, octocorals	565	200- 700	Y	Norfanz Image Collection
3242	289	upper slope	slope	Igneous Rock (?), low outcrop, mixed faunal community	573	200- 700	Y	Norfanz Image Collection
3243	290	upper slope	slope	Igneous Rock (?), high outcrop, no fauna	590	200- 700	Y	Norfanz Image Collection
3244	291	upper slope	slope	Igneous Rock (?), high outcrop, mixed faunal community	593	200- 700	Y	Norfanz Image Collection
3076	251	upper slope	Slope	Sedimentary rock, subcrop, no fauna	650	200- 700	Y	WA Image Collection
3190	067	upper slope	canyon, slope	Sedimentary rock, subcrop, large sponges	651	200- 700	Y	SE Image Collection
3192	070	upper slope	canyon	Sedimentary rock, subcrop, small sponges	652	200- 700	Y	SE Image Collection
3178	033	upper slope	slope	Sedimentary rock, subcrop, mixed faunal community	653	200- 700	Y	SE Image Collection
3217	148	upper slope	slope	Sedimentary rock, subcrop, octocorals	655	200- 700	N	SE Image Collection
3181	036	upper slope	slope	Sedimentary rock, subcrop, encrustors	656	200- 700	Y	SE Image Collection
3245	292	upper slope	slope	Sedimentary Rock (?), subcrop, sedentary (with trawl marks)	657	200- 700	Y	Norfanz Image Collection
3168	256	upper slope	Slope	Sedimentary rock, outcrop, octocorals	665	200- 700	Y	WA Image Collection
3180	035	upper slope	slope	Sedimentary rock, outcrop, encrustors	666	200- 700	Y	SE Image Collection
3230	257	upper slope	Shelf break	Sedimentary rock, low outcrop, no fauna	670	200- 700	3	WA Image Collection
3215	145	upper slope	canyon, slope	Sedimentary rock, low outcrop, large sponges	671	200- 700	N	SE Image Collection
3216	146	upper slope	slope	Sedimentary rock, low outcrop, small sponges	672	200- 700	Y	SE Image Collection
3193	071	upper slope	Shelf break	Sedimentary, low outcrop, small encrustors	676	200- 700	3	WA Image Collection
3171	261	upper slope	Slope	Sedimentary, outcrop, sedentary (anemones)	677	200- 700	Y	WA Image Collection
3172	264	upper slope	Slope	Sedimentary, high outcrop, octocoral	683	200- 700	Y	WA Image Collection
3182	039	upper slope	slope	Sedimentary rock, outcrop, crinoids	684	200- 700	Y	SE Image Collection
3233	265	upper slope	Slope	Sedimentary rock (mudstone?), high outcrop, no fauna	690	200- 700	3	WA Image Collection
3173	267	upper slope	Slope	Sedimentary rock (mudstone?), high outcrop, small sponges	692	200- 700	Y	WA Image Collection
3189	066	upper slope	canyon	Sedimentary rock, outcrop, crinoids	694	200- 700	Y	SE Image Collection

3174	269	upper slope	Slope	Sedimentary, outcrop, octocorals	695	200- 700	Y	WA Image Collection
3179	034	upper slope	slope	Sedimentary rock, outcrop, encrustors	696	200- 700	Y	SE Image Collection
3236	270	upper slope	Slope	Sedimentary, high outcrop, solitary epifauna	697	200- 700	Y	WA Image Collection
3246	293	upper slope	slope	Rock/ biogenic matrix, low outcrop, mixed faunal community	763	200- 700	Y	Norfanz Image Collection
3199	128	upper slope	slope	Bryozoan based communities	XX6	200- 700	Y	Norfanz Image Collection
3059	161	mid-slope	slope	mud, unrippled, small sponges	002	700- 1500	N	SE Image Collection
3160	221	mid-slope	Slope	Mud, irregular (bioturbators), crinoids/ featherstars on whip	005	700-1500	Y	WA Image Collection
3066	222	mid-slope	Slope	Mud, flat, solitary	007	700-1500	Y	WA Image Collection
3056	158	mid-slope	slope	mud, current rippled, bioturbators	019	700- 1500	N	SE Image Collection
3058	160	mid-slope	slope	mud, irregular, sedentary	037	700- 1500	N	SE Image Collection
3057	159	mid-slope	slope	mud, irregular, bioturbators	039	700- 1500	N	SE Image Collection
3055	156	mid-slope	slope	Fine sediments, unrippled, no fauna	100	700- 1500	Y	Norfanz Image Collection
3042	063	mid-slope	slope	fine sediments, unrippled, octocorals	105	700- 1500	Y	SE Image Collection
3219	228	mid-slope	Slope	Fine, unrippled, solitary	107	700-1500	Y	WA Image Collection
3247	294	mid-slope	slope	Fine sediments, unrippled, bioturbators	109	700- 1500	Y	Norfanz Image Collection
3015	230	mid-slope	Slope	fine sediments, irregular, no fauna	130	700-1500	Y	WA Image Collection
3040	061	mid-slope	slope	fine sediments, irregular, bioturbators	139	700- 1500	Y	SE Image Collection
3036	057	mid-slope	slope	fine sediments, subcrop, bioturbators	150	700- 1500	Y	SE Image Collection
3220	232	mid-slope	Slope	Fine sediments, subcrop, octocorals	155	700-1500	Y	WA Image Collection
3080	295	mid-slope	slope	Fine sediments, subcrop, encrustors	156	700- 1500	Y	Norfanz Image Collection
3052	153	mid-slope	slope	coarse sediments, unrippled, no fauna	200	700- 1500	N	SE Image Collection
3041	062	mid-slope	slope	coarse sediments, unrippled, octocorals	205	700- 1500	Y	SE Image Collection
3049	150	mid-slope	slope	coarse sediments, current rippled, no fauna	210	700- 1500	N	SE Image Collection
3050	151	mid-slope	slope	coarse sediments, current rippled, octocorals	215	700- 1500	N	SE Image Collection
3051	152	mid-slope	slope	Coarse sediments, current rippled, sedentary	217	700- 1500	Y	Norfanz Image Collection
3081	296	mid-slope	slope	Coarse sediments, irregular, no fauna	230	700- 1500	Y	Norfanz Image Collection
3038	059	mid-slope	slope	coarse sediments, irregular,low encrusting	236	700- 1500	Y	SE Image Collection
3082	297	mid-slope	slope	Coarse sediments, subcrop, no fauna	250	700- 1500	Y	Norfanz Image Collection
3083	298	mid-slope	slope	Coarse sediments, low outcrop, no fauna	260	700- 1500	Y	Norfanz Image Collection
3017	243	mid-slope	Slope	Gravel, irregular, low encrustings	336	700-1500	2	WA Image Collection
3037	058	mid-slope	slope	cobble, unrippled, small sponges	402	700- 1500	Y	SE Image Collection
3071	244	mid-slope	Slope	Igneous rock/boulder, rubble bank, none	440	700-1500	Y	WA Image Collection
3053	154	mid-slope	slope	cobble, debris flow, crinoids	444	700- 1500	N	SE Image Collection

3054	155	mid-slope	slope	slabs/ boulders, debris flow, octocorals	445	700- 1500	Y	SE Image Collection
3029	050	mid-slope	slope	cobble, debris flow, encrustors	446	700- 1500	Y	SE Image Collection
3072	245	mid-slope	Slope	boulders and slabs, subcropping, octocorals	455	700-1500	Y	WA Image Collection
3030	051	mid-slope	slope	cobble, outcrop, no fauna	460	700- 1500	Y	SE Image Collection
3039	060	mid-slope	slope	cobble, outcrop, crinoids	464	700- 1500	Y	SE Image Collection
3043	064	mid-slope	slope	Sedimentary slab and mud boulders, outcrop, crinoids	464	700- 1500	Y	SE Image Collection
3228	248	mid-slope	Slope	Igneous rock, rubble bank, no fauna	540	700-1500	Y	WA Image Collection
3074	249	mid-slope	Seamount	Igneous rock, rubble bank, octocorals	545	700-1500	Y	WA Image Collection
3032	053	mid-slope	slope	Igneous rock, low outcrop, sedentary	567	700- 1500	Y	SE Image Collection
3075	250	mid-slope	Seamount	Igneous rock, low outcrop, no fauna	570	700-1500	Y	WA Image Collection
3014	213	mid-slope	Seamount	Igneous rock (?), outcrop, octocoral	575	700-1500	Y	WA Image Collection
3028	049	mid-slope	slope	Igneous rock, high outcrop, crinoids	594	700- 1500	Y	SE Image Collection
3085	157	mid-slope	slope	Igneous rock, high outcrop, octocorals	595	700- 1500	N	SE Image Collection
3046	081	mid-slope	seamount	Sedimentary rock, unrippled, no fauna	600	700- 1500	Y	SE Image Collection
3048	085	mid-slope	seamount	Sedimentary rock, unrippled, encrustors	606	700- 1500	Y	SE Image Collection
3034	055	mid-slope	slope	Sedimentary rock, unrippled, sedentary	607	700- 1500	Y	SE Image Collection
3060	162	mid-slope	slope	Sedimentary rock, debris flow, crinoids	644	700- 1500	N	SE Image Collection
3062	164	mid-slope	slope	Sedimentary rock, subcrop, crinoids	654	700- 1500	Y	SE Image Collection
3063	165	mid-slope	slope	Sedimentary rock, subcrop, octocorals	655	700- 1500	Y	SE Image Collection
3229	252	mid-slope	Slope	Sedimentary, subcrop, small encrustors	656	700-1500	2	WA Image Collection
3077	253	mid-slope	Slope	rock (conglomerate/sedimentary), subcrop, bioturbators	659	700-1500	Y	WA Image Collection
3035	056	mid-slope	slope, canyons, seamounts	Sedimentary rock, outcrop, mixed faunal community	673	700- 1500	Y	SE Image Collection
3031	052	mid-slope	slope	Sedimentary rock, outcrop, octocorals	675	700- 1500	Y	SE Image Collection
3044	071	mid-slope	canyon	Sedimentary rock, outcrop, encrustors	676	700- 1500	Y	SE Image Collection
3045	080	mid-slope	seamount	Sedimentary rock, outcrop, encrustors	676	700- 1500	Y	SE Image Collection
3047	084	mid-slope	seamount	Sedimentary rock, outcrop, sedentary	677	700- 1500	Y	SE Image Collection
3232	262	mid-slope	Slope	sedimentary/mudstone, high outcrop, no fauna	680	700-1500	Y	WA Image Collection
3033	054	mid-slope	slope	Sedimentary rock, outcrop, crinoids	694	700- 1500	Y	SE Image Collection
3061	163	mid-slope	slope	Sedimentary rock, high outcrop, octocorals	695	700- 1500	Y	SE Image Collection

Scoping Document S2 B2. Pelagic Habitats

A list of the pelagic habitats for the Hand Collection Sector of the Coral Sea Fishery. Blue denotes habitats occurring within the jurisdictional boundary of the fishery that are not subject to effort from Sea Cucumber, Lobster and Trochus, and Aquarium collection methods.

ERAEF Habitat Number	Pelagic Habitat type	Depth (m)	Comments	Reference
P4	North Eastern Pelagic Province - Oceanic	0 – > 600	this is a compilation of the range covered by Oceanic Community (1) and (2)	dow167A1, A2, A4
P5	Northern Pelagic Province - Coastal	0 – 200		dow167A1, A2, A4
P15	North Eastern Pelagic Province - Plateau	0 – > 600	this is a compilation of the range covered by the Northeastern Plateau Community (1) and (2)	dow167A1, A2, A4
P16	North Eastern Pelagic Province - Seamount Oceanic	0 – > 600	this is a compilation of the range covered by 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 in which fishing activity occurs in CSF Sea Cucumber sub-fishery (x). Shaded cells indicate communities within the province.

Demersal community	Cape	North Eastern Transition	North Eastern	Central Eastern Transition	Central Eastern	South Eastern Transition	Central Bass	Tasmanian	Western Tas Transition	Southern	South Western Transition	Central Western	Central Western Transition	North Western	North Western Transition	Timor	Timor Transition	Heard & McDonald Is	Macquarie Is
Inner Shelf 0 – 110m [1,2]																			
Outer Shelf 110 – 250m [1,2,]																			
Upper Slope 250 – 565m [3]																			
Mid–Upper Slope 565 – 820m[3]																			
Mid Slope 820 – 1100m[3]																			
Lower slope/ Abyssal > 1100m[6]																			
Reef 0 -110m[7, 8]																			
Reef 110-250m[8]																			
Seamount 0 – 110m			x																
Seamount 110- 250m																			
Seamount 250 – 565m																			
Seamount 565 – 820m																			
Seamount 820 – 1100m																			
Seamount 1100 – 3000m																			
Plateau 0 – 110m			x																

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

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

Scoping Document S2C2. Pelagic communities

Pelagic communities that overlie the demersal communities in which fishing activity occurs in the CSF Sea Cucumber sub-fishery (x). Shaded cells indicate all communities that exist in the province.

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

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

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

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

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

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

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

Scoping Document S3 Components and Sub-components Identification of Objectives

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
		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

Component	Core Objective	Sub-component	Example Operational Objectives	Example Indicators	Rationale
		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
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

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, 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
		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

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

Component	Core Objective	Sub-component	Example Operational Objectives	Example Indicators	Rationale
		4. Trophic/size structure	4.1 Community size spectra/trophic structure does not vary outside acceptable bounds	Size spectra of the community Number of octaves, Biomass/number in each size class Mean trophic level Number of trophic levels	4.1
		5. Bio- and geo-chemical cycles	5.1 Cycles do not vary outside acceptable bounds	Indicators of cycles, salinity, carbon, nitrogen, phosphorus flux	5.1

2.2.4 Hazard Identification (Step 4)

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

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

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

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

Scoping Document S4. Hazard Identification Scoring Sheet

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

Fishery Name: Coral Sea Fishery (CSF) –Hand Collection sector
Sub-fishery Name: Sea Cucumber sub-fishery
Date: 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 actual fishing.
	Incidental behaviour	1	Trolling, line and spear fish for private use when off watch
Direct impact without capture	Bait collection	0	No bait collection occurs
	Fishing	1	Benthic species may be disturbed by divers moving over them. Impact is considered to be minimal.
	Incidental behaviour	1	Recreational fishing when off watch. Minimal consequences
	Gear loss	0	Hand collection only – no gear used
	Anchoring/ mooring	1	Possibly damage to animals and seafloor where anchor drops. Mother boat only anchors at night. Tender boats drift off main boat. Some night fishing for SC involved. Establishment of permanent moorings is being considered by the association (CSF Stakeholders meeting 2006) to be located at the most heavily used locations, e.g. night anchor locations.
	Navigation/steaming	1	
Addition/ movement of biological material	Translocation of species	1	Could occur incidentally via boat hulls and anchor/anchor chains or entanglement in diving gear, involving introduced species or movement of species from coastal areas into the CSF area, particularly relevant for fisheries which move from shallow port areas into similarly shallow fishing areas. Ports predominantly used are Townsville, Cairns and Bundaberg.
	On board processing	1	Sea cucumbers gutted and boiled on board. Guts and water discharged offshore, away from reef, in areas of high current –voluntary code of practice
	Discarding catch	0	No discarding
	Stock enhancement	0	Does not occur.
	Provisioning	0	Does not occur.
	Organic waste disposal	1	Disposal of organic wastes (sewage) from the permit boat. MARPOL guidelines apply.
Addition of non-biological material	Debris	0	Rubbish not thrown overboard. MARPOL guidelines apply.
	Chemical pollution	1	(STET) Detergent and shampoo. MARPOL guidelines apply.
	Exhaust	1	Exhaust as a result of diesel and other engines (e.g. diesel cooker)
	Gear loss	0	Hand collection only – with the exception of diving gear, no gear is used.

Direct impact of Fishing	*Fishing Activity*	Score (0/1)	Documentation of Rationale
	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. May interact with wildlife – e.g. Dolphin riding bow wave, bird settling on boat. Night lighting may have minimal impact on wildlife
Disturb physical processes	Bait collection	0	No bait collection occurs
	Fishing	1	Divers may disturb sediment locally. Impact low
	Boat launching	0	Main vessels in fishery come from designated ports outside of the Coral Sea. Tenders launched at sea.
	Anchoring/ mooring	1	Anchoring/mooring may affect the physical processes in the area that anchors and anchor chains contact the seafloor. Mother boat anchors at night or in rough weather only. Tender boats do not anchor but drift from the mother boat. Establishment of permanent moorings is being considered by the association (CSF Stakeholders meeting 2006) to be located at the most heavily used locations, e.g. night anchor locations.
	Navigation/ steaming	1	
External Hazards (specify the particular example within each activity area)	Other capture fishery methods	1	Other hand collection sub-fisheries (Lobster/Trochus, and Aquarium), line and trawl sectors, state fisheries and recreational
	Aquaculture	0	offshore
	Coastal development	0	offshore
	Other extractive activities	0	At present, no current petroleum permits exist and no new releases have been granted for the CSF area (Department of Industry Tourism and Resources 2005 CD-ROM)
	Other non-extractive activities	1	Shipping lanes
	Other anthropogenic activities	1	Recreational fishing and diving/tourism (*CSF Stakeholders Meeting 2005*)

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 crews 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	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

Direct Impact of Fishing	Fishing Activity	Examples of Activities Include
	movements, reballasting)	the fishery.
	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

Direct Impact of Fishing	Fishing Activity	Examples of Activities Include
		flow patterns.
	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:

- Environmental Assessment Report 2003
- Statement of Management Arrangements 2004
- AFMA At a glance web page
  http://www.afma.gov.au/fisheries/ext_territories/coral_sea/at_a_glance.htm
  Last updated 14 September 2005.

Other publications that may provided information include

- Bureau of Rural Sciences (BRS) Fishery Status Reports

The detailed bibliography for the Sea Cucumber sub-fishery is included in the Reference section.

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

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

In this case, 16 out of 26 possible internal activities were identified as occurring in this fishery. Three out of 6 external activities were identified. No Bycatch component exists for the Coral Sea Fishery: Sea Cucumber sub-fishery. Thus, a total of 19 activity-component scenarios will be considered at Level 1. This results in 76 total scenarios (of 160 possible) to be developed and evaluated using the unit lists (species, habitats, communities).

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

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

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

Step1: Record the hazard identification score (absence (0) presence (1) scores) identified at step 3 at the scoping level (Scoping Document S3) onto the SICA table
Step 2: Score spatial scale of the activity
Step 3: Score temporal scale of the activity
Step 4: Choose the sub-component most likely to be affected by activity
Step 5: Choose the most vulnerable unit of analysis for the component e.g. species, habitat type or community assemblage
Step 6: Select the most appropriate operational objective
Step 7: Score the intensity of the activity for that sub-component
Step 8: Score the consequence resulting from the intensity for that sub-component
Step 9: Record confidence/uncertainty for the consequence scores
Step 10: Document rationale for each of the above steps
Step 11: Summary of SICA results
Step 12: Evaluation/discussion of Level 1
Step 13: Components to be examined at Level 2

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

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

2.3.2 Score spatial scale of activity (Step 2)

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

Spatial scale score of activity

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

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

2.3.3 Score temporal scale of activity (Step 3)

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

Temporal scale score of activity

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

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

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

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

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

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

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

2.3.6 Select the most appropriate operational objective (Step 6)

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

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

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

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

Level	Score	Description
Negligible	1	remote likelihood of detection at any spatial or temporal scale
Minor	2	occurs rarely or in few restricted locations and detectability even at these scales is rare
Moderate	3	moderate at broader spatial scale, or severe but local
Major	4	severe and occurs reasonably often at broad spatial scale
Severe	5	occasional but very severe and localised 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; L1.2 - Byproduct and Bycatch Component; L1.3 - TEP Species Component; L1.4 - Habitat Component; L1.5 - Community Component**

SICA steps 1-10. Tables of descriptions of consequences for each component and each sub component provide a guide for scoring the level of consequence (see Table5, Appendix C)

L1.1 - Target Species Component

Direct impact of fishing	Fishing Activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale	Internal / External
Capture	Bait collection	0									does not occur	I
	Fishing	1	5	3	age/size/sex structure	*Holothuria whitmaei*, black teatfish	4.3	4	3	2	fishing area between 100-500 nm, 1-100 days fished/year; although this has been given a spatial score of 5, actual fishing is restricted to features such as seamounts/reefs/bomboras and as such is localised activity within this spatial scale =>intensity severe locally; teatfish listed as overfished in BRS Status report; =>consequence likely to be localised but may become severe, catches decreasing and generally larger individuals targeted; =>confidence high using reports and logbook records. TACs and move-on provisions in place. No data is available to indicate whether move-on provisions are effective. Voluntary 3yr reef-rotation MoU to be implemented (Stakeholder Meeting April 2006).	I
	Incidental behaviour	1	5	3	behaviour/movement	black teatfish	6.1	2	1	2	Trolling, line and spear fish for private use when off watch (operator comments); Activities unlikely to affect teatfish. =>Intensity minor, =>consequence negligible. =>Confidence high by consensus.	I
Direct impact without capture	Bait collection	0									does not occur	I
	Fishing	1	5	3	population size	black teatfish	1.2	2	2	1	Logic dictates that habitat disturbance may occur by divers and may impact on teatfish numbers; sediment disturbance may effect larval settlement and so reduce recruitment, intensity minor =>consequence minor =>confidence low due to lack of data. Voluntary 3yr reef-rotation MoU to be implemented (Stakeholder Meeting April 2006)	I

	Incidental behaviour	1	5	3	behaviour/movement	black teatfish	6.1	1	1	2	Trolling, line and spear fish for private use when off watch (operator comments); Activities unlikely effect teatfish. =>Intensity minor, =>consequence negligible. =>Confidence high by consensus.	I
	Gear loss	0									does not occur	I
	Anchoring/ mooring	1	5	3	behaviour/movement	black teatfish	6.1	3	2	2	Possibly damage to animals and disturbance to seafloor where anchor drops. Mother boat only anchors at night. Tender boats drift off main boat. Some night fishing for Sea Cucumbers involved. Logic dictates that habitat disturbance may occur during anchoring and may impact on teatfish numbers; =>intensity may be severe at a local scale, =>consequence minor, =>confidence high (Operator comments CSF Workshop 2005)	I
	Navigation/ steaming	1	5	3	behaviour/movement	black teatfish	6.1	3	1	2	=>intensity moderate, particularly in localised areas =>consequence likely to be negligible, =>confidence high due to logic.	I
Addition/ movement of biological material	Translocation of species	1	5	3	population size	black teatfish	1.1	3	3	1	Could occur incidentally via boat hulls, and entanglement in diving gear and anchor/chains, involving introduced species or movement of species from coastal areas into the CSF area. Potential to impact on benthic community's species composition and thereby affecting target species through changing species competition. =>intensity localised moderate, particularly with use of tender boats increasing the scale of the activity =>consequence moderate; directly impacts benthic species =>confidence low, translocation examples from within the GBR, but no data to refute or confirm from within CSF.	I
	On board processing	1	5	3	population size	black teatfish	1.2	4	2	2	Gutted and boiled on board. Guts and water discharged offshore, away from reef, in areas of high current -code of practice; =>intensity major, =>consequence minor; =>confidence high (operator comments)	I
	Discarding catch	0									does not occur	I
	Stock enhancement	0									does not occur	I
	Provisioning	0									does not occur	I
	Organic waste disposal	1	5	3	behaviour/movement	black teatfish	6.1	2	1	1	potential for organic waste disposal =>intensity minor =>consequence likely to be negligible; =>confidence low due to lack of data	I
Addition of non-biological material	Debris	0									Rubbish not thrown overboard. MARPOL guidelines apply.	I
	Chemical pollution	1	5	3	behaviour/movement	black teatfish	6.1	2	1	1	chemical pollution (diesel, etc) likely to occur at times, =>confidence low due to lack of data	I
	Exhaust	1	5	3	behaviour/movement	black teatfish	6.1	3	1	2	=>intensity localised moderate =>consequence on benthic species likely to be negligible, =>confidence high through logic.	I

	Gear loss	0									does not occur	I
	Navigation/ steaming	1	5	3	behaviour/movement	black teatfish	6.1	3	1	2	=>intensity moderate locally =>consequence likely to be negligible for benthic species; =>confidence high due to logic.	I
	Activity/ presence on water	1	5	3	behaviour/movement	black teatfish	6.1	3	1	2	The activity of vessels will introduce noise and visual stimuli into the environment. May interact with wildlife – e.g. Dolphin riding bow wave, bird settling on boat. Night lighting may have minimal impact on wildlife. Vessel activity unlikely to affect benthic species, =>confidence high through logic.	I
Disturb physical processes	Bait collection	0									does not occur	I
	Fishing	1	5	3	population size	black teatfish	1.2	3	2	2	Teatfish may relocate due to disturbance but unlikely to move far; =>intensity moderate locally =>consequence minor =>confidence high through logic.	I
	Boat launching	0									Main vessels in fishery come from designated ports outside of Coral Sea. Tenders launched at sea.	I
	Anchoring/ mooring	1	5	3	behaviour/movement	black teatfish	6.1	3	2	1	Mother boat anchors at night or in rough weather only. Tender boats do not anchor but drift from the mother boat. Logic dictates that habitat disturbance may occur during anchoring and may impact on teatfish numbers; =>confidence low due to lack of data	I
	Navigation/steaming	1	5	3	behaviour/movement	black teatfish	6.1	3	1	2	The navigation and steaming of vessels may produce localised changes to current flows, increase sediment flux and produce added noise/vibration stimuli. =>intensity moderate; locally severe =>consequence negligible =>confidence logic	I
External Impacts (specify the particular example within each activity area)	Other fisheries	1	5	6	population size	black teatfish	1.3	3	3	2	Fishing occurs in 2 major reef areas within CSF; 7 other sub-fisheries occurring over most of year targeting range of species; =>intensity moderate- effort low and sometimes decreasing in some fisheries -none catching sea cucumbers in reef communities; =>consequence moderate - considering overfished status likely to detect changes in species composition up to 10%; =>confidence high logbook data	E
	Aquaculture	0									offshore fishery; does not occur	E
	Coastal development	0									offshore fishery; does not occur	E
	Other extractive activities	0										E
	Other non-extractive activities	1	5	5	behaviour/movement	black teatfish	6.1	2	2	1	Shipping probably occurs commonly across the Coral Sea but unlikely to impact on species. =>Intensity minor; =>consequence minor; =>confidence low	E
	Other anthropogenic activities	1	5	5	behaviour/movement	black teatfish	6.1	3	2	2	increasing tourism activity noted in reports which may increase biological, non-biological and physical disturbance factors, =>Intensity localised moderate; =>consequence moderate; =>data from stakeholder reports is considered sound so confidence high.	E

L1.2 - Byproduct and Bycatch Component;

NB. No Byproduct/bycatch component occurs in the CSF Hand collection sub-fisheries

L1.3 - TEP Species Component;

Direct impact of fishing	Fishing Activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale	Internal / External
Capture	Bait collection	0									does not occur	I
	Fishing	1	5	3	interaction with fishery	*Disteira kingii*, seasnake	7.2	2	1	1	divers may come into contact with seasnakes while diving, but capture would be unlikely, and accidental; =>intensity minor =>consequence negligible; =>confidence low	I
	Incidental behaviour	1	5	3	interaction with fishery	*Disteira kingii*, seasnake	7.2	1	1	1	Trolling, line and spear fish for private use when off watch (operator comments); Activities unlikely to impact TEP's. =>Intensity negligible =>consequence negligible. =>Confidence high by consensus.	I
Direct impact without capture	Bait collection	0									does not occur	I
	Fishing	1	5	3	population size	*Disteira kingii*, seasnake	1.1	1	1	1	divers may come into contact with seasnakes while diving; =>intensity minor -unlikely to be detected; =>consequence negligible; =>confidence low	I
	Incidental behaviour	1	5	3	interaction with fishery	*Disteira kingii*, seasnake	7.2	1	1	1	Trolling, line and spear fish for private use when off watch (operator comments); Activities unlikely effect teatfish. =>Intensity minor, =>consequence negligible. =>Confidence high by consensus.	I
	Gear loss	0									does not occur	I
	Anchoring/ mooring	1	5	3	behaviour/movement	*Calonectris leucomelas*, shearwater	6.1	3	2	1	Possibly damage to animals and disturbance to seafloor where anchor drops. Mother boat only anchors at night. Tender boats drift off main boat. Some night fishing for Sea Cucumbers involved. shearwaters may be disturbed by presence of boating; >=intensity may be severe at a local scale, =>consequence would be minor - scale of hours; =>confidence high by consensus (discussions at CSF Workshop Nov05)	I
	Navigation/ steaming	1	5	3	behaviour/movement	*Rhincodon typus*, whale shark; *Natator depressus* flatback turtle	6.2	2	1	2	whale sharks and turtles may be disturbed by boating activity; =>minor intensity; =>consequence negligible; =>confidence high	I

Addition/ movement of biological material	Translocation of species	1	5	3	population size	Pipefish species	1.1	2--3	3	1	Translocation could occur incidentally via boat hulls or anchor fouling, involving introduced species or movement of species from shallow coastal into similarly shallow fishing areas. This may indirectly effected pipefish through subsequent changes to benthic communities and removal of structures on which to attach for breeding and protection. =>Intensity known to be moderate at a broader scale, but would be severe due to localised nature of this fishery =>consequence moderate, but from other GBR examples shown to be particularly great for sedentary species or species associated with benthic structures, and greatest risk in shallower fishing areas which are by necessity those most used by hand collection => confidence low- there is no data and no observer program for the hand collection sector; data exists for areas of GBR, but no other data to refute or confirm for this sub-fishery. No mitigation measures in place.	I
	On board processing	1	5	3	interaction with fishery	*Tursiops truncatus*, bottlenose dolphin	7.2	3	2	2	Gutted and boiled on board. Guts and water discharged offshore, away from reef, in areas of high current -code of practice; =>intensity moderate, localised =>consequence minor; =>confidence high (operator comments)	I
	Discarding catch	0									does not occur	I
	Stock enhancement	0									does not occur	I
	Provisioning	0									does not occur	I
	Organic waste disposal	1	5	3	behaviour/movement	*Rhincodon typus*, whale shark	6.1	1	1	1	whale sharks may be disturbed by boating activity; =>minor intensity; =>consequence negligible; =>confidence low	I
Addition of non-biological material	Debris	0									Rubbish not thrown overboard. MARPOL guidelines apply.	I
	Chemical pollution	1	5	3	behaviour/movement	*Calonectris leucomelas*, shearwater	6.2	1	1	1	change of seabird diet may result through species changes; =>intensity negligible -remote likelihood of detection, =>consequence negligible, =>confidence low	I
	Exhaust	1	5	3	behaviour/movement	*Calonectris leucomelas*, shearwater	6.2	1	1	1	change of seabird diet may result through species changes; =>intensity negligible -remote likelihood of detection, =>consequence negligible, =>confidence low	I
	Gear loss	0									does not occur	I
	Navigation/ steaming	1	5	3	behaviour/movement	*Rhincodon typus*, whale shark; *Natator depressus* flatback turtle	6.2	2	1	2	whale sharks and turtles may be disturbed by boating activity; =>minor intensity; =>consequence negligible; =>confidence high	I
	Activity/ presence on water	1	5	3	behaviour/movement	*Calonectris leucomelas*, shearwater	6.2	2	2	1	The activity of vessels will introduce noise and visual stimuli into the environment. May interact with wildlife – e.g. Dolphin riding bow wave, bird settling on boat. Night lighting also present which may have minimal impact on wildlife. shearwaters may be disturbed by presence of boating; =>intensity minor-localised activity =>consequence would be minor; =>confidence logic	I

Disturb physical processes	Bait collection	0									does not occur	I
	Fishing	1	5	3	behaviour/movement	*Disteira kingii*, seasnake	6.1	1	1	1	divers may come into contact with seasnakes while diving; =>intensity negligible -unlikely to be detected; =>consequence negligible; =>confidence low	I
	Boat launching	0									does not occur	I
	Anchoring/ mooring	1	5	3	behaviour/movement	*Calonectris leucomelas*, shearwater	6.1	3	2	2	Mother boat anchors at night or in rough weather only. Tender boats do not anchor but drift from the mother boat. Shearwaters may be disturbed by presence of boating; => intensity may be severe at a local scale, =>consequence minor =>confidence logic	I
	Navigation/steaming	1	5	3	behaviour/movement	*Rhincodon typus*, whale shark	6.2	1	1	2	whale sharks may be disturbed by boating activity; negligible intensity; =>consequence negligible; =>confidence high	I
External Impacts (specify the particular example within each activity area)	Other fisheries	1	5	6	interaction with fishery	*Disteira kingii* spectacled seasnake	6.1	3	2	1	Fishery covers a reasonably small spatial area in which all other CSF sub-fisheries occur, using different targeting methods and gears, with only hand collection methods overlapping at these depths. Fishing occurs in 2 major reef areas within aquarium fishery; 7 other CSF sub-fisheries occurring over most of year targeting range of species; =>intensity moderate- effort low and sometimes decreasing in some fisheries; =>consequence minor - likely to detect localised interactions up to 5%; =>confidence low-no baseline data to refute or confirm	E
	Aquaculture	0									offshore fishery; does not occur	E
	Coastal development	0									offshore fishery; does not occur	E
	Other extractive activities	0										E
	Other non-extractive activities	1	5	5	population size	*Calonectris leucomelas*, shearwater	1.1	2	2	1	Shipping probably occurs commonly across the Coral Sea but unlikely to impact on species. =>Intensity minor; =>consequence minor; =>confidence low	E
	Other anthropogenic activities	1	5	5	behaviour/movement	*Calonectris leucomelas* streaked shearwater	6.1	3	2	2	shearwaters may be disturbed by presence of boating; =>intensity moderate -but localised activity =>consequence minor - scale of hours; =>confidence logic	E

L1.4 - Habitat Component;

Direct impact of fishing	Fishing Activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale	Internal / External
Capture	Bait collection	0										I
	Fishing	1	5	3	Habitat structure and Function	fine sediments, unrippled, mixed faunal community, inner shelf	5.1	1	1	2	Hand collection of sea cucumber targets sandy grounds in offshore reef systems. Activity occurs between 100-500 nm, 1-100 days fished/year; although this has been given a spatial score of 4, actual fishing is restricted to features such as seamounts/reefs/bomboras and as such is localised activity within this spatial scale. =>Intensity and consequence -Impacts likely to be localised on species but negligible on habitat. =>Confidence high species easy to collect off sandy benthos. Voluntary 3yr reef-rotation MoU being developed (Stakeholder Meeting April 2006)	I
	Incidental behaviour	1	5	3	Habitat structure and Function	North Eastern Pelagic Province - Plateau	5.1	2	1	2	Trolling, line and spear fish for private use when off watch (operator comments); Activities unlikely effect benthic sediment habitats. =>Intensity minor, =>consequence negligible. =>Confidence high by consensus.	I
Direct impact without capture	Bait collection	0										I
	Fishing	1	5	3	Habitat structure and Function	fine sediments, unrippled, mixed faunal community, inner shelf	5.1	1	1	2	Hand collection of sea cucumber targets sandy grounds in offshore reef systems. Activity occurs between 100-500 nm, 1-100 fishing days/yr; although this has been given a spatial score of 4, actual fishing is restricted to features such as seamounts/reefs/bomboras and as such is localised activity within this spatial scale. =>Intensity and consequence impacts likely to be localised on species but negligible on habitat. =>Confidence high species easy to collect off sandy benthos. Voluntary 3yr reef-rotation MoU to be implemented (Stakeholder Meeting April 2006)	I
	Incidental behaviour	1	5	3	Habitat structure and Function	North Eastern Pelagic Province - Plateau	5.1	2	1	2	Trolling, line and spear fish for private use when off watch (operator comments); Activities unlikely effect benthic sediment habitats. =>Intensity minor, =>consequence negligible. =>Confidence high by consensus.	I

	Gear loss	0										I
	Anchoring/ mooring	1	5	3	Habitat structure and Function	fine sediments, unrippled, mixed faunal community, inner shelf	5.1	2	2	1	Direct impact to coral structure will occur if anchoring occurs on bombies, most anchoring for this activity likely to occur on sandy bottoms. Mother boat only anchors at night. Tender boats drift off main boat. =>Intensity minor, relatively localised, not significant on sediments. =>Consequence minor if fishers spread effort, may be locally intense if same reef systems are harvested too frequently. =>Confidence low, documented effect, unknown extent in CSF.	I
	Navigation/ steaming	1	5	3	Habitat structure and Function	North Eastern Pelagic Province - Plateau	5.1	3	1	2	Navigation/ steaming occurs daily during fishing trips, however is scored against a higher spatial scale than actual fishing activity given traveling time to offshore reefs. The pelagic water quality may change with increased turbulence and changes in water mixing that could occur from movement of vessels through water. =>Intensity moderate. =>Consequence negligible due to remote likelihood of detection at any spatial or temporal scale, and interactions that may be occurring are not detectable against natural variation. =>Confidence scored high because of logical constraints.	I
Addition/ movement of biological material	Translocation of species	1	5	3	Habitat structure and Function	Rock/ biogenic matrix, low outcrop, mixed faunal community, inner shelf	5.1	3	3	1	Could occur incidentally via boat hulls and anchor fouling, involving introduced species or movement of species from coastal areas into the CSF area. Potential to impact on benthic communities which may affect target species. =>intensity localised moderate, particularly with use of tender boats increasing the scale of the activity =>consequence moderate. =>confidence low -other examples from within the GBR, but no data to refute or confirm from CSF.	I
	On board processing	1	5	3	Water quality	North Eastern Pelagic Province - Plateau	1.1	4	2	2	Gutted and boiled on board. Guts and water discharged offshore, away from reef, in areas of high current -code of practice; =>intensity major, =>consequence minor, scavengers likely to quickly take up discards before they reach the benthos; =>confidence high (operator comments)	I
	Discarding catch	0										I
	Stock enhancement	0										I
	Provisioning	0										I
	Organic waste disposal	1	5	3	Water quality	North Eastern Pelagic Province - Plateau	1.1	1	2	2	Organic waste disposal possible on a daily basis over the entire scale of fishing effort. Water quality of pelagic habitats is considered to experience greatest impact of organic waste disposal. Overall volume of waste likely to be too small to reach benthos, or accumulate even if it does. =>Intensity negligible. =>Consequence minor, addition of high nutrient material is realistically expected to cause short term peaks in productivity or scavenging species interactions, with minimal detectibility within minutes to hours. =>Confidence high logical constraints.	I
Addition of	Debris	0										I

non-biological material	Chemical pollution	1	5	3	Water quality	North Eastern Pelagic Province - Plateau	1.1	1	2	1	Chemical losses considered to happen infrequently. Boats not likely to be scrubbed or antifouled out at sea. =>Intensity negligible, considered an uncommon event. =>Consequence minor for pelagic habitats unless major spill, small losses likely to be dispersed rapidly in winds. =>Confidence low, there is a lack of verified data on rates and types of chemical pollution.	I
	Exhaust	1	5	3	Air quality	North Eastern Pelagic Province - Plateau	2.1	1	1	1	Emissions are created during vessel operations within sub-fishery, likely to impact bird species attracted, temporarily altering air quality while they remain in contact with the exhaust. Amounts of exhaust fumes released will vary between vessels. =>Intensity and Consequence -overall likely to be negligible and losses rapidly dispersed in breezes. =>Confidence low, little data.	I
	Gear loss	0										I
	Navigation/ steaming	1	5	3	Water quality	North Eastern Pelagic Province - Plateau	1.1	3	1	2	Navigation/ steaming occurs daily during fishing trips. Navigation and steaming adds non biological stimulus to the water column for as long as it takes the vessel to pass through a province. =>Intensity moderate. =>Consequence negligible due to remote likelihood of detection at any spatial or temporal scale, and interactions that may be occurring are not detectable against natural variation. =>Confidence scored high because of logical constraints.	I
	Activity/ presence on water	1	5	3	Habitat structure and Function	North Eastern Pelagic Province - Plateau	5.1	3	1	2	Activity/presence on water occurs over the entire spatial scale of the fishery, daily during fishing trips, and may disrupt normal habitat function as species alter behavior accordingly. =>Intensity moderate. =>Consequence negligible, remote likelihood of impact at any spatial or temporal scale. =>Confidence high, considered to occur only for length of time disturbance is present.	I
Disturb physical processes	Bait collection	0										I
	Fishing	1	5	3	Substrate quality	fine sediments, unrippled, mixed faunal community, inner shelf	3.1	1	1	2	Disturbance of coarse grained sandy sediments possible during collection of target species but unlikely to remain in suspension for long given weight. =>Intensity and consequence negligible. =>Confidence high logic	I
	Boat launching	0										I
	Anchoring/ mooring	1	5	3	Substrate quality	fine sediments, unrippled, mixed faunal community, inner shelf	5.1	2	2	1	Direct impact to coral structure will occur if anchoring occurs on bombies, most anchoring for this activity likely to occur on sandy bottoms. =>Intensity minor, relatively localised. =>Consequence minor, effect considered not significant on sediments. =>Confidence low, documented effect, unknown extent in CSF.	I
	Navigation/steaming	1	5	3	Water quality	North Eastern Pelagic Province - Plateau	1.1	3	1	2	Navigation/ steaming may occur daily during fishing season. Disturbance of physical processes will occur during the normal course of steaming throughout the fishing zone. Turbulence and disturbance of pelagic water quality is unlikely to affect normal water column processes for long. Any disruption to these processes	I

											can therefore be expected to alter habitat function only briefly for macroscopic fauna. =>Intensity moderate. =>Consequence negligible due to remote likelihood of detection at any spatial or temporal scale, and interactions that may be occurring are not detectable against natural variation. =>Confidence scored high because of logical constraints.	
External Impacts (specify the particular example within each activity area)	Other fisheries	1	5	6	Habitat structure and Function	fine sediments, unrippled, mixed faunal community, inner shelf	5.1	3	2	1	Effort overlap is only considered for hand collection sectors, as these target in similar depths but from reefs directly, whereas Sea cucumber are benthic on sandy bottoms. Fishing activity occurs over the same reef systems within a limited spatial range, over which there can be daily fishing activity during total few months a year. =>Intensity moderate, the impact was considered to be potentially severe at local scales. =>Consequence minor, it is considered that other hand collection methods will add little cumulative effect as impact on sediments minor. =>Confidence low because of insufficient knowledge of impact of hand collection methods.	E
	Aquaculture	0										E
	Coastal development	0										E
	Other extractive activities	0										E
	Other non-extractive activities	1	5	5	Water quality	North Eastern Pelagic Province - Plateau	1.1	2	2	1	Shipping probably occurs commonly across the Coral Sea but unlikely to impact on habitats. =>Intensity minor; =>consequence minor; =>confidence low	E
	Other anthropogenic activities	1	5	5	Habitat structure and Function	fine sediments, unrippled, mixed faunal community, inner shelf	5.1	3	3	2	Tourism and charter activities occur in this fishery area ~ 300 days per year, therefore spatial scale increased to accommodate trips into and out of distant ports. Must include recreational dive/ research as well as fishing activity. =>Intensity moderate over the scale of the fishery. Increasing tourism activity noted in reports. =>Consequence possibly moderate given the localised intensity in the same locations used by commercial fishers. =>Data is considered sound so confidence high.	E

L1.5 - Community Component

Direct impact of fishing	Fishing Activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale	Internal / External
Capture	Bait collection	0									No bait collection occurs	I
	Fishing	1	5	3	Functional group composition	North Eastern Plateau 0-110	2.1	3	3	1	Fishing occurring in 2 major reef areas within fishery but effort declining since 2000=>fishing can occur all year but months fished has declined since 2000 (e.g. 03-04 only 2 mo), reef communities chosen where most effort is located =>intensity moderate - several species considered overfished however fishers are required to "move on" by a minimum of 15 nm when a total combined catch of 5 tonnes have been caught; =>consequence moderate - 5 species targeted but not keystone species; possibly affect functional group composition by less than 10% but little known about recovery period =>confidence low (logbook data). Voluntary 3yr reef-rotation and MoU to be implemented (Stakeholder Meeting April 2006)	I
	Incidental behaviour	1	5	3	Species composition	North Eastern Plateau 0-110	1.1	1	1	2	Trolling, line and spear fish for private use when off watch (operator comments); may affect species composition or abundance =>Intensity minor, =>consequence negligible. =>Confidence high by consensus.	I
Direct impact without capture	Bait collection	0									No bait collection occurs	I
	Fishing	1	5	3	Functional group composition	North Eastern Plateau 0-110	2.1	2	2	1	reef community chosen where most effort is located =>intensity minor -direct hand collection therefore no post-capture mortality but possible some cucumbers are handled before rejection =>consequence minor =>confidence high based on catch data	I
	Incidental behaviour	1	5	3	Species composition	North Eastern Plateau 0-110	1.1	1	1	2	Trolling, line and spear fish for private use when off watch (operator comments); may affect species composition or abundance =>Intensity minor, =>consequence negligible. =>Confidence high by consensus.	I
	Gear loss	0										I
	Anchoring/ mooring	1	5	3	Species composition	North Eastern Plateau 0-110	1.1	2	2	1	mother ships and tenders anchor on or near reefs but activity declining since 2000 =>intensity minor -damage to reef from	I

											anchoring may disturb benthic species but very localised and changes in species composition unlikely to be detectable =>consequence minor - unlikely to detect any changes =>confidence low based on assumption	
	Navigation/ steaming	1	5	3	Species composition	North Eastern Plateau (1) 0-600m	1.1	2	1	1	Pelagic community above seamount reefs chosen where most effort is located & interaction with pelagic species most likely to occur . Navigation/steaming to port as well as on fishing grounds where pelagic species may encounter vessels causing mortality =>intensity minor - effort low and decreasing =>consequence negligible -unlikely to detect any changes to species abundance & composition =>confidence low no data	I
Addition/ movement of biological material	Translocation of species	1	5	3	Species composition	North Eastern Plateau 0-110	1.1	2	3	1	Translocation could affect species composition of the reef community via introduction of species from hull fouling, particularly of concern due to shallow nature of this sub-fishery =>intensity minor -activity only in restricted areas =>consequence moderate -effect is likely to be localised but severe and no catastrophic effects have been observed =>confidence low- there is no data or observer program for the CSF hand collection sector to refute or confirm this risk.	I
	On board processing	1	5	3	Species composition	North Eastern Plateau (1) 0-600m	1.1	4	2	2	Gutted and boiled on board. Guts and water discharged offshore, away from reef, in areas of high current -code of practice; =>intensity major, =>consequence minor if attraction to scavengers temporary unlikely to be detectable; =>confidence high (operator comments)	I
	Discarding catch	0										I
	Stock enhancement	0										I
	Provisioning	0										I
	Organic waste disposal	1	5	3	Distribution of the community	North Eastern Plateau (1) 0-600m	3.1	2	1	1	pelagic community over reef chosen where most effort is located and higher predators may be attracted to food scraps temporarily changing abundance and distribution locally =>intensity minor - effort decreasing, food scraps probably discarded - boats operating under MARPOL regulations =>consequence negligible - unlikely to detect any changes not persistent =>confidence low	I
Addition of non-biological material	Debris	0										I
	Chemical pollution	1	5	3	Species composition	North Eastern Plateau (1) 0-600m	1.1	1	1	1	pelagic community over reef chosen where most effort is located Chemical pollution could cause local mortality affecting species composition =>intensity negligible - most boats operating under MARPOL regulations however could cause local mortality if occurred =>consequence negligible - unlikely to detect any changes =>confidence low	I
	Exhaust	1	5	3	Distribution of the community	North Eastern Plateau (1) 0-600m	3.1	1	1	1	Pelagic community over reef chosen where most effort is located interaction with pelagic species most likely to occur. Exhaust unlikely to affect marine pelagic communities but may repel birds	I

											temporarily changing distribution =>intensity minor - effort low and decreasing, exhaust unlikely to affect marine pelagic communities =>consequence negligible - unlikely to detect any changes =>confidence low	
	Gear loss	0										I
	Navigation/ steaming	1	5	3	Distribution of the community	North Eastern Plateau (1) 0-600m	3.1	2	2	1	Pelagic community over reef chosen where most effort is located & interaction with pelagic species most likely to occur. Navigation and steaming of vessels will introduce noise (engine noise and echo-sounders) and visual stimuli into the environment thus changing distribution of community members =>intensity minor - effort low and decreasing. =>consequence minor unlikely to detect any changes =>confidence low	I
	Activity/ presence on water	1	5	3	Distribution of the community	North Eastern Plateau (1) 0-600m	3.1	2	2	1	Pelagic community over reef chosen where most effort is located & interaction with pelagic species most likely to occur. Activity/presences will introduce noise and visual stimuli into the environment thus changing distribution of community members =>intensity minor -effort low and decreasing. =>consequence minor unlikely to detect any changes =>confidence low	I
Disturb physical processes	Bait collection	0									No bait collection occurs	I
	Fishing	1	5	3	Distribution of the community	North Eastern Plateau 0-110	3.1	3	2	1	reef community chosen where most effort is located =>intensity moderate -effort low and decreasing , divers may disturb habitat while fishing => consequence minor -unlikely to detect any changes but benthic species distribution may be disturbed =>confidence low	I
	Boat launching	0									No ports or harbors within the Coral Sea. Vessels in fishery come from designated ports.	I
	Anchoring/ mooring	1	5	3	Distribution of the community	North Eastern Plateau 0-110	3.1	1	1	1	Reef community chosen where most effort is located =>intensity negligible -effort low and decreasing. Anchoring/mooring may affect the physical processes in the area where anchors and anchor chains contact the seafloor. =>Consequence negligible unlikely to detect any changes =>confidence low	I
	Navigation/steaming	1	5	3	Distribution of the community	North Eastern Plateau (1) 0-600m	3.1	2	1	1	boats steam to & from port, pelagic community chosen where most effort is located & interaction with pelagic species most likely to occur =>Intensity minor- effort low, navigation and steaming of vessels will change flow characteristics of water but unlikely to affect species =>Consequence negligible - unlikely to detect any changes =>confidence low	I
External Impacts (specify the particular example within each	Other fisheries	1	5	6	Species composition	North Eastern Plateau 0-110	1.1	3	3	2	Fishing occurring in 2 major reef areas within fishery=>7 other sub-fisheries occurring over most of year targeting range of species in community =>intensity moderate- effort low and sometimes decreasing in some fisheries -none catching sea cucumbers in reef communities =>consequence moderate - likely to detect changes in species composition up to 10% =>confidence high logbook data	E

activity area)	Aquaculture	0										E
	Coastal development	0										E
	Other extractive activities	0										E
	Other non-extractive activities	1	5	5	Distribution of the community	North Eastern Seamount Oceanic (1) 0-600m	1.1	2	2	1	Shipping occurs commonly across the Coral Sea and impact on distribution of community by introducing noise, visual stimuli into the pelagic community temporarily repelling species. =>Intensity minor =>consequence minor =>confidence low -no data or information	E
	Other anthropogenic activities	1	5	5	Distribution of the community	North Eastern Seamount Oceanic (1) 0-600m; North Eastern Plateau 0-110; North Eastern Plateau (1) 0-600m.	1.1	3	2	1	Recreational diving/tourism occurs in area presumably near/on the reef or seamount communities (CSF Stakeholders Meeting 2005). Activities may affect distribution of community unless significant take of fish by divers will impact species abundances and possibly community composition. =>Intensity moderate =>consequence minor =>confidence low	E

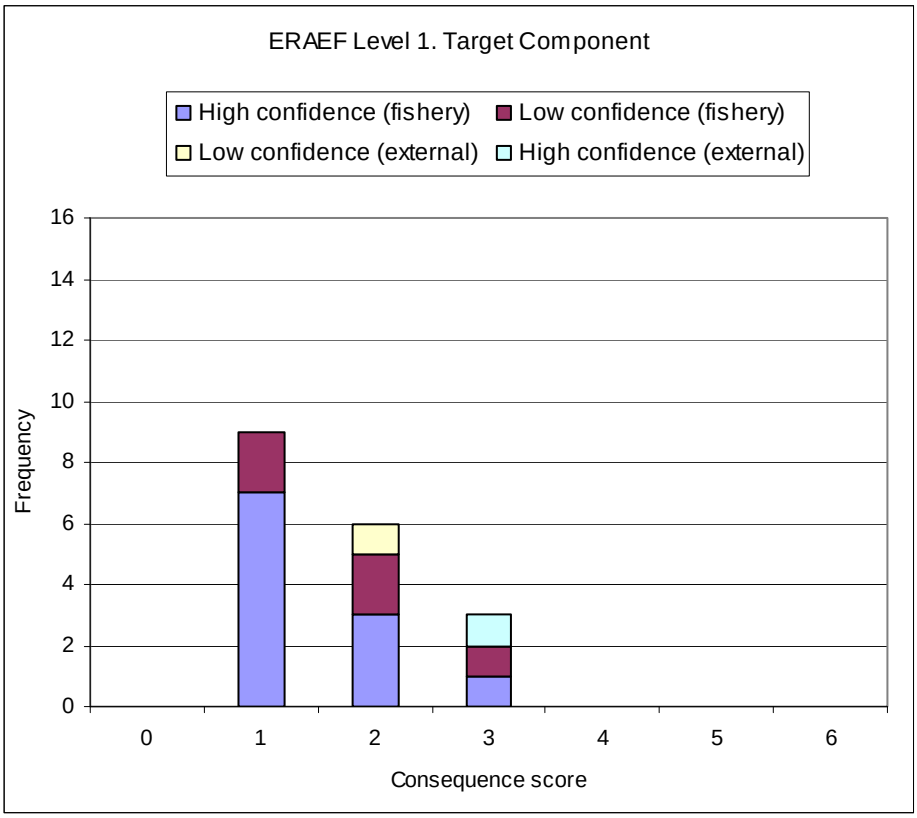
2.3.11 Summary of SICA results

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

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

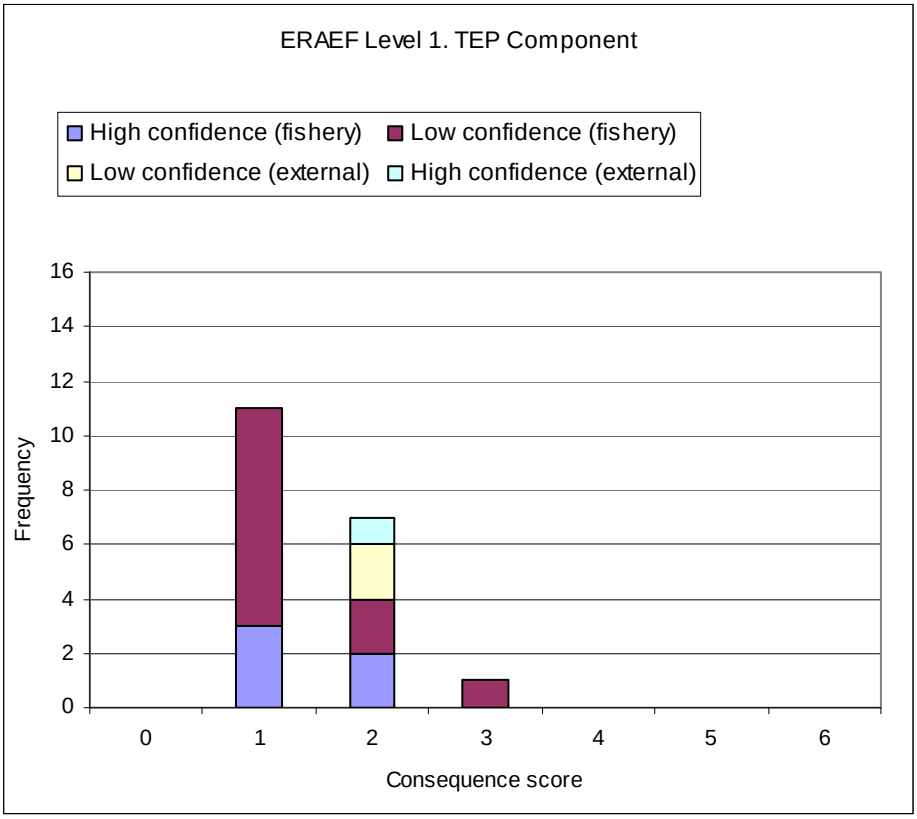
Direct impact	Activity	Target species	Byproduct and bycatch species	TEP species	Habitats	Communities
Capture	Bait collection					
	Fishing	**3**		1	**1**	3
	Incidental behaviour	**1**		1	**1**	**1**
Direct impact without capture	Bait collection					
	Fishing	2		1	**1**	2
	Incidental behaviour	**1**	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

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

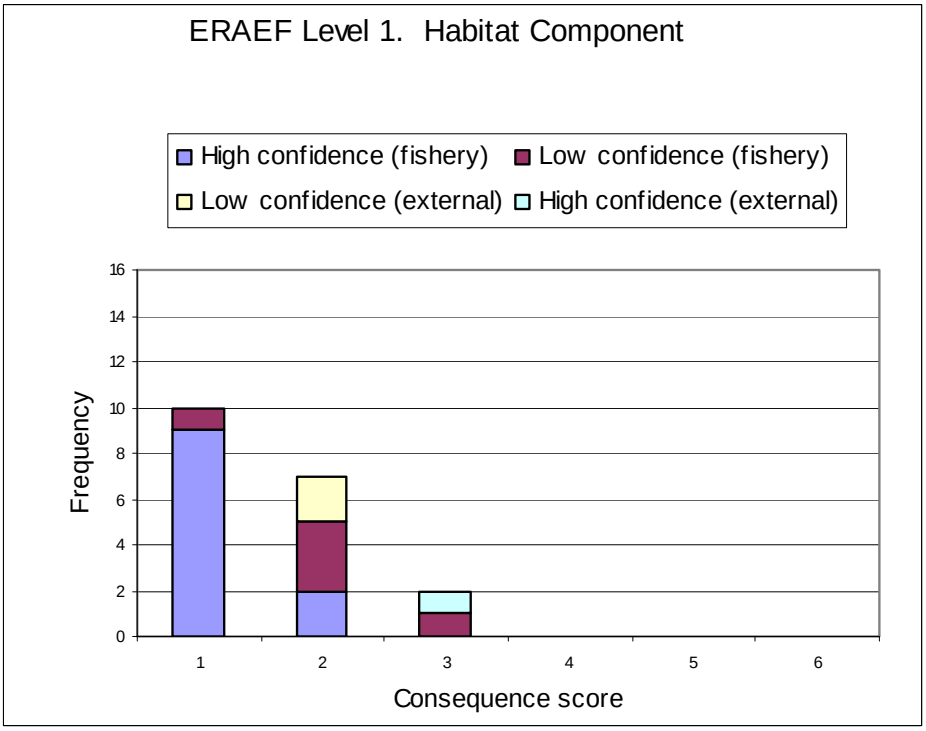


Byproduct and bycatch species:
NB. There is no associated bycatch in the CSF Sea Cucumber sub-fishery.

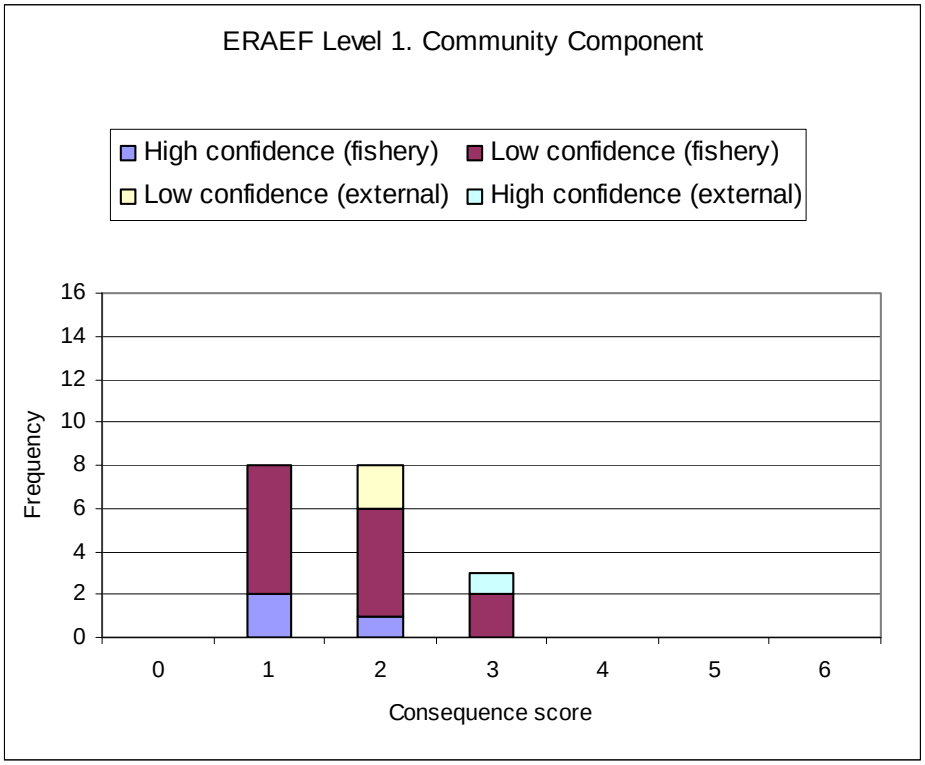
TEP species: Frequency of consequence score differentiated between high and low confidence (SICA excel workbook)



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



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



2.3.12 Evaluation/discussion of Level 1

All four components assessed in the level 1 analysis contained consequence scores three or above. The hazards involved are:

- Capture: Fishing (Target and Communities component);
- Addition of biological material: Translocation of species (all components);
- External hazards: other fisheries (Target and Communities components); and
- External hazards: Other anthropogenic activities (Habitat).

Of the hazards assessed to be significant, all are assessed at risk score 3 (moderate), and only the impact of fishing on target species has a confidence score of high. Several of the target species are considered to be overfished (BRS 2004). Little information is available on the life history and biology of the CSF sea cucumber species, but information inferred from other Australian sea cucumber fisheries suggest a 'boom and bust', slow recovery scenario for almost all regional sea cucumber fisheries (Benzie and Uthicke 2003, Stutterd and Williams 2003). The impact of fishing on community (functional group) composition has been assessed to be moderate, but the target species are not considered to be keystone species, and the confidence in this risk score is considered to be low.

Translocation of species is particularly relevant in the Hand collection sector, as the fishing vessels move between relatively shallow ports and similarly shallow offshore

fishing areas (diving depths). The lack of baseline data at a species, habitat or community level and the absence of an observer program to monitor the Hand collection sector, have resulted in low confidence levels in the assessment of this risk.

A recent BRS final report (Summerson and Curran 2005) has also noted the high risk associated with hand collection methods through entrainment of organisms and entanglement of vegetation, and recommends close inspection of all diving gear, anchor chains and anchors, to reduce translocation of motile organisms, particularly small crustacean, seastars and plant fragments. The use of the observer program has also been strongly endorsed to provide empirical data on which to assess this risk.

2.3.13 Components to be examined at Level 2

No Level 2 analysis has been conducted for the Coral Sea Fishery: Sea Cucumber Sub-fishery. Level 1 assessment for the Coral Sea Fishery: Sea Cucumber Sub-fishery has been completed as required for the ERAEF Stage 2 process. As such, further documentation in this report is included only as a means of understanding the ERAEF process in full.

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

2.4 Level 2 Productivity and Susceptibility Analysis (PSA)

NB. No PSA has been produced for the Coral Sea Fishery: Sea Cucumber Sub-fishery during the Stage 2ERA process.

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 generally 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 filed observations or expert knowledge.

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

Habitats

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

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

Communities

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

During the Level 2 assessment, each unit of analysis within each ecological component (species or habitat) is scored for risk based on attributes for productivity and susceptibility, and the results are plotted as shown in Figure 13.

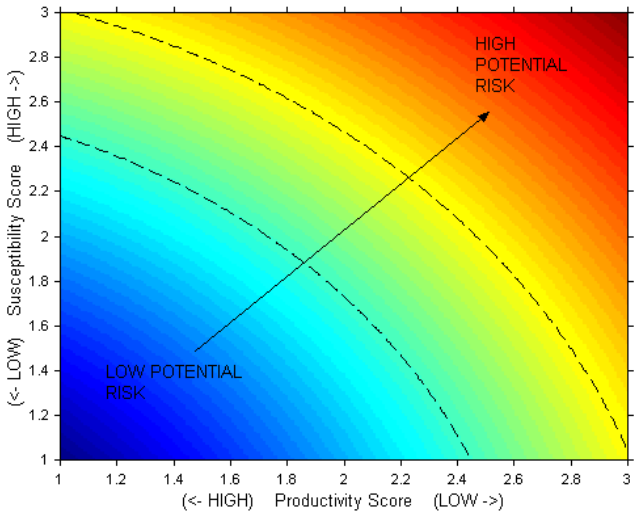


Figure 13. The axes on which risk to the ecological units is plotted. The *x*-axis includes attributes that influence the productivity of a unit, or its ability to recover after impact from fishing. The *y*-axis includes attributes that influence the susceptibility of the unit to impacts from fishing.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

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

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

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

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

ERA Species ID	Taxa Name	Scientific Name	CAAB Code	Family Name	Common Name	Role In Fishery	Source	Reason for removal

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

Summary of Species PSA results

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

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

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

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

The PSA Tables also report on “missing information” (the number of attributes with missing data that therefore score at the highest risk level by default). There are seven attributes used to score productivity and four aspects (availability, encounterability, selectivity and post capture mortality) used to score susceptibility (though encounterability is the average of two attributes). An attribute or aspect is scored as missing if there are no data available to score it, and it has defaulted to high risk for this

reason. For some species, attributes may be scored on information from related species or other supplementary information, and even though this information is indirect and less reliable than if species specific information was available, this is not scored as a missing attribute.

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

Observer data and observer expert knowledge are important sources of information in the PSA analyses, particularly for the bycatch and TEP components. There is no observer program currently in place for this sub-fishery.

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

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 4)	Productivity (additive) 1- low , 3 - high	Susceptibility (multiplicative) 1- low , 3 - high	Overall risk score 1.41- low , 4.24 - high	Override used?	PSA risk category	Comments

Summary of Habitat PSA results

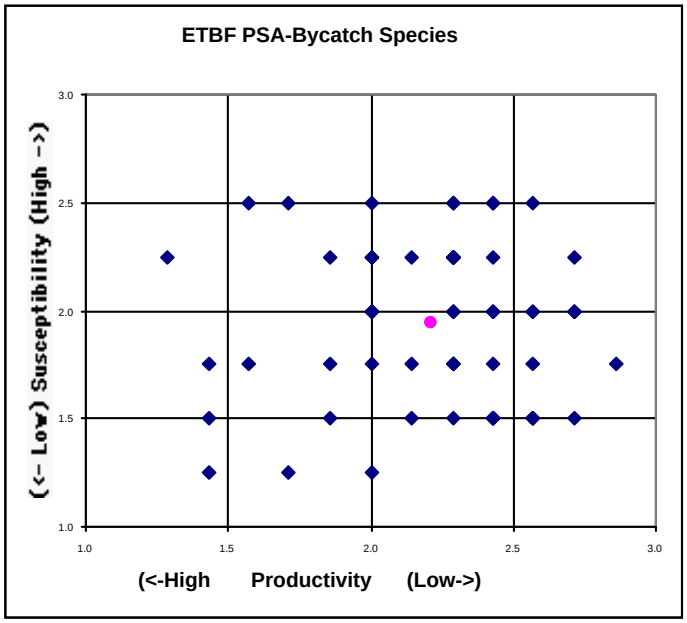
A summary of the habitats considered at Level 2 is presented below, and is sorted by the overall risk score (high, medium, low), by sub-biome, and by SGF score (Habitat type).

Record #	ERA habitat #	Sub-biome	Feature	Habitat Name	SGF Score	*n* missing attributes	Productivity score (Average)	Susceptability score (Multiplicative)	Overall Risk Score (P&Sm)	Overall Risk Ranking (2D multiplicative)	Risk ranking over-ride	Rationale

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

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

Results of the PSA plot from PSA workbook ranking worksheet would follow the format of the example below:



PSA plot for target species
PSA plot for byproduct species
PSA plot for discards/bycatch species
PSA plot for TEP species
PSA plot for habitats
PSA plot for communities

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)**.

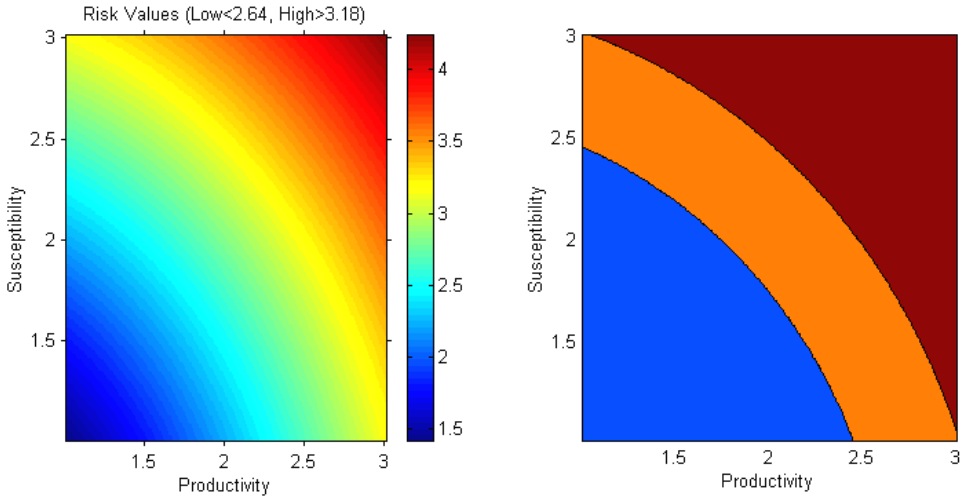


Figure 17. Overall risk values in the PSA plot. Left panel. Colour map of the distribution of the euclidean overall risk values. Right panel. The PSA plot contoured to show the low risk (blue), medium risk (orange) and high risk (red) values.

The PSA output allows identification and prioritisation (via ranking the overall risk scores) of the units (e.g. species, habitat types, communities) at greatest risk to fishing activities. This prioritisation 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/did not vary] between the attributes (as per summary below). With regard to the Productivity attributes, [least known Productivity attribute] was missing in [X]% of [units], and so the most conservative score was used, while information on [best known Productivity attribute] could be found or calculated for [Y% of units]. The current method of scoring the Susceptibility attributes provides a value for each attribute for each species – some of these are based on good information, whereas others are merely sensible default values.

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

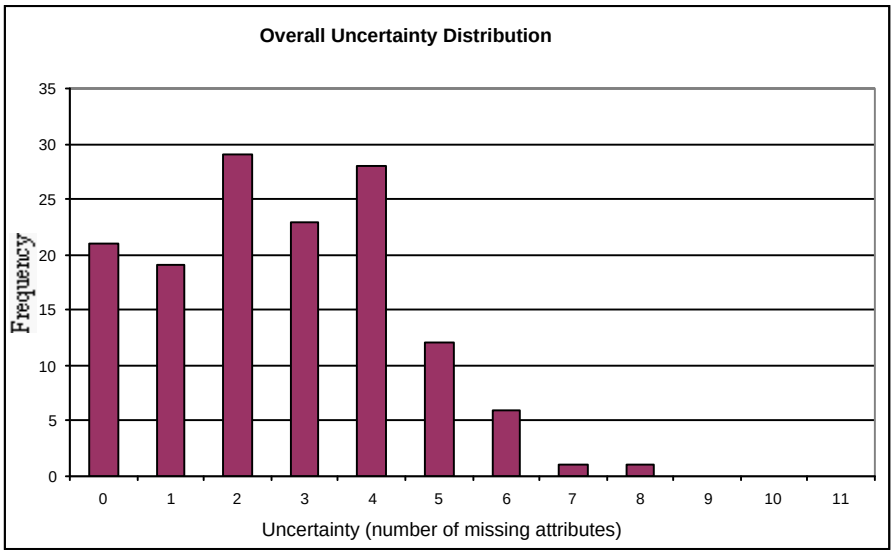
Results from PSA workbook ranking worksheet (species only).

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							
n species scores with attribute unknown, (conservative score used)							
% unknown information							
Susceptibility Attributes	Availability	Encounterability		Selectivity	PCM		
		Bathymetry overlap	Habitat				
Total species scores for attribute							
n species scores with attribute unknown, (conservative score used)							
% unknown information							

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

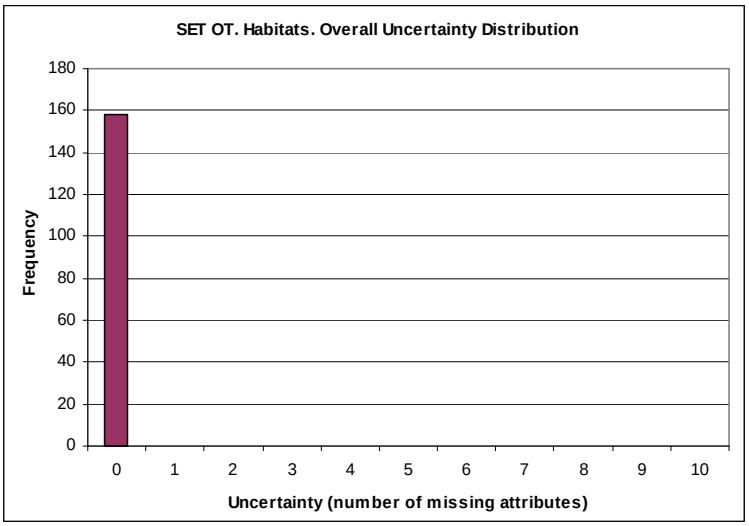
Results Overall uncertainty distribution in PSA workbook ranking graphs worksheet

Species uncertainty distribution histogram would follow the format of the example below:



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

Habitats: Twenty-one attributes are used in the habitat PSA. All attributes are scored according to Habitat attribute tables 9-27. Only attributes that could be ranked are utilised and therefore there are no missing attributes. [example below]



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: The attributes selected for productivity and susceptibility [were/were not] strongly correlated (as per correlation matrix below for Productivity

and susceptibility). The strongest productivity attribute correlation was between [attribute J and attribute K], while the strongest susceptibility correlation was between [attribute L and attribute M]. This correlation analysis suggests that each attribute [was/was not] "measuring" a different aspect of the [unit] characteristics and [all/not 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		X					
Fecundity			X				
Max size				X			
Min size at maturity					X		
Reproductive strategy						X	
Trophic level							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		X		
Selectivity			X	
Post-capture mortality				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] strongly correlated (as per correlation matrix below for productivity and susceptibility). There was [X] correlation between the productivity attributes Regeneration of Fauna and Natural disturbance (r = [x]). 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/X] correlation between the attributes used to calculate Encounterability and Selectivity. All attributes were suitable for inclusion in the PSA.

Productivity Correlation Matrix	Regeneration of fauna	Natural disturbance
Regeneration of fauna	X	
Natural disturbance	X	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	X	
Selectivity score (average)	X	X	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 Values for Species

The average productivity score for all [units] was [X ± Y] (mean ± SD of scores calculated using n-1 attributes) and the mean susceptibility score was [X ± Y] (as per summary of average productivity and susceptibility scores as below). Individual scores are shown in Appendix B: Summary of PSA results. The [small/large] variation in the average of the boot-strapped values (using n-1 attributes), indicates the productivity and susceptibility scores [are/are not] robust to elimination of a single attribute. Information for a single attribute [does not/does] have a disproportionately large effect on the productivity and susceptibility scores. Information was missing for an average of [Z] attributes out of [Y] possible for each [unit].

Productivity and Susceptibility Values for Habitat units.

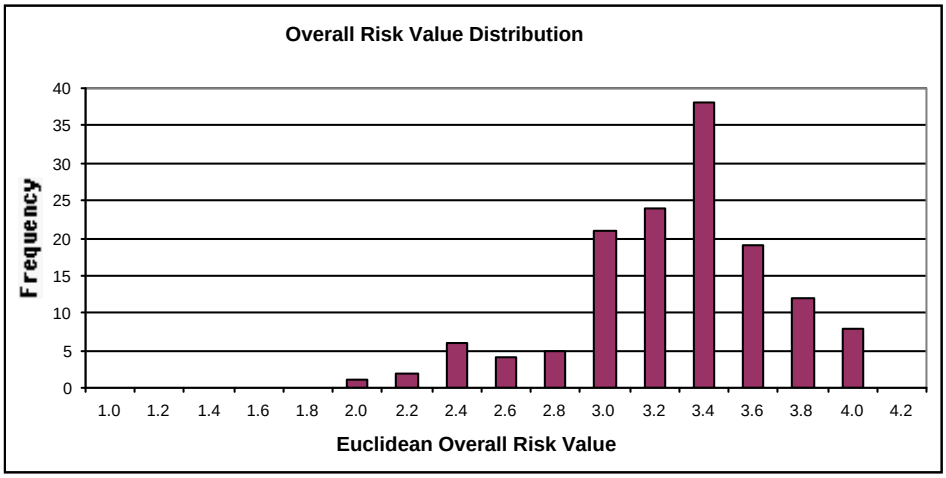
The average productivity score for all habitats was [X ± Y] (mean ± SD of scores calculated using n-1 attributes) and the mean susceptibility score was [X ± Y] (as per summary of average productivity and susceptibility scores as below). Individual scores are shown in Appendix B: Summary of PSA results. The small/large 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/does] have a disproportionately large effect on the productivity and susceptibility scores. Information was missing for an average of [Z] attributes out of [Y] possible for each [unit].

Overall Risk Values for Species

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

The actual values for each species are shown in Appendix B: Summary of PSA results. A total of [A units, (B%)] were classed as high risk, [B (C%)] were in the medium risk category, and [D (E%)] as low risk**.**

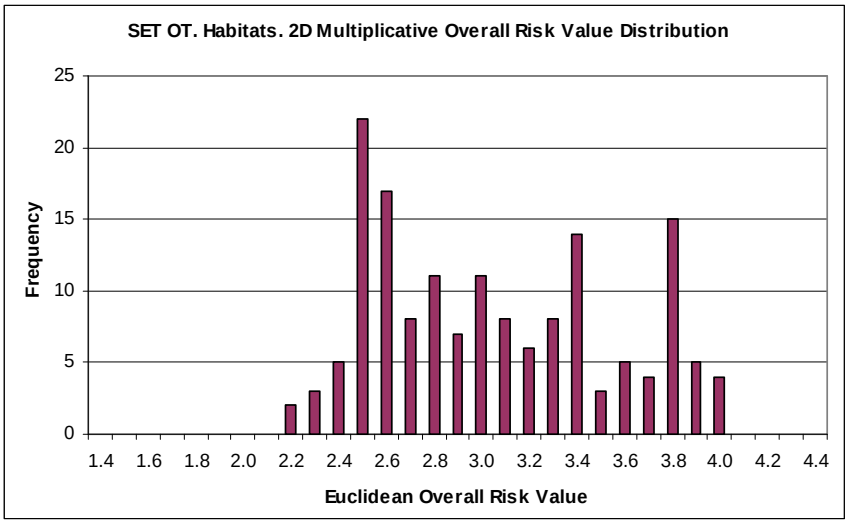
Results: Frequency distribution of the overall PSA risk values.
Evaluation example only



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

Overall Risk Values for Habitats

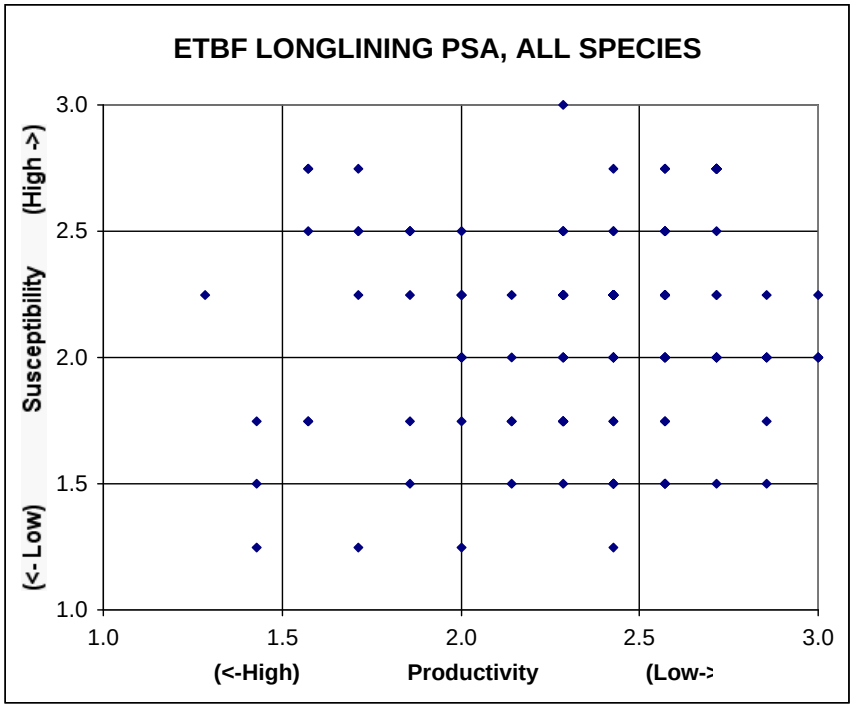
The overall risk values (Euclidean distance on the PSA plot) could fall between 1 and 4.24 (scores of 1&1 and 3&3 for both productivity and susceptibility respectively). The mean observed overall risk score was 3.01, with a range of 2.18- 3.97**.**
The actual values for each species are shown in Appendix B: Summary of PSA results. A total of 46 units, (29%) were classed as high risk, 58units, (37%) were in the medium risk category, and 54 (34%) as low risk**.**



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

The distribution of the overall risk values of all species is shown on the PSA plot below. The species are distributed in the [all/lower left/upper right] parts of the plot, indicating that [both high and low risk units] are potentially impacted in the [fishery sub-fishery].

Results Plot for all species in the sub-fishery PSA risk values.
Evaluation example only



PSA plot for all [units] in the [fishery sub-fishery]. Species in the upper right of the plot are at highest risk.

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

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

2.4.6 Evaluation of the PSA results (Step 6)

No PSA assessment was carried out for the Coral Sea Fishery: Sea Cucumber Sub-fishery during the Stage 2 ERAEF process. Level 1 assessment for the Coral Sea Fishery: Sea Cucumber Sub-fishery has been completed as required for the ERAEF Stage 2 process. Information regarding PSA analysis is included to provide a full understanding of the ERAEF process.

Species components:
Overall

Results

Discussion

Habitat components:
Overall

Results:

Summary of the average productivity, susceptibility and overall risk scores.

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

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

Risk category	High	Medium	Low	Total
Total Habitats	X	X	X	X

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

2D Risk Score	Inner-shelf	Outer-shelf	Upper-slope	Mid-slope	Total habitats
High	X	X	X	X	X
Medium	X	X	X	X	X
Low	X	X	X	X	X
Total	X	X	X	X	X

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

2D Risk Score	Inner-shelf	Outer-shelf	Upper-slope	Mid-slope	Total habitats
High	X	X	X	X	X
Medium	X	X	X	X	X
Low	X	X	X	X	X
Total	X	X	X	X	X

[No] inner shelf habitats are classified as high risk, [X] as medium risk, and [X] as low risk. [X] outer shelf habitats produce high risk scores, [X] medium and [X] are at low risk. Of the upper slope [X] are classified as high risk,[X] at medium and [no] upper slope habitats appear at low risk. Habitats at mid-slope depths are either at high risk (X) or at medium risk (X), none are considered low risk.

Discussion

****

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.

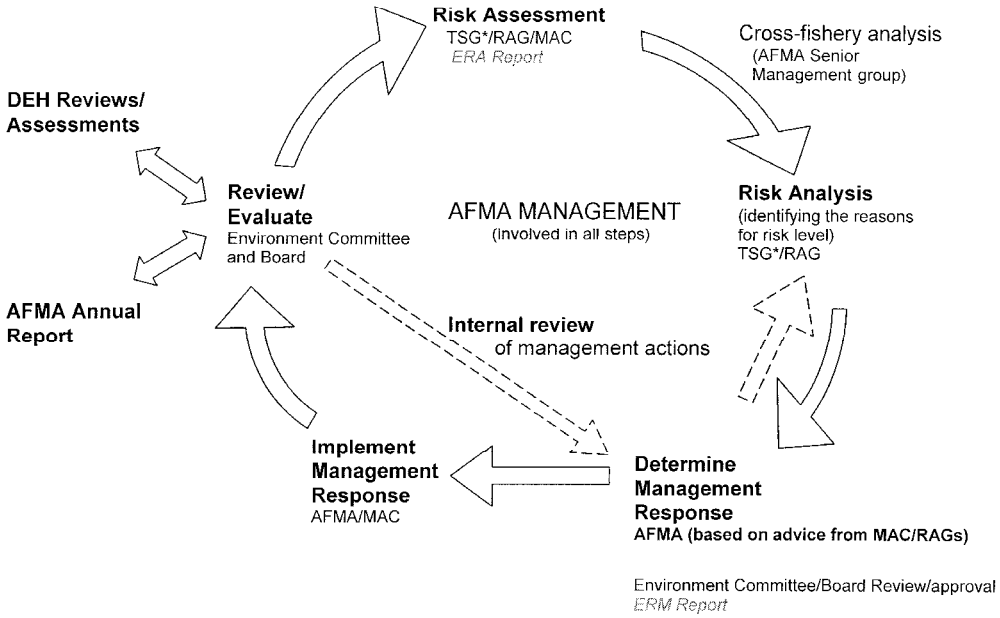
For example, if in a Level 2 analysis of habitat types, two of seven habitat types were determined to have risk from the sub-fishery, only those two habitat types would be considered at Level 3.

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.

2.5 Level 3

No Level 3 analyses have been undertaken for species, habitats or communities associated with the Coral Sea Fishery: Sea Cucumber sub-fisheries.

3. General discussion and research implications

The Coral Sea Fishery: Sea Cucumber sub-fishery is one of three Hand collection sub-fisheries in this fishery zone. It operates in diving depths only, with no gear employed other than diving equipment. A maximum of two tender boats may be used, with no more than 7 persons working from the nominated permit holder's boat.

Due to the overfished status of the blackteatfish (*Holothuria whitmaei*) and concerns raised by a 2002 preliminary assessment for the whiteteatfish, sand redfish and sandfish (*H. nobilis*, *H. scabra* and *Actinipyga mauritiana* respectively) (Caton and McLoughlin 2004), selected species TACs were introduced together with a 'move on provision' of 15 nautical miles once catches reach 5 tonnes (all catch species combined).

In the absence of a full assessment of target species within the CSF Sea Cucumber sub-fishery, the Torres Strait Sea Cucumber fishery provides an example of the risk of these animals, where sandfish collection was prohibited due to concerns of serious resource depletion resulting from overexploitation. As such, empirical data on which to base future assessments, from within the CSF itself, is suggested as a high priority, to address impacts both at a species and a community level.

3.1 Level 1

Two main issues were identified through this assessment. The first is the issue of fishing itself, and the concern presented by the lack of specific data from within the CSF on which to base assessment of species recovery for the sea cucumber specifically, but for community composition generally.

The second issue identified was the hazard presented by the addition of biological material -Translocation of species. This hazard scored a consequence score of three – moderate- for all components assessed (Target, TEP, Habitat and Community). No mitigation measures are currently in place. Food and Agriculture Organisation (1995) suggests the use of a precautionary approach with corrective or mitigating procedures established before any effect occur. Similarly, Department of Agriculture, Fisheries and Forestry (DAFF) are soon to release a Code of Practice ('*National system for prevention and management of marine pest incursions*', due October 2006) which will also provide risk reduction measures. Consideration of these documents is recommended.

It is important to note that the risks from translocation of species (in this sub-fishery most likely due to hull and anchor fouling) present the classical problem for risk assessment – a low probability event combined with a potentially high impact consequence. This introduces a lot of uncertainty about risk levels associated with such hazards. In general the risk levels for this hazard have been scored as only moderate, reflecting the low probability of occurrence.

In the absence of data on translocation issues within the CSF, it is recommended that a system be established to provide baseline and continuing data on the incidence of hull fouling occurrence within the hand collection sector, and the presence/absence of

invasive species, particularly the crown of thorns starfish, known to occur within the adjacent GBR area. The hazard presented by translocation of species is noted in all components of this Level 1 assessment.

External hazards scoring at moderate risk in the Habitat and Community components would both be initially addressed through the operator-initiated 'Memorandum of Understanding' being considered by stakeholders and the Tourism sector, which would exclude fishing from 5 reef systems within the CSF. Similarly, a suggested voluntary 3-year reef-rotational zoning system would also provide a risk reduction measure, and further development leading to its implementation should be actively encouraged.

Discussions at Stakeholder meetings have also recognised the value that could be gained by Observer Programs, and in obtaining underwater video footage as a means of monitoring habitat issues, community assemblages, and providing baseline data on which further risk assessment could be judged.

3.2 Level 2

Level 2 assessment was not carried out for the Coral Sea Fishery: Sea Cucumber Sub-fishery as part of the Stage 2 ERAEF process.

3.3 Key Uncertainties / Recommendations for Research and Monitoring

Two important uncertainties were identified in this analysis. The first was the overfished status of the fishery, based on a preliminary 2002 stock status, but with no updated stock assessment on which to judge success or otherwise of the 'move on provisions' or current catch limits. The second was the possible impact of translocations, particularly through hull and anchor/anchor chain fouling.

Specific recommendations, arising from the Coral Sea Fishery: Sea Cucumber sub-fishery assessment, include:

- Updating the assessment of the stock status for all teatfish species targeted, and investigating whether current management arrangements have reversed the decline in populations.
- Depending on uncertainty in assessments based only on logbook data, initiate additional data collection via observer or industry based methods.

Current industry or management initiatives that would help mitigate some risks include:

- implementation of the Coral Sea Fishery Stakeholders Associations' Memorandum of Understanding for a reef-rotational system
- implementation of the Coral Sea Fishery Stakeholders Associations permanent moorings initiative
- adoption of mitigating measures to address translocation risks, by consulting –
    - Department of Agriculture, Fisheries and Forestry (DAFF) "National system for prevention and management of marine pest incursions" document, due for release in October 2006; or

- Food and Agriculture Organisation (1995) precautionary approach documents;
- Bureau of Rural Sciences (BRS) recommendations for risk reduction with regard to introduced marine pests (Summerson and Curran 2005).

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Glossary of Terms

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

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

Appendix A: General summary of stakeholder feedback

Date	Format received	Comment from stakeholder	Action/explanation
Sept 28 2006	AFMA/Stakeholder provided comments	For all sub-fisheries Under “Input controls” “a specified number of fishing days per permit per season” should read “a specified number of **minimum fishing** days per permit per season”	No change – already specifies “**minimum**” days.

Appendix B: PSA results - summary of stakeholder discussions

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

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

Taxa name	Scientific name	Common name	Role in fishery	PSA risk ranking (H/M/L)	Comments from meeting, and follow-up	Action	Outcome	Possible management response

NB. No Level 2 analysis has been conducted for Coral Sea sub-fisheries.

Appendix C: SICA consequence scores for ecological components

Table 5A. Target Species. Description of consequences for each component and each sub-component. Use table as a guide for scoring the level of consequence for target species.

(Modified from Fletcher *et al.* 2002)

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

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

Table 5B. Bycatch and Byproduct species. Description of consequences for each component and each sub-component. Use table as a guide for scoring the level of consequence for bycatch/byproduct species.

(Modified from Fletcher *et al*. 2002)

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

Sub-component	Score/level					
	1 Negligible	2 Minor	3 Moderate	4 Major	5 Severe	6 Intolerable
Distribution of the community	**3. Distribution of the community** Interactions which affect the distribution of communities unlikely to be detectable against natural variation.	**3. Distribution of 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.	**3. Distribution of the community** Detectable change in geographic range of communities with some impact on community dynamics Change in geographic range up to 10 % of original.	**3. Distribution of the 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.	**3. Distribution of the 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.	**3. Distribution of the 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.

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