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Australian Government
Australian Fisheries Management Authority

Ecological Risk Assessment for Effects of Fishing

REPORT FOR THE TORRES STRAIT PRAWN FISHERY

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Turnbull, C., Furlani, D., Bulman, C. and Dowdney, J. (2007) Ecological Risk Assessment for the Effects of Fishing: Report for the Torres Strait Prawn Fishery. Report for the Australian Fisheries Management Authority, Canberra.

<u>Notes to this document:</u>
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 Torres Strait Prawn Fishery was undertaken using the ERAEF method version 9.2. ERAEF stands for "Ecological Risk Assessment for Effect of Fishing", and was developed jointly by CSIRO Marine and Atmospheric Research, and the Australian Fisheries Management Authority. ERAEF provides a hierarchical framework for a comprehensive assessment of the ecological risks arising from fishing, with impacts assessed against five ecological components – target species; by-product and by-catch species; threatened, endangered and protected (TEP) species; habitats; and (ecological) communities.

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

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

This assessment of the Torres Strait Prawn Fishery includes the following:

- Scoping
- Level 1 results for all components
- No Level 2 analysis has been conducted for the Torres Strait Prawn fishery as part of the ERAEF Stage 2 process.

Fishery Description

Gear:	Otter trawl
Area:	Torres Strait Protected Zone and ‘outside but near’ area
Depth range:	12 to 88m
Fleet size:	61 licensed vessels in 2006, but 7 are inactive in the fishery
Effort:	Average of 9,164 fishing days per annum for the years 2000-04; For 2006, a total effort cap of 9,200 fishing days (6,867 available to Australian operators and the remainder to meet PNG treaty obligations.
Landings:	Average of 1,631 tonnes per annum for the years 2000-04
Discard rate:	rate of discard of target species unknown but low; discard of bycatch 100%
Main target species:	Brown tiger, blue endeavour and red spot king prawns
Management:	Input controls
Observer program:	AFMA, industry funded observer program since 2005 season

Ecological Units Assessed

Target species:	10
By-product species:	14
Discard Species:	476
TEP species:	112
Habitats:	158 (157 benthic, 1 pelagic)
Communities:	3 (2 demersal, 1 overlying pelagic)

Level 1 Results

No ecological components were eliminated at Level 1 (there was at least one risk score of 3 – moderate – or above for all 5 component).

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

- Fishing capture (Target, Bycatch/byproduct, TEP and Habitat components)
- Fishing without capture (Bycatch/byproduct and Habitat)
- Translocation of species (Target, Bycatch/byproduct, TEP, Habitat and Communities components), and
- Discarding catch (Target, TEP and Habitat).

These remaining internal hazards where assessed at low confidence for the Byproduct and TEP components, but at high confidence for the Target and Habitat components. The exception was the Translocation hazard, which was assessed at low confidence for all components.

Three internal hazards were scored as a major hazard (consequence level 4): Habitat component Fishing capture and Translocation; and TEP component Discarding.

Significant external hazards included:

- Other fisheries (Bycatch/byproduct, TEP species, Habitat and Communities)
- Other non-extractive activities (all five components)
- Other anthropogenic activities (Bycatch/byproduct and TEP species).

Level 2 Results

Species

No Torres Strait Prawn species were assessed at Level 2 using the PSA analysis during Stage 2 of the ERA process.

Habitats

No Torres Strait Prawn habitats were assessed at Level 2 using the habitat PSA analysis during Stage 2 of the ERA process.

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

Internal risks were predominantly rated as moderate (consequence level3). Those internal hazards rated as major or above (risk scores 4 or 5) were related to direct or indirect impacts from primary fishing operations (Habitat Fishing capture, Habitat Translocation of species, andTEP Discarding). No internal hazards were rated as severe (risk score 5).

Target

In the case of the target species, fishing (direct capture) was considered to have a moderate impact (consequence level 3) on the brown tiger prawn stocks as the current stock assessments suggest that this species was fully fished during the 1990's. In recent years (2004-05) the level of fishing effort has declined below the estimate of E_{msy} for brown tiger prawns due to a combination of low prawn prices and high fuel costs while catch rates have increased and the annual tiger prawn catch remained stable. The November 2005 reduction in allocated fishing days and voluntary surrender of allocated fishing days to give effect to the cross-boarder fishing arrangements now limits effort in the fishery to E_{msy} (9,200 days for 2006). Fishing effort by Australian operators is currently restricted to 6867 days for 2006.

Discarding of bycatch was also considered to have a moderate impact on the Target component. Discarding of bycatch occurs extensively throughout the fished region, and is known to attract predators. These predators will in turn prey upon the resident prawn population. The effects of discarding of bycatch are well documented in the TSPF.

Translocation was noted as a low confidence but moderate risk activity, with the potential to affect target species population size by introducing a foreign competitor or through transmission of disease, but also directly or indirectly through changing trophic linkages. This risk is increased by the endorsement of TS vessels in other adjacent fisheries, the use of ports known to harbour introduced species (Darwin and Cairns), and the presence of introduced species in the adjacent NPF area. These issues similarly give rise to the moderate risk scores in the Bycatch/byproduct, TEP and Community components also.

Bycatch/byproduct

In the case of bycatch/byproduct species fishing, both capture and direct impact without capture are considered to have a moderate (consequence level 3) impact. Elasmobranches, in general, are considered more susceptible to overfishing than bony fish, but there is likely to be a range of sensitivities among the species (Walker 1998; Stevens *et al*. 2000). Of the species recorded in the TSPF aside from pristids (sawfish), the benthic species (wobbegongs and rays) are likely to be of most concern due to their high susceptibility and little information available to estimate their recovery. The mobility of elasmobranch species also means that they may be impacted by several fisheries (Stobutzki TSFAG Prawn Workshop Report 2001). The consequence were scored as moderate as a precautionary measure although there is no data to suggest these species are impacted by trawl fishing in the TSPF. Our confidence in this assessment is low as data on these species is limited.

Sharks and rays larger than ~1m are excluded from the catch by Turtle Excluder Devices (TEDs), therefore it could be assumed that this has increased their survival rate, however this may not be the case as they may be damaged by contact with a TED. As a precautionary measure, although there is no data to suggest these species are impacted by trawl fishing, the consequence was scored as moderate. Confidence in this assessment is low as there is limited data on survival of these species after passing through the TED.

TEP

In the case of TEP species sea snakes were considered the species mostly likely to be of concern as the survival of sea snakes after trawling has been estimated as 49% (Wassenberg *et al*. 2001). The risk to these species is dependent on the relative proportion of the population taken by trawling, however this is unknown. In the research surveys conducted in Torres Strait the catch rates of sea snakes has been very low and these taxa were rarely identified to species level. The consequence was scored as moderate as a precautionary measure although the available data suggests that sea snake catch rates are low in the TSPF. The confidence in this assessment is low as data on these species is limited. The existing observer program in the TSPF should be used to obtain data on the catch rates and species of sea snakes that occur in the commercial catch.

The discarding of bycatch was assessed as a major hazard (consequence level 4) impacting the TEP Tern species through modification of behaviour and movement. Discarding of high volumes of bycatch occurs after each trawl shot, throughout the nine-month season on the fishing grounds. Scavenging behaviour by terns behind trawlers is a common activity. They are known to continuously follow trawlers to feed on these discards, and may become dependent on discarding as a food source. This in turn has the potential to impact the population dynamics of the terns, and may take some weeks after the close of the season for normal foraging behaviour to return.

Habitat

The Habitat component was assessed to be at major risk of impact by the fishing capture activity, and moderate risk without capture. The prawn trawl-gear footprint is large, and the highly localised nature of the operations may result in severe localised structural modification of susceptible epifaunal and infaunal habitats, with damage and removal particularly of erect, rugose and inflexible octocorals associated with soft muddy substrata. Octocorals that are not removed by prawn trawl gear are also likely to encounter some degree of damage. Although inner shelf habitats may recover relatively quickly, the more structurally complex forms may take many years to recover. These habitat risks were assessed with high confidence due to the availability of data for some species within the Torres Strait region.

Addition/Movement of biological material was assessed as a moderate risk to Habitats through the hazard presented by catch discarding. Accumulation of large volumes of solid biomass, particularly in shallow waters, will alter the substrate quality via changed biogeochemical processes and sediment ecology, and further modify the habitat by the attraction of scavengers and predators. This hazard was assessed at high confidence based on documented data within the Torres Strait and tropical region (Harris and Poiner 1990, Hill and Wassenberg 1990, Wassenberg and Hill 1990)

Translocation of species, particularly through hull fowling, was assessed as a major risk (risk score 4) to Habitat structure and function. Species translocated may establish throughout the Torres Strait Prawn Fishery area, but are particularly likely to affect shallower habitats where they pose a hazard to previously compromised area, by altering pelagic and sediment processes, and displacing existing species. Fishing vessels regularly move between the TSPF and the adjacent NPF and ECOTF water. This hazard was assessed at low confidence as little data exists on the translocation of species by prawn trawlers, but the potential risk associated with this hazard has major consequence due to the potential to alter habitat dynamics.

External hazards

There are a number of external hazards in the Torres Strait Prawn Fishery (TSPF) that are likely to be as important, or more important, than those identified from the fishery itself. Translocation of pest species or a major oil spill caused by international shipping potentially poses a greater threat to the Torres Strait environment than the activities associated with the Torres Strait Prawn Fishery. Dugong, turtle and elasmobranches are probably the most at risk TEP species in Torres Strait. Illegal fishing by foreign fishing vessels and traditional fishing activities in Torres Strait could have a much greater impact on these species than the TSPF.

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.

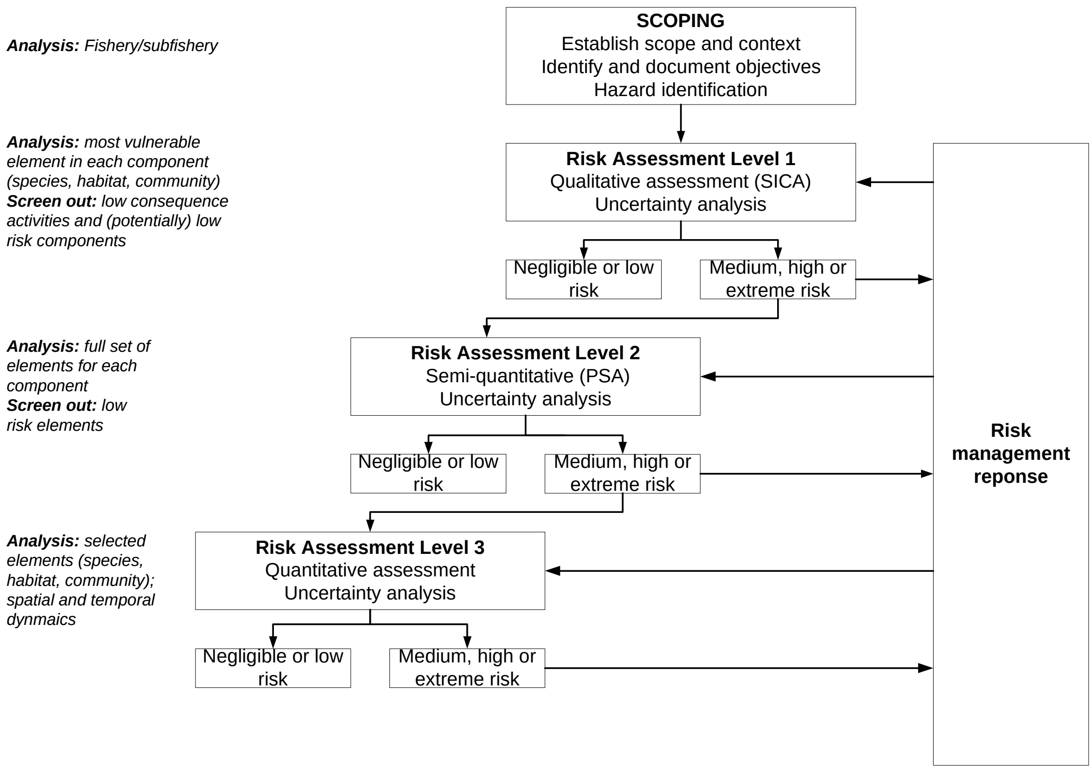


Figure 1. Overview of ERAEF showing focus of analysis for each level at the left in italics.

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.

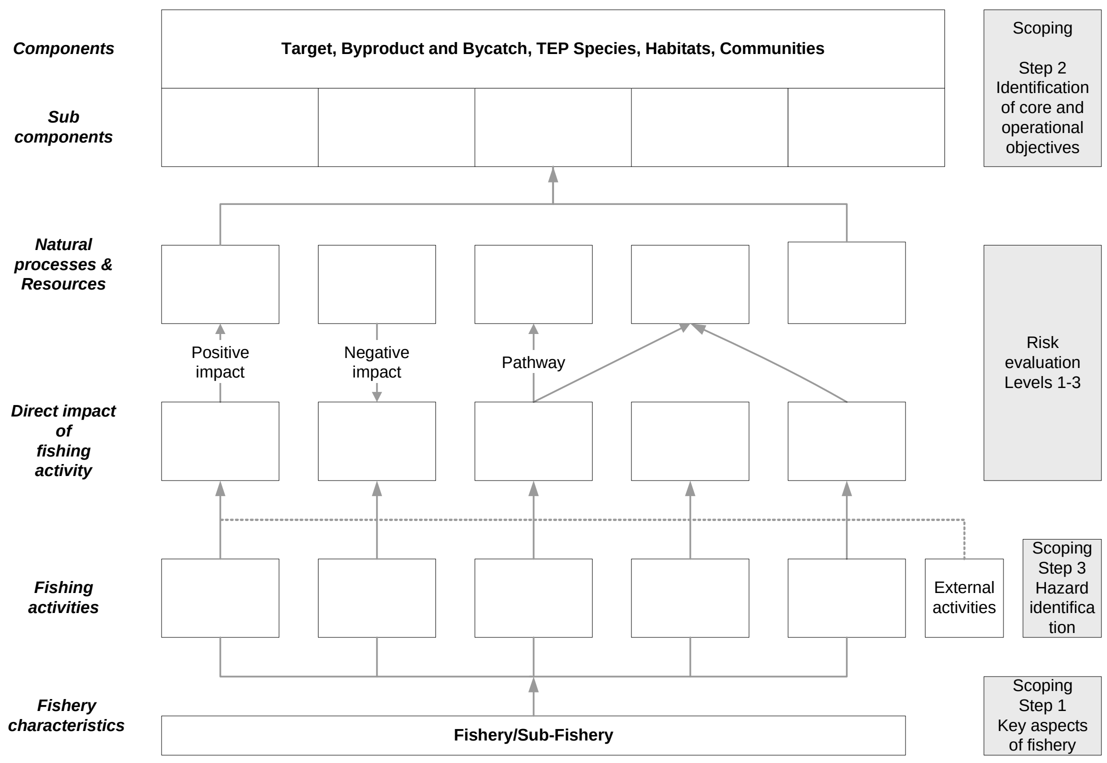


Figure 2. Generic conceptual model used in ERAEF.

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. <u>Identification of units of analysis</u> (species, habitats and communities) potentially impacted by fishery activities (section 2.2.2; Scoping Documents S2A, S2B and S2C).
2. <u>Selection of objectives</u> (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)

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 the Australian Fisheries Management Authority (AFMA) for a range of management purposes, including addressing 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 Torres Strait Prawn Fishery.

2.1 Stakeholder engagement

2.1 Summary Document SD1. Summary of stakeholder involvement for fishery

Torres Strait Prawn Fishery

Fishery ERA report stage	Type of stakeholder interaction	Date of stakeholder interaction	Composition of stakeholder group (names or roles)	Summary of outcome
Scoping	Private discussions during TSPMAC meeting.	14/06/06	Barry Wilson, Industry representative on TSPMAC	Confirmed some aspects of the Hazards score sheet with an industry representative.
Scoping	Workshop: to allow review by fishery	Scheduled for 23/09/06	TSPMAC (managers, fishers, TSRA, science, environment	To review Scoping documents and Hazards score sheet.
Level 1 (SICA)	Workshop: to allow review by fishery	Scheduled for 23/09/06	TSPMAC (managers, fishers, TSRA, science, environment)	To debate the credible scenarios, and rationals of the consequence scoring, and reach agreement that Level 1 is acceptable.
Level 2 (PSA)				Not conducted for Torres Strait Prawn during Stage 2 of the ERAEF process.
ERAEF reporting	AFMA external review comments received	30/06/2006	MG?	Comments addressed, changes incorporated where appropriate.
ERAEF reporting	AFMA comments on draft report received	14/07/2006		Comments addressed. Final draft provided albeit without stakeholder review or comment
ERAEF reporting	Internal review comments received	14/09/2006		Comments addressed. Final draft submitted.
ERAEF reporting	No Stakeholder comments received			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

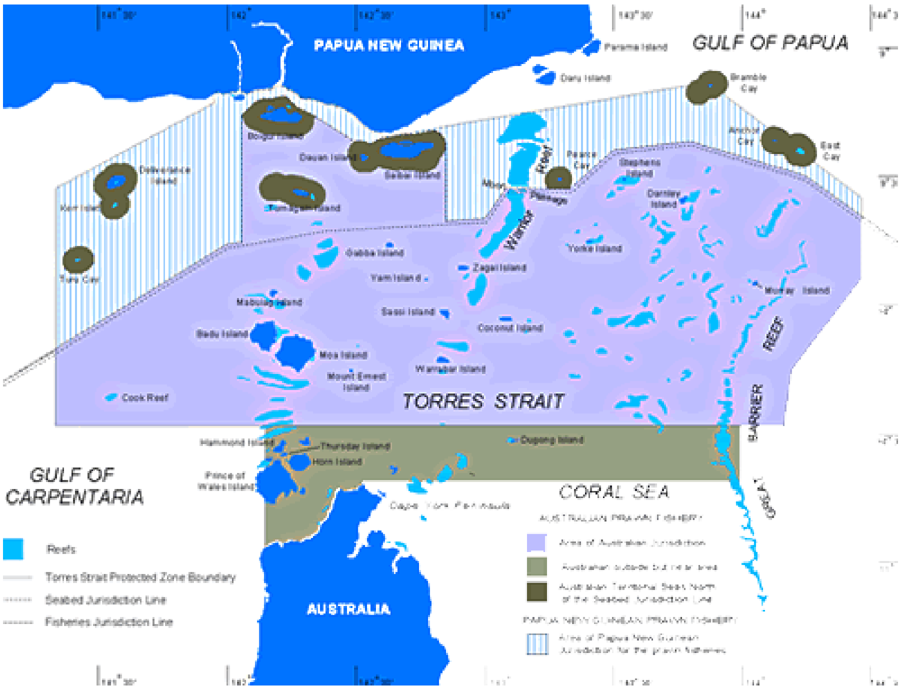
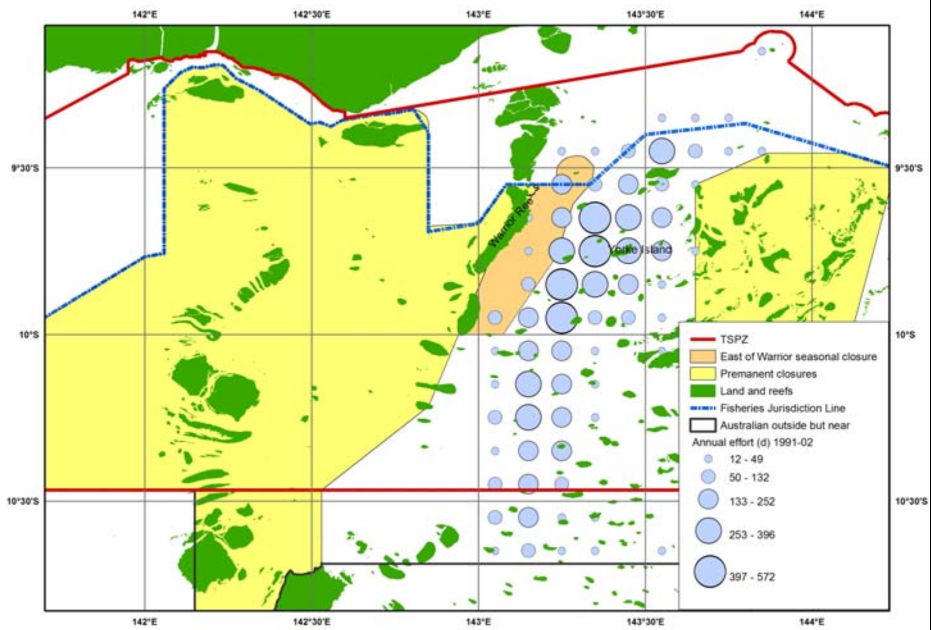
2.2.1 General Fishery Characteristics (Step 1).

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: Torres Strait Prawn Fishery
Date of assessment: 9 June 2006
Assessor: Clive Turnbull

General Fishery Characteristics	
Fishery Name	Torres Strait Prawn Fishery (TSPF)
Sub-fisheries	*Identify sub-fisheries on the basis of fishing method/area.* There are no sub-fisheries.
Sub-fisheries assessed	*The sub-fisheries to be assessed on the basis of fishing method/area in this report.* Torres Strait Prawn Fishery (TSPF)
Start date/history	*Provide an indication of the length of time the fishery has been operating.* The prawn trawl fishery in Torres Strait began in the mid-1970s, extending northward from the prawn fishery along the Queensland east coast. When the Torres Strait prawn fishery began, all east coast and Northern Prawn Fishery prawn trawlers were entitled to fish in Torres Strait, effectively allowing access to all of about 1200 vessels. When the Torres Strait Treaty was ratified in 1985 approximately 500 vessels had obtained a licence to operate in the Torres Strait Prawn Fishery (TSPF).
Geographic extent of fishery	*The geographic extent of the managed area of the fishery. Maps of the managed area and distribution of fishing effort should be included in the detailed description below, or appended to the end of this table.* The Torres Strait Prawn Fishery (TSPF) is an international multi-species prawn fishery that operates in the eastern section of the Torres Strait Protected Zone (TSPZ) and the defined ‘outside but near’ area (Maps 1 and 2). The area where fishing occurs is ~20% (~8,000 square km) of the fishery management area (the TSPZ and Australian outside

	but near area). **Map 1.** Torres Strait Prawn Fishery Area (2003); **www.pzja.gov.au** Last updated May 2005.  **Map 2.** Location of the Torres Strait Prawn Fishery indicated by the annual fishing effort summarised by six-minute grids, the Torres Strait Protected Zone, the Fisheries Jurisdiction Lines, and the Australian outside but near area of the prawn fishery. 
Regions or Zones within the fishery	*Any regions or zones used within the fishery for management purposes and the reason for these zones if known* The regions within the fishery are: PNG waters (north of the Fisheries Jurisdiction Line) with the TSPZ), Australian waters (south of the Fisheries Jurisdiction Line within the TSPZ), the Australian outside but near area (the area between the TSPZ and the ECOTF) and the Australian Territorial Waters around Pearce Cay and Bramble. These

	are defined in and used in the Torres Strait Treaty arrangements – in particular the Australia / PNG catch share arrangements.
Fishing season	*What time of year does fishing in each sub-fishery occur?* The fishing season is the period from the 1 March to 1 December.
Target species and stock status	*Species targeted and where known stock status.* Unlike other tropical prawn trawl fisheries in Australia, the commercial target species catch categories of tiger; endeavour and king prawns in the TSPF are essentially single species. • Tiger prawns; brown tiger prawn (*Penaeus esculentus*) plus a small percentage of grooved tiger prawns (*Penaeus semisulcatus*)- fully fished • Endeavour prawn; blue endeavour prawn (*Metapenaeus endeavouri*) plus a small percentage of (*Metapenaeus ensis*)– unknown • King prawn; red spot king prawn (*Penaeus* (revised to *Melicertus*) *longistylus*) plus a small percentage of (*Penaeus latisulcatus*) – unknown
Bait Collection and usage	*Identify bait species and source of bait used in the subfishery. Describe methods of setting bait and trends in bait usage.* There are no bait or bait collection issues in this fishery.
Current entitlements	*The number of current entitlements in the fishery. Note latent entitlements. Licences/permits/boats and number active.* At the 6th April 2006 there were 61 Australian vessel licences with a total of 6,867 allocated fishing days. Seven of these licences and the 729 fishing access days allocated to these licences were inactive. Under the current catch sharing arrangements for 2006 Australia has agreed to endorse up to six PNG vessels to operate in the Australian area of jurisdiction of the TSPZ for the full season (275 days) to meet Australia's catch sharing obligations under the Torres Strait Treaty. To date no PNG vessel have cross boarder fished the TSPF. Although it is possible that one or two PNG vessels may apply to cross boarder fish in the near future it is highly unlikely that six vessels would apply to cross boarder fish during the next few years. In addition it is unlikely that they would cross boarder fish for the full season.
Current and recent TACs, quota trends by method	*The most recent catch quota levels in the fishery by fishing method (sub-fishery). Summary of the recent quota levels in the fishery by fishing method (sub-fishery).In table form* There are no quotas. The TSPF is managed through input controls; limited entry (number of licences), effort restrictions (allocated fishing days assigned to each licence), vessel and gear restrictions and a system of seasonal spatial and temporal closures. On the 3rd November 2005 the PZJA agreed that the fishery will move to a modern management arrangement including the adoption of a unitised system where effort levels in the fishery are adjusted in accordance with sustainable catches and that the system of unitisation will be developed over the course of 2006 to commence in 2007. The June 2006 TSPMAC meeting discussed these issues and the advice from the MAC was to convert the current allocated days to units and a percentage of access to the fishery on a 1:1 basis.
Current and recent fishery effort trends by method	*The most recent estimate of effort levels in the fishery by fishing method (sub-fishery). Summary of the recent effort trends in the fishery by fishing method (sub-fishery). In table form* Effort in the TSPF during 2005 was ~6,600 days (based on VMS data – the logbook data for 2005 were incomplete when the 2006 Prawn Handbook Logbook Stats were complied in early February 2006). Since 1999 which had the second highest fishing effort on record (10,904 days, the highest was 11,907 days in 1992) effort has declined dramatically particularly in the last two years (7,041 days in 2004) due to increasing fuel costs and declining prawn prices (Table 1).

	Due to the November 2005 pro-rata reduction in allocated fishing days from 13,454 to 9,197 (the estimate of E_{msy} for tiger prawns), the buy back of licenses and fishing days and the current economics of prawn fishing it is unlikely that the Australian fishing effort for 2006 will exceed ~6,000 days. It is also unlikely that PNG will utilise their catch sharing entitlement during the 2006 season. **Table 1 Yearly totals since 1989 (t = tonnes) * at the time of publication the 2005 figures were based on incomplete logbook data with and estimated 97% coveraged. Most of the missing data was for October & November.**

Year	All prawn (t)	Hours Trawled	Nights Fished	Tiger (t)	Endeavour (t)	King (t)
1989	1,188	71,069	7,824	539	614	25
1990	858	56,480	5,688	396	435	23
1991	1,871	100,683	9,983	709	1,079	70
1992	2,048	123,618	11,907	880	1,103	55
1993	1,417	89,077	8,525	487	885	38
1994	1,528	97,261	9,244	465	1,013	45
1995	1,861	86,594	8,158	648	1,179	31
1996	1,592	91,073	8,453	670	893	25
1997	1,799	108,227	10,097	694	1,065	35
1998	2,119	109,738	10,182	965	1,050	104
1999	2,202	117,912	10,904	629	1,511	61
2000	1,634	107,331	9,979	479	1,079	72
2001	1,797	108,946	10,158	621	1,095	77
2002	1,753	104,477	9,641	721	864	165
2003	1,597	97,272	9,000	712	759	126
2004	1,373	76,108	7,041	606	689	74
2005*	1,295	62,497	5,894	647	589	44
average (95-04)	1,773	100,768	9,361	675	1,018	77

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* The current estimates of catch for the 2005 season are 647 t of tiger prawns, 589 t of endeavour prawns and 44 t of king prawns based on a 97% coverage of the data for 2005 (2006 edition of the Torres Prawn Handbook). These figures will be updated using full logbook coverage in the 2007 edition of the handbook. Although tiger prawn catches have remained stable in recent years despite the large reduction in effort the endeavour prawn catch has decreased from an average ~1000 t to ~600 t (see Table 1, above). The decline in endeavour catch largely reflects increased targeting of tiger prawns as fuel prices have increased and prawn prices decreased.
Current and recent value of fishery ($)	*Note current and recent value trends by sub-fishery. In table form* The GVP of the fishery in 2004-05 was $15.6 million, which was less than half the record value of $33.7 million recorded in 1998-99 (Galeano *et al* 2006). This would be largely due to increasing fuel costs, lower prawn prices in international markets and reduced catches of endeavour prawns. The reduction in endeavour prawn annual catch reflects a large reduction in fishing effort combined with an increased targeting of tiger prawns which are a higher value product.
Relationship with other fisheries	*Commercial and recreational, state, national and international fisheries List other fisheries operating in the same region; any interactions* The TSPF borders or shares common waters with other international, commonwealth, state recreational and traditional fisheries, although direct interaction for common

	resources is negligible. *Commonwealth fisheries* – NPF, Coral Sea Fisheries, Tuna fisheries *Qld fisheries* – ECOTF *Torres Strait* – TRL, Pearl, Turtle, Dugong, Reefline, Spanish mackerel, BDM, Trochus Interactions with other Torres Strait fisheries are minimised through area closures (Darnley Island and West of Warrior closures that protect the pearl grounds and inter reef lobster habitat) and restrictions on the carriage of particular species by prawn trawlers in Torres Strait (lobster, pearl shell, shark fin, turtle and coral – nil, shark 5 kg, mackerel & finfish 50 kg).
Gear	
Fishing gear and methods	*Description of the methods and gear in the fishery, average number days at sea per trip.* Otter trawling mainly uses a quad gear configuration. NPF endorsed vessels tend to use twin gear. As most vessels are also endorsed to fish the ECOTF and some are also endorsed to fish in the NPF most vessels move between fisheries during the season. A small number of vessels that have a large number of TSPF allocated fishing days tend to stay in the fishery for most of the season. In the past product was generally unloaded to, and supplies obtained from, mother ships therefore average trip lengths were quite long with some vessels only returning to port at the end of the season. This trend however is changing and more vessels are starting to return to Cairns during the season to unload and obtain supplies to reduce mother shipping costs.
Fishing gear restrictions	*Any restrictions on gear* The total combined length of the nets (headline plus ground line) must not exceed 88 metres (including the try net). There are mesh size and ground chain weight restrictions and all nets must be fitted with an approved TED's and BRD's.
Selectivity of gear and fishing methods	*Description of the selectivity of the sub-fishery methods* Although the trawl mesh size is designed to be selective for prawns, trawling is an indiscriminate fishing method, which can capture organisms of various sizes, motile or sessile, which are in the path of the net. The ground chains are generally set to maximise the capture of prawns while minimising the retention of bycatch. Large amounts of bycatch are still retained however with the average weight of retained bycatch being on average 3-4 times that of the commercial prawn weight (Research survey data).
Spatial gear zone set	*Description where gear set i.e. continental shelf, shelf break, continental slope (range nautical miles from shore)* All trawling occurs on the continental shelf that joins Cape York with PNG and is within 20-90 nm of the Australian on PNG coast lines.
Depth range gear set	*Depth range gear set at in metres* Although the depth on the trawl grounds in the TSPF ranges between 12-88m most fishing occurs in 18-40m.
How gear set	*Description how set, pelagic in water column, benthic set (weighted) on seabed* The trawl gear is towed over suitable habitat at an average of 3 knots during a 2.5 to 4 hour shot. Trawling only takes place at night and there are generally 3 or 4 shots during the night.
Area of gear impact per set or shot	*Description of area impacted by gear per set (square metres)* The estimated area swept by a vessel each night of operation is ~ 3 square km. This is based on a trawl speed of 3 knots, 4 5-fathom nets with a spread ratio of 0.67 and 10 hours of trawl time per night.
Capacity of gear	*Description number hooks per set, net size weight per trawl shot*

	The total combined length of the nets (headline plus ground line) must not exceed 88 metres (including the try net). The estimated total capacity (all nets deployed by a single vessel) of a single trawl shot is ~310 kg for 3 shots per night and ~234 kg for 4 shots per night (Clive Turnbull – estimated from research survey data and logbook records).
Effort per annum all boats	*Description effort per annum of all boats in fishery by shots or sets and hooks, d for all boats* Effort and catch is recorded in the current commercial logbooks as catch per day of fishing. Many fishers also record the fishing time which is supposedly the total time that the fishing gear is on the seabed. The accuracy of this data is however uncertain as many of the consecutive daily vessel records are the same. It is also possible that fishers may be recording a time based on the difference between the start of the first shot and the end of the last shot. The average number of days fished during 2000-04 is 9,164 which would equate to 27,492 and 36,656 shots per annum based on 3 and 4 shots per night respectively.
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* Trawl gear loss mainly occurs as a result of the nets bogging in soft sediment (wonky holes). These occurrences are rare as the vessel can usually recover the gear. Generally the gear is only lost if the vessel is damaged, capsizes or runs aground. Small patches of net are sometimes lost, but again this is minimal. If lost, the net has minimal impact on marine communities, particularly for TEP species, since the net generally sinks and remains on the substrate.
Issues	
Target species issues	*List any issues, including biological information such as spawning season and spawning location, major uncertainties about biology* The biology of tiger, endeavour and king prawns in the TSPF has been well studied. Tiger prawns are generally considered to be the species most at risk from over fishing in the TSPF and if the effort in the fishery is restricted to levels considered sustainable for the tiger prawn stock then the risk of overfishing of the other species is considered to be low. The most recent stock assessment for the tiger prawn stock indicates that since 2000 the stock size has been above B_{msy} and fishing effort in 2004 and 2005 was well below the estimate of E_{msy} for tiger prawns. Although the catch of endeavour prawns has declined in recent years this is related to the decrease in fishing effort and increased targeting of the tiger prawns as fuel prices have increased and prawn prices have decreased. The catch of king prawns is largely a byproduct of the tiger/ endeavour catch. The king prawn catch appears to be function of the total effort and the strength of the annual king prawn recruitment. Although the distributions of tiger and endeavour prawn catches strongly overlaps, the catch rates of tiger prawns tend to be higher in the northern section of the fishery. Conversely the catch rates of endeavour prawns tend to be higher in the southern section of the fishery (>10°). The areas of higher endeavour prawn catch rates in the north are largely on the western side of the fishery, close to Warrior Reef. In contrast the high tiger prawn catch rates extend into the deeper waters on the eastern side of the fishery.
Byproduct and bycatch issues and interactions	*List any issues, as for the target species above* The main byproduct species in the TSPF are bugs (*Thenus indicus* and *Thenus orientalis*), squid (a mixture of species, *Photoligo spp.*) and cuttlefish (Sepiidae). Small amounts of octopus (a mixture of species) and scallops (*Amusium pleuronectes*) are also occasionally retained as byproduct. Only the larger animals are retained as byproduct, the rest are discarded. There is a minimum size limit for bugs and retention of berried females is prohibited.

	Tropical rock lobster (*Panulirus ornatus*) can occur in large numbers in trawl catches in Torres Strait. Although this species is potentially a valuable byproduct (and was a legal byproduct in the early 1980's) it is illegal for prawn trawlers in the TSPF to retain this species. This restriction was introduced in the mid 1980's to prevent targeted trawling for this species and reduce interactions with the Torres Strait Rock Lobster (TRL) Fishery which is restricted to fishing by spearing and hand collection while diving or reef walking. Although representatives of Torres Strait Island Communities and the TRL fishery have expressed concerns that the TSPF negatively impacts on the TRL stocks there is some scientific evidence to the contrary. Joint tagging research conducted by CSIRO and the National Fisheries Agency (NFA) of Papua New Guinea during 1984 indicates that trawled lobster have a good survival rate when discarded from prawn trawlers and continue their breeding migration to the waters around Yule Island, PNG. Due to the indiscriminate nature of trawling and the small net mesh size used, the TSPF interacts with a diversity of organisms (>380 spp.) that include teleosts, invertebrates and elasmobranchs. There are also interactions with endangered, threatened or protected species; turtles, sea snakes and sygnathids (seahorses and pipefish). The total annual biomass of bycatch landed by the fishery is estimated to be around 6,000 tonnes. Many vessel started trialling the use of TEDs and BRDs in the late 1990's. Since the start of the 2002, TEDs have been compulsory and exclude turtles and large (>1 m) elasmobranchs and sponges. The use of BRDs has been compulsory since the start of the 2004 season. Most of the bycatch landed on the sorting tray is returned to the water severely damaged or dead. Research by CSIRO on the fate of discards indicates that bycatch returned to the water alive has a low survival rate. There is little information on the basic biology or distribution of the majority of the TSPF bycatch species. An assessment by Ilona Stobutzki, CSIRO (2001, TSFAG Prawn Workshop Report to TSFSAC) suggests that for the fish species in the TSPF bycatch, those least likely to be sustainable are *Apistops Caloundra* (short finned waspfish), *Polydactylus sheridan*i (threadfin), *Dactyloptena orientalis* (oriental searobin), *Paraploactis trachyderma* (velvet fish), *Paracentropogon vespa* (spot fin waspfish). These species are ranked as highly susceptible to capture due to their benthic or demersal nature and most also prefer soft/muddy sediments. There have been no systematic on-board surveys for sharks in the TSPF and fishers were not required to record shark bycatch in logbooks. There are interactions with sawfish (*Pristidae* spp.) which are vulnerable to trawling. Sawfish are caught more rarely in the TSPF than the NPF. One wide sawfish (*Pristidae pectinata*) was recorded from 369, 30-minute prawn trawl shots on the Torres Strait fishing grounds between 1985 and 1986 (Harris and Ward 1999).
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.* The fishery interacts with a number of TEP species that include turtles (6 spp.), sea snakes, cetaceans and Sygnathids. Since 2002, TEDs have been compulsory in the fishery which has essentially eliminated the capture of turtles. Sea snakes could be of concern in TSPF they do occur in trawl catches in the TSPF and are a group considered at risk to the impacts of trawl fishing in the NPF and in areas along the Queensland east coast. A current FRDC project is trialing various BRDs that may reduce the capture of sea snakes and NPF fishers have been educated in handling techniques to reduce injury to the snakes as they are returned to the sea. There is currently very limited data on sea snake catches in the TSPF.

	Dolphins and sea birds are abundant in the TSPF and feed on discards from the trawlers; however, they are rarely caught or injured by the vessel and trawl gear. The main impact would be on behaviour and movements as they are attracted to and follow the vessels during fishing operations.
Habitat issues and interactions	*List any issues for any of the habitat units identified in* ***Scoping Document S1.2****. This should include reference to any protected, threatened or listed habitats* There are risks to the seabed habitat due to trawling since commercial prawn species occur on or near the seabed. Removal, modification and disturbance of the seabed biota by trawling is well documented. The extent and effects of these impacts on the ecosystem are little understood, although they have been studied extensively on the Great Barrier Reef (Poiner *et al.* 1998) and a recent CSIRO project investigated these effects in the NPF (Haywood *et al*. 2005). The TS CRC Task 2.1 *Mapping and Characterisation of Key Biotic & Physical Attributes of the Torres Strait Ecosystem*, will provide additional habitat and community data for TSPF.
Community issues and interactions	*List any issues for any of the community units identified in* ***Scoping Document S1.2****.* There is a risk that by removing a species or a size range of the population the food web dynamics may change. This may be due to an increase in prey species or competitive species, and possible declines of predators that rely on the species removed by trawling. There is also the potential that discards provide additional food resources for sharks and birds, which may have the opposite effect on these species groups, and probably has flow-on effects through community.
Discarding	*Summary of discarding practices by sub-fishery, including bycatch, juveniles of target species, high-grading, processing at sea.* The fishery processes and discards bycatch and juveniles of target species overboard at sea. There is no evidence of high grading occurring in the fishery. There is no incentive to high grade as it is not a quota fishery and vessels have a large freezer capacity and can regularly unload at sea to transport vessels.
Management: planned and those implemented	
Management Objectives	*The management objectives from the most recent management plan* The objectives stated in the current draft management plan for the TSPF are: 1. To give regard to the rights and obligations conferred on Australia by the Torres Strait Treaty and in particular to the traditional way of life and livelihood of traditional inhabitants, including their rights in relation to traditional fishing; 2. To conserve the stock of prawns; and 3. That the incidental catches of non-target commercial and other species in the fishery is reduced to a minimum. These objectives were discussed at the June 2006 TSPMAC meeting and new objectives are currently being drafted by a working group for the draft management plan.
Fishery management plan	*Is there a fisheries management plan is it in the planning stage or implemented what are the key features* There is a draft management plan that is still in the planning and consultation stage. The plan content was discussed at the June 2006 Torres Strait Prawn Management Advisory Committee meeting and advice on the plan provided to the PZJA. The MAC also discussed and agreed on the management draft management objectives for the fishery. The current time-line for implementation of the management plan has a completion date of early 2008 with the qualifier that there are no lengthy appeals. The key features of the plan are the management objectives, the legal framework for the management plan and the management arrangements for the 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. The TSPF is managed through input controls; limited entry (number of licences), effort restrictions (allocated fishing days assigned to each licence), vessel (maximum of 20 m) and gear restrictions (maximum of 88 m of headline and bottom-line, including the try net) and a suite of seasonal, permanent spatial and spatial /temporal closures.
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.* There are currently no output controls in the TSPF (i.e. ITQs) due to difficulties in accurately determining total annual catch and individual quotas. Under an ITQ output control management regime there would be an incentive to high grade and under record of catches in logbooks.
Technical measures	*Summary of any technical measures in the fishery, e.g. size limits, bans on females, closed areas or seasons. Gear mesh size, mitigation measures such as TEDs. Primarily focused on target species as other species are addressed below.* As this fishery is regulated by input controls there are a range of technical measures that are listed under the input controls above.
Regulations	*Regulations regarding species (bycatch and byproduct, TEP), habitat, and communities; Marpol and pollution; rules regarding activities at sea such as discarding offal and/or processing at sea.* There are restrictions on byproduct species and the fishery is regulated under the MARPOL 73/78 convention by AMSA.
Initiatives and strategies	*BAPs; TEDs; industry codes of conduct, MPAs, Reserves* A Bycatch Action Plan for the fishery has existed since 1999. TEDs of specified designs have been required since the start of the 2002 season and BRD's of specified design have been required since the start of the 2004 season. The fishery has adopted the QCFO code of Fishing ethics in relation to the capture of turtles.
Enabling processes	*Monitoring (logbooks, observer data, scientific surveys); assessment (stock assessments); performance indicators (decision rules, processes, compliance; education; consultation process* The fishery is has been monitored via logbooks since 1980, scientific recruitment surveys (during February) since 1998 and an observer program that commenced in 2005. A number of Stock assessments have been conducted for the tiger prawn stocks. Performance indicators are being developed as part of the management plan.
Other initiatives or agreements	*State, national or international conventions or agreements that impact on the management of the fishery/sub-fishery being evaluated.* TSPF is an international fishery that is managed under the Torres Strait Treaty between Australia and Papua New Guinea.
Data	
Logbook data	*Verified logbook data; data summaries describe programme* During 1978 to 1988 monthly unloading catch-statistics were recorded by the Northern Fisheries Unit (a Commonwealth Authority) and provides the prawn total harvests by catch categories (tiger, endeavour, king) for those years. During the years 1980-1988 all Northern Prawn Fishery endorsed vessels were required to record daily catch and effort whilst in the NPF and Torres Strait Fisheries. In addition some non-NPF vessels voluntarily filled out the NPF logbook whilst fishing in Torres Strait. Since 1988 it has been compulsory for all Torres Strait endorsed vessels to provide daily logbook returns.
Observer data	*Objective observer programme; describe parameters, how many years run; coverage – random or full coverage; comments on interactions with species; observer training, species identification, and length of service; data summaries*

	In 2005 AFMA initiated an industry/Government joint-funded observer program to collected data on target species, bycatch and interactions with TEP species.
Other data	*Studies, surveys* During the late 1980's and early 1990's DPI&F conducted prawn tagging and monthly research surveys to collect data on the growth, migration and fecundity the commercial prawn stocks in the TSPF. Since 1998 DPI&F has been conduction recruitment surveys during February of each year as a component of the Long Term Monitoring Program for Queensland fisheries.

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 the Torres Strait Prawn Fishery

Target species:	10
By-product species:	14
Discard Species:	476
TEP species:	112
Habitats:	158 (157 benthic, 1 pelagic)
Communities:	3 (2 demersal, 1 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 Torres Strait Prawn Fishery

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

ERAEF species ID	Taxa	Family name	Scientific name	Common Name	CAAB code	Role in fishery	Reference
1324	Invertebrate	Penaeidae	*Melicertus longistylus*	Redspot king prawn	28711048	TA	GENLOG
1521	Invertebrate	Penaeidae	*Melicertus latisulcatus, M. plebejus* & *M. longistylus*	King prawns	28711910	TA	GENLOG
1535	Invertebrate	Penaeidae	*Penaeus esculentus*	brown tiger prawn	28711044	TA	GENLOG

1537	Invertebrate	Penaeidae	*Melicertus latisulcatus*	western king prawn	28711047	TA	GENLOG
1538	Invertebrate	Penaeidae	*Penaeus semisulcatus*	grooved tiger prawn	28711053	TA	GENLOG
2185	Invertebrate	Penaeidae	*Penaeus esculentus, Penaeus semisulcatus, Penaeus monodon*	Tiger prawns	28711906	TA	GENLOG
2221	Invertebrate	Penaeidae	*Penaeus monodon*	black tiger prawn	28711051	TA	GENLOG
2222	Invertebrate	Penaeidae	*Metapenaeus endeavouri* & *Metapenaeus ensis*	penaeid prawns	28711902	TA	GENLOG
2745	Invertebrate	Penaeidae	*Metapenaeus endeavouri*	Blue endeavour prawn	28711026	TA	GENLOG
2746	Invertebrate	Penaeidae	*Metapeaeus ensis*	Red endeavour prawn	28711027	TA	GENLOG

Byproduct species Torres Strait Prawn Fishery

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

ERAEF species ID	Taxa	Family name	Scientific name	Common Name	CAAB code	Role in fishery	Reference
2003	Invertebrate	Order Octopoda	Order Octopoda - undifferentiated	octopods	23650000	BP	GENLOG
1998	Invertebrate	Order Teuthoidea	Order Teuthoidea - undifferentiated	squid	23615000	BP	GENLOG
2023	Invertebrate	Scyllaridae	Scyllaridae - undifferentiated	shovel-nosed /slipper lobsters	28821000	BP	GENLOG
1996	Invertebrate	Sepiidae	Sepiidae - undifferentiated	cuttlefish	23607000	BP	GENLOG
2531	Invertebrate	Loliginidae	*Sepioteuthis lessoniana*	squid	23617904	BP	DPI&F
24	Invertebrate	Scyllaridae	*Thenus orientalis*	bug	28821008	BP	DPI&F
2529	Invertebrate	Scyllaridae	*Thenus indicus*	bug	28821007	BP	DPI&F
2537	Invertebrate	Sepiidae	*Sepia elliptica*	cuttlefish	23607003	BP	DPI&F
2538	Invertebrate	Sepiidae	*Sepia papuensis*	cuttlefish	23607007	BP	DPI&F
2539	Invertebrate	Sepiidae	*Sepia pharaonis*	cuttlefish	23607008	BP	DPI&F
2540	Invertebrate	Sepiidae	*Sepia smithi*	cuttlefish	23607013	BP	DPI&F
2543	Invertebrate	Sepiidae	*Metasepia pfefferi*	cuttlefish	23607015	BP	DPI&F
2711	Invertebrate	Loliginidae	*Photololigo sp3* – (previous: *Photololigo chinensis* or *Photololigo ethreridgei*)	squid	23617901	BP	DPI&F
2217	Invertebrate	Pectinidae	*Amusium pleuronectes*	northern saucer scallop	23270003	BP	DPI&F

<u>Discard species Torres Strait Prawn Fishery</u>
List the discard (bycatch) species (excluding TEP species) of the sub-fishery. Bycatch as defined in the Commonwealth Policy on Fisheries Bycatch 2000 refers to:

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

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

ERAEF species ID	Taxa	Family name	Scientific name	Common Name	CAAB code
1100	Teleost	Antennariidae	*Antennarius hispidus*	striped anglerfish	37210008
1101	Teleost	Apistidae	*Apistops Caloundra*	[a waspfish]	37287033
1105	Teleost	Apogonidae	*Apogon cookie*	Cook's cardinalfish	37327050
1109	Teleost	Apogonidae	*Siphamia argyrogaster*	spotted siphonfish	37327024
1400	Teleost	Balistidae	*Abalistes stellatus*	starry trigger fish	37465011
1113	Teleost	Batrachoididae	*Batrachomoeus trispinosus*	[a frogfish]	37205003
1117	Teleost	Caesionidae	*Dipterygonotus balteatus*	mottled fusilier	37346013
1118	Teleost	Caesionidae	*Caesio cuning*	yellow tail fusilier	37346018
657	Teleost	Carangidae	*Carangoides chrysophrys*	trevally	37337011
1122	Teleost	Carangidae	*Seriolina nigrofasciata*	black-banded kingfish	37337014
1129	Teleost	Carangidae	*Caranx kleinii*	razorbelly trevally	37337036
1130	Teleost	Carangidae	*Decapterus russelli*	red tailed round scad	37337023
1131	Teleost	Carangidae	*Megalaspis cordyla*	torpedo scad	37337028
3224	Teleost	Carangidae	*Alepes sp.*	A trevally	
1137	Teleost	Chaetodontidae	*Chelmon muelleri*	Muller's coralfish	37365015
1139	Teleost	Chirocentridae	*Chirocentrus dorab*	dorab wolf herring	37087001
1142	Teleost	Clupeidae	*Herklotsichthys koningsbergeri*	large-spotted herring	37085007
1144	Teleost	Cynoglossidae	*Cynoglossus bilineatus*	[a tongue sole]	37463013
1145	Teleost	Cynoglossidae	*Cynoglossus puncticeps*	[a tongue sole]	37463018
1146	Teleost	Cynoglossidae	*Paraplagusia bilineata*	four lined tongue sole	37463001

1148	Teleost	Dactylopteridae	*Dactyloptena orientalis*	[a flying gurnard]	37308004
1151	Teleost	Drepaneidae	*Drepane punctata*	spotted batfish	37362005
1152	Teleost	Echeneidae	*Echeneis naucrates*	slender suckerfish	37336001
1153	Teleost	Engraulidae	*Thryssa setirostris*	longjaw anchovy	37086004
1154	Teleost	Ephippidae	*Zabidius novemaculeatus*	nine spined batfish	37362003
1156	Teleost	Gerreidae	*Gerres macracanthus*	[a silver biddy]	37349021
3225	Teleost	Gerreidae	*Gerres poeti*	A silverbiddy	
1162	Teleost	Haemulidae	*Pomadasys trifasciatus*	silver grunter	37350008
1163	Teleost	Holocentridae	*Myripristis murdjan*	white tipped squirrel fish	37261002
1169	Teleost	Labridae	*Choerodon venustus*	venus tuskfish	37384042
1172	Teleost	Leiognathidae	*Leiognathus equulus*	narrow-banded ponyfish	37341014
3226	Teleost	Leiognathidae	*Leiognathus sp.*	a ponyfish	
674	Teleost	Lethrinidae	*Lethrinus laticaudis*	Grass Emperor	37351006
721	Teleost	Lethrinidae	*Lethrinus ornatus*	emperor	37351015
679	Teleost	Lutjanidae	*Lutjanus johnii*	Golden Snapper	37346030
1380	Teleost	Lutjanidae	*Lutjanus sp.* (in Yearsley, Last & Ward, 1999) [western form]	Russell's snapper	37346012
1175	Teleost	Menidae	*Mene maculate*	razor trevally	37340001
1176	Teleost	Monacanthidae	*Paramonacanthus choirocephalus*	[a leatherjacket]	37465064
1183	Teleost	Monacanthidae	*Aluterus monoceros*	unicorn leatherjacket	37465022
1187	Teleost	Mullidae	*Parupeneus cyclostomus*	goldsaddle goatfish	37355025
1188	Teleost	Mullidae	*Parupeneus indicus*	Indian goatfish	37355005
1192	Teleost	Muraenesocidae	*Muraenesox cinereus*	dark-finned pike eel	37063002
1198	Teleost	Ostraciidae	*Tetrosomus gibbosus*	black-blotched turret fish	37466006
1202	Teleost	Paralichthyidae	*Pseudorhombus quinquocellatus*	five-eyed flounder	37460025
1205	Teleost	Paralichthyidae	*Pseudorhombus dupliciocellatus*	ocellated flounder	37460004
1214	Teleost	Platycephalidae	*Platycephalus arenarius*	northern sand flathead	37296021
1216	Teleost	Platycephalidae	*Kumococius rodericensis*	white-finned flathead	37296019
1217	Teleost	Platycephalidae	*Platycephalus endrachtensis*	yellow-tailed flathead	37296020
1220	Teleost	Polynemidae	*Polydactylus macrochir*	king threadfin	37383005
1226	Teleost	Sciaenidae	*Johnius laevis*	round-nosed croaker	37354004
1228	Teleost	Scombridae	*Rastrelliger kanagurta*	Indian mackerel	37441012
1230	Teleost	Scorpaenidae	*Pterois russelii*	[a lionfish]	37287012
440	Teleost	Serranidae	*Epinephelus tauvina*	rock cod	37311057

1231	Teleost	Siganidae	*Siganus puellus*	bluelined rabbitfish	37438011
1232	Teleost	Siganidae	*Siganus lineatus*	goldlined rabbitfish	37438010
1395	Teleost	Siganidae	*Siganus nebulosus*	dusky rabbitfish	37438001
144	Teleost	Sillaginidae	*Sillago lutea*	Mud Whiting	37330007
1235	Teleost	Sillaginidae	*Sillago burrus*	western trumpeter whiting	37330004
1236	Teleost	Soleidae	*Pardachirus pavoninus*	peacock sole	37462009
1397	Teleost	Soleidae	*Zebrias craticulus*	wicker-work sole	37462003
1399	Teleost	Soleidae	*Phyllichthys sclerolepis*	[a sole]	37462031
183	Teleost	Sphyraenidae	*Sphyraena obtusata*	Striped Seapike / Pike	37382001
614	Teleost	Sphyraenidae	*Sphyraena barracuda*	Great Barracuda	37382008
1237	Teleost	Sphyraenidae	*Sphyraena putnamae*	chevron barracuda	37382006
1244	Teleost	Synodontidae	*Synodus dermatogenys*	clearfin lizardfish	37118003
1247	Teleost	Terapontidae	*Terapon puta*	[a grunter]	37321006
1253	Teleost	Tetraodontidae	*Torquigener tuberculiferus*	[a toadfish]	37467062
1255	Teleost	Tetraodontidae	*Arothron stellatus*	dotted pufferfish	37467014
1260	Teleost	Tetrarogidae	*Paracentropogon vespa*	[a scorpionfish]	37287060
1368	Teleost	Tetrarogidae	*Liocranium praepositum*	black spot waspfish	37287015
227	Teleost	Triacanthidae	*Triacanthus biaculeatus*	short-nosed triple spine	37464002
447	Teleost	Triglidae	*Lepidotrigla argus*	gurnard	37288032
2460	Teleost		*Gerres macrosoma*	silverbiddies	
616	Teleost	Labridae	*Cheilinus trilobatus*	Maori Wrasse	37384044
678	Teleost	Lethrinidae	*Lethrinus sp*. [Carpenter, pers comm]	Spangled Emperor	37351001
1388	Teleost	Lethrinidae	*Lethrinus spp*	Emperor	37351902
620	Teleost	Scombridae	*Scomberomorus commerson*	Spanish Mackerel	37441007
622	Teleost	Scombridae	*Scomberomorus munroi*	Australian Spotted Mackerel-DoggySchol	37441015
623	Teleost	Scombridae	*Scomberomorus semifasciatus*	Broad-barred Mackerel - Grey Mack	37441018
688	Teleost	Scombridae	*Grammatorcynus bicarinatus*	Shark Mackerel	37441025
158	Teleost	Sparidae	*Pagrus auratus*	Snapper/Squirefish	37353001
599	Teleost	Lutjanidae	*Lutjanus sebae*	Red Emperor	37346004
684	Teleost	Lutjanidae	*Lutjanus malabaricus*	Scarlet Sea Perch/Large Mouth Nannygai	37346007
147	Teleost	Rachycentridae	*Rachycentron canadum*	cobia	37335001

579	Teleost	Serranidae	*Plectropomus leopardus*	Northern Cod, Leopard Coralgrouper	37311078
1765	Chondrichthyan	Multi-family group	Sharks – other	Sharks (other)	37990003
2043	Chondrichthyan	Squatinidae	Squatinidae - undifferentiated	angel sharks	37024000
2228	Invertebrate	Palinuridae	*Panulirus spp* except *P. cygnus*	tropical rocklobster	28820901
2018	Invertebrate	Penaeoidea & Caridea	Penaeoidea & Caridea – undifferentiated	prawns	28710000
2245	Teleost	Ariidae	*Arius spp*	catfish	37188901
2159	Teleost	Arripidae	*Arripis trutta* & *Arripis truttaceus*	Australian salmon	37344900
68	Teleost	Berycidae	*Centroberyx gerrardi*	bight redfish	37258004
919	Teleost	Gadidae	*Gadus morhua*	Cod - unspecified	37226790
1087	Teleost	Gempylidae	*Thyrsites atun*	Barracouta	37439001
1386	Teleost	Haemulidae	*Plectorhinchus spp.*	Sweetlips	37350903
615	Teleost	Labridae	*Achoerodus viridis*	Eastern Blue Groper	37384043
597	Teleost	Lutjanidae	*Aphareus rutilans*	rusty jobfish	37346001
1381	Teleost	Lutjanidae	*Lutjanus spp.*	Sea Perch	37346905
2231	Teleost	Lutjanidae	*Lutjanus vitta/ carponotatus/ lutjanus* & *L. quinquelineatus*	flagfish	37346913
592	Teleost	Ophidiidae	*Dannevigia tusca*	Australian Tusk	37228001
873	Teleost	Scombridae	*Scomber scombrus*	Atlantic mackerel	37441790
689	Teleost	Serranidae	*Cromileptes altivelis*	Humpback Grouper/Barramundi cod	37311044
2236	Teleost	Serranidae	*Plectropomus spp* & *Variola spp*	coral trout	37311905
1229	Teleost	Scombridae	*Scomberomorus queenslandicus*	school mackerel	37441014
513	Chondrichthyan	Dasyatidae	*Dasyatis leylandi*	Painted Maskray	37035013
335	Chondrichthyan	Rhinobatidae	*Rhynchobatus djiddensis*	White-spotted Guitarfish	37026001
2738	Invertebrate	Penaeidae	*Metapenaeopsis mogiensis*	prawn	28711015
2739	Invertebrate	Penaeidae	*Metapenaeopsis novaeguineae*	prawn	28711016
2740	Invertebrate	Penaeidae	*Metapenaeopsis palmensis*	prawn	28711017
2741	Invertebrate	Penaeidae	*Metapenaeopsis rosea*	prawn	28711019
2749	Invertebrate	Penaeidae	*Parapenaeopsis cornuta*	prawn	28711031
2754	Invertebrate	Penaeidae	*Trachypenaeus anchoralis*	prawn	28711054
2755	Invertebrate	Penaeidae	*Trachypenaeus curvirostris*	prawn	28711055
2756	Invertebrate	Penaeidae	*Trachypenaeus fulvus*	prawn	28711056
2758	Invertebrate	Penaeidae	*Trachypenaeus granulosus*	prawn	28711058
30	Invertebrate	Portunidae	*Portunus (Portunus) pelagicus*	blue swimmer crab	28911005

2718	Invertebrate	Squillidae	*Carinosquilla thailandensis*	mantis shrimp	28051015
2721	Invertebrate	Squillidae	*Erugosquilla grahami*	mantis shrimp	28051032
2722	Invertebrate	Squillidae	*Erugosquilla woodmasoni*	mantis shrimp	28051033
2728	Invertebrate	Squillidae	*Oratosquillina inornata*	mantis shrimp	28051051
2731	Invertebrate	Squillidae	*Oratosquillina quinquedentate*	mantis shrimp	28051054
2569	Invertebrate		*Lupocyclus rotundatus*	swimmer crab	
2573	Invertebrate		*Parthenope longimanus*	crab	
2593	Invertebrate		*Izanami inermis*	moon crab	
2643	Invertebrate		*Thalamita sima*	swimmer crab	
2646	Invertebrate		*Dorippe quadridens*	crabs	
2672	Invertebrate		*Sphenopus marsupialis*	zoanthid anemone	
2692	Invertebrate		*Hyastenus sp.*	Spider crab	
2495	Teleost	Aploactinidae	*Kanekonia queenslandica*	deep velvetfish	37290007
2424	Teleost	Apogonidae	*Apogon septemstriatus*	[a cardinal fish]	37327012
2481	Teleost	Apogonidae	*Apogon cavitiensis*	[a cardinal fish]	37327028
2482	Teleost	Apogonidae	*Apogon fuscomaculatus*	[a cardinal fish]	37327140
2483	Teleost	Apogonidae	*Apogon semilineatus*	[a cardinal fish]	37327004
2289	Teleost	Ariidae	*Arius thalassinus*	catfish	37188001
1364	Teleost	Bathysauridae	*Saurida grandisquamis*	grey lizardfish	37118016
2496	Teleost	Bregmacerotidae	*Bregmaceros japonicus*	codlet	37225004
2404	Teleost	Callionymidae	*Repomucenus sublaevis*	[a stinkfish]	37427010
654	Teleost	Carangidae	*Carangoides caeruleopinnatus*	trevally	37337021
1120	Teleost	Carangidae	*Alepes apercna*	banded scad	37337010
2405	Teleost	Carangidae	*Carangoides gymnostethus*	[a trevally]	37337022
2450	Teleost	Chaetodontidae	*Coradion chrysozonus*	butterflyfish	37365004
2441	Teleost	Clupeidae	*Amblygaster sirm*	herring	37085006
2473	Teleost	Clupeidae	*Sardinella albella*	herring	37085014
2474	Teleost	Clupeidae	*Herklotsichthys lippa*	herring	37085008
2377	Teleost	Cynoglossidae	*Paraplagusia sinerama*	sole	37463022
2505	Teleost	Diodontidae	*Cyclichthys orbicularis*	[a porcupinefish]	37469007
2475	Teleost	Exocoetidae	*Parexocoetus mento*	flying fish	37233003
88	Teleost	Fistulariidae	*Fistularia commersonii*	smooth flute mouth	37278001
1157	Teleost	Gerreidae	*Gerres oblongus*	[a silver biddy]	37349022

2459	Teleost	Gerreidae	*Gerres filamentosus*	[a silverbiddy]	37349003
2461	Teleost	Gerreidae	*Gerres subfasciatus*	[a silverbiddy]	37349005
2470	Teleost	Gobiidae	*Acentrogobius caninus*	[a goby]	37428019
2388	Teleost	Hemiramphidae	*Hemiramphus robustus*	garfish	37234013
1379	Teleost	Leiognathidae	*Leiognathus sp*. [in Sainsbury *et al*, 1985]	slender ponyfish	37341003
2456	Teleost	Leiognathidae	*Leiognathus decorus*	[a ponyfish]	37341016
2462	Teleost	Leiognathidae	*Leiognathus leuciscus*	[a ponyfish]	37341005
2464	Teleost	Leiognathidae	*Leiognathus fasciatus*	[a ponyfish]	37341009
2466	Teleost	Leiognathidae	*Leiognathus moretoniensis*	[a ponyfish]	37341012
2467	Teleost	Leiognathidae	*Secutor insidiator*	[a ponyfish]	37341006
1546	Teleost	Lutjanidae	*Lutjanus russelli [The eastern form]*	[a tropical snapper]	37346065
2339	Teleost	Mullidae	*Parupeneus heptacanthus*	[a mullett]	37355004
2442	Teleost	Mullidae	*Upeneus sp. 1* [in Sainsbury *et al*, 1985]	[a mullett]	37355008
2360	Teleost	Nemipteridae	*Pentapodus paradiseus*	[a threadfin bream]	37347028
2319	Teleost	Pteroidae	*Pterois volitans*	[a scorpionfish]	37287040
2335	Teleost	Scaridae	*Scarus ghobban*	[a parrotfish	37386001
2324	Teleost	Scorpaenidae	*Scorpaenopsis furneauxi*	[a scorpionfish]	37287038
2326	Teleost	Scorpaenidae	*Scorpaenopsis neglecta*	[a scorpionfish]	37287030
2327	Teleost	Scorpaenidae	*Scorpaenopsis venosa*	[a scorpionfish]	37287086
2368	Teleost	Soleidae	*Zebrias cancellatus*	sole	37462006
2393	Teleost	Soleidae	*Aseraggodes melanostictus*	sole	37462016
2526	Teleost	Synanceiidae	*Minous trachycephalus*	stinger	37287024
1599	Teleost	Syngnathidae	*Hippocampus hendriki*	[a pipefish]	37282125
2380	Teleost	Synodontidae	*Synodus hoshinonis*	lizard fish	37118010
2384	Teleost	Tetraodontidae	*Arothron manilensis*	[a toadfish]	37467020
2303	Teleost	Tetrarogidae	*Paracentropogon longispinus*	fortesque	37287016
1099	Teleost	Antennariidae	*Tathicarpus butleri*	smooth spot anglerfish	37210003
1102	Teleost	Apistidae	*Apistus carinatus*	ocellated waspfish	37287011
1103	Teleost	Aploactinidae	*Adventor elongatus*	[a velvetfish]	37290004
1104	Teleost	Aploactinidae	*Paraploactis trachyderma*	[a velvetfish]	37290011
1106	Teleost	Apogonidae	*Apogon melanopus*	monster apogonid	37327016
1107	Teleost	Apogonidae	*Apogon poecilopterus*	pearly-finned cardinalfish	37327026
1108	Teleost	Apogonidae	*Siphamia roseigaster*	pink-breasted siphonfish	37327017

1111	Teleost	Apogonidae	*Apogon nigripinnis*	yellow ring cardinal	37327009
1112	Teleost	Apogonidae	*Apogon albimaculosus*	yellow-spot cardinalfish	37327014
1375	Teleost	Apogonidae	*Apogon brevicaudatus*	seven striped cardinalfish	37327005
1376	Teleost	Apogonidae	*Apogon truncates*	flag-fin cardinalfish	37327013
2422	Teleost	Apogonidae	*Apogon fasciatus*	[a cardinal fish]	37327158
1363	Teleost	Bathysauridae	*Saurida argentea*	shortfin lizardfish	37118005
1115	Teleost	Bothidae	*Arnoglossus waitei*	[a lefteye flounder]	37460045
1116	Teleost	Bothidae	*Grammatobothus polyophthalmus*	three-eyed flounder	37460010
1396	Teleost	Bothidae	*Engyprosopon grandisquamum*	spiny headed flounder	37460012
1119	Teleost	Callionymidae	*Dactylopus dactylopus*	fingered dragonet	37427005
1391	Teleost	Callionymidae	*Calliurichthys grossi*	[a stinkfish]	37427007
1392	Teleost	Callionymidae	*Orbonymus rameus*	high-finned dragonet	37427009
1393	Teleost	Callionymidae	*Repomucenus belcheri*	[a stinkfish]	37427011
1394	Teleost	Callionymidae	*Repomucenus limiceps*	[a stinkfish]	37427012
663	Teleost	Carangidae	*Gnathanodon speciosus*	Golden Trevally	37337012
1121	Teleost	Carangidae	*Parastromateus niger*	black pomfret	37337072
1123	Teleost	Carangidae	*Caranx bucculentus*	blue-spotted trevally	37337016
1124	Teleost	Carangidae	*Carangoides hedlandensis*	bumpnose trevally	37337042
1125	Teleost	Carangidae	*Carangoides humerosus*	dusky shoulder trevally	37337031
1126	Teleost	Carangidae	*Pantolabus radiatus*	fringe-finned trevally	37337047
1127	Teleost	Carangidae	*Carangoides talamparoides*	imposter trevally	37337043
1128	Teleost	Carangidae	*Selar boops*	oxeye scad	37337008
1132	Teleost	Carangidae	*Selaroides leptolepis*	yellowstripe scad	37337015
1377	Teleost	Carangidae	*Alectis indica*	Indian threadfin	37337038
1133	Teleost	Centriscidae	*Centriscus scutatus*	grooved razor fish	37280001
1134	Teleost	Centrogeniidae	*Centrogenys vaigiensis*	pretty-fins	37311030
1135	Teleost	Centropomidae	*Psammoperca waigiensis*	glasseye perch	37310001
1136	Teleost	Chaetodontidae	*Chelmon marginalis*	margined coralfish	37365007
1138	Teleost	Chaetodontidae	*Parachaetodon ocellatus*	ocellated coralfish	37365003
1140	Teleost	Clupeidae	*Sardinella gibbosa*	goldstripe sardine	37085013
1141	Teleost	Clupeidae	*Pellona ditchela*	Indian pellona	37085009
1143	Teleost	Clupeidae	*Dussumieria elopsoides*	sharp nosed sprat	37085010
1147	Teleost	Cynoglossidae	*Cynoglossus maculipinnis*	spotted-fin tongue sole	37463003

1149	Teleost	Dactylopteridae	*Dactyloptena papilio*	large-spot flying gurnard	37308001
1150	Teleost	Diodontidae	*Tragulichthys jaculiferus*	three spot porcupine fish	37469004
1155	Teleost	Ephippidae	*Platax teira*	round-faced batfish	37362004
89	Teleost	Fistulariidae	*Fistularia petimba*	rough flutemouth	37278002
1158	Teleost	Gerreidae	*Pentaprion longimanus*	long-fin silver biddy	37349002
659	Teleost	Glaucosomatidae	*Glaucosoma magnificum*	pearl perch	37320002
1159	Teleost	Gobiidae	*Yongeichthys nebulosus*	[a goby]	37428001
1160	Teleost	Haemulidae	*Pomadasys maculatus*	blotched javelinfish	37350002
1161	Teleost	Haemulidae	*Diagramma labiosum*	painted sweetlip	37350003
1165	Teleost	Labridae	*Choerodon monostigma*	dark spot tusk fish	37384008
1167	Teleost	Labridae	*Choerodon cephalotes*	purple tusk fish	37384004
1389	Teleost	Labridae	*Choerodon sugillatum*	wedge-tailed wrasse	37384009
1170	Teleost	Leiognathidae	*Leiognathus splendens*	black-tipped ponyfish	37341010
1171	Teleost	Leiognathidae	*Leiognathus elongatus*	elongate pony fish	37341011
1173	Teleost	Leiognathidae	*Leiognathus bindus*	orange tipped ponyfish	37341002
1174	Teleost	Leiognathidae	*Gazza minuta*	toothed ponyfish	37341007
677	Teleost	Lethrinidae	*Lethrinus lentjan*	Red Spot Emperor	37351007
713	Teleost	Lethrinidae	*Lethrinus genivittatus*	emperor	37351002
637	Teleost	Lutjanidae	*Lutjanus vitta*	brownband seaperch	37346003
739	Teleost	Lutjanidae	*Lutjanus carponotatus*	stripey seaperch	37346011
1177	Teleost	Monacanthidae	*Anacanthus barbatus*	bearded leatherjacket	37465010
1178	Teleost	Monacanthidae	*Monacanthus chinensis*	fan-bellied leatherjacket	37465009
1179	Teleost	Monacanthidae	*Pseudomonacanthus elongatus*	four-banded leather jacket	37465029
1180	Teleost	Monacanthidae	*Pseudomonacanthus peroni*	pot bellied leatherjacket	37465020
1181	Teleost	Monacanthidae	*Chaetodermis penicilligera*	prickly leatherjacket	37465013
1182	Teleost	Monacanthidae	*Paramonacanthus filicauda*	threadfin leatherjacket	37465024
1184	Teleost	Mullidae	*Upeneus sundaicus*	dark-finned goatfish	37355013
1185	Teleost	Mullidae	*Upeneus asymmetricus*	gold band orange bar goatfish	37355010
1186	Teleost	Mullidae	*Upeneus moluccensis*	gold-band goatfish	37355003
1189	Teleost	Mullidae	*Upeneus luzonius*	saddle goatfish	37355009
1190	Teleost	Mullidae	*Upeneus tragula*	spotted goatfish	37355014
1191	Teleost	Mullidae	*Upeneus sulphureus*	yellow goatfish	37355007
1193	Teleost	Nemipteridae	*Nemipterus peronii*	notched threadfin bream	37347003

1194	Teleost	Nemipteridae	*Nemipterus hexodon*	ornate threadfin bream	37347014
1195	Teleost	Nemipteridae	*Nemipterus furcosus*	rosy threadfin bream	37347005
1196	Teleost	Nemipteridae	*Nemipterus nematopus*	yellow tipped threadfin bream	37347002
1384	Teleost	Nemipteridae	*Scolopsis taenioptera*	red spot monocle bream	37347008
1199	Teleost	Ostraciidae	*Lactoria cornuta*	cowfish	37466004
1402	Teleost	Ostraciidae	*Rhynchostracion nasus*	small nosed boxfish	37466005
221	Teleost	Paralichthyidae	*Pseudorhombus jenynsii*	small-toothed flounder	37460002
1201	Teleost	Paralichthyidae	*Pseudorhombus elevatus*	deep-bodied flounder	37460008
1203	Teleost	Paralichthyidae	*Pseudorhombus diplospilus*	four twin-spot flounder	37460015
1204	Teleost	Paralichthyidae	*Pseudorhombus arsius*	large-toothed flounder	37460009
1206	Teleost	Paralichthyidae	*Pseudorhombus argus*	peacock flounder	37460038
1207	Teleost	Paralichthyidae	*Pseudorhombus spinosus*	spiny flounder	37460011
1208	Teleost	Pegasidae	*Pegasus volitans*	slender seamoth	37309002
1210	Teleost	Pinguipedidae	*Parapercis nebulosa*	red-barred grubfish	37390005
1211	Teleost	Platycephalidae	*Platycephalus indicus*	bartail flathead	37296033
1212	Teleost	Platycephalidae	*Elates ransonnetii*	dwarf flathead	37296013
1213	Teleost	Platycephalidae	*Suggrundus macracanthus*	large-spined flathead	37296012
1215	Teleost	Platycephalidae	*Inegocia japonica*	rusty flathead	37296029
1370	Teleost	Platycephalidae	*Papilloculiceps nematophthalmus*	fringed eye flathead	37296023
1526	Teleost	Platycephalidae	*Sorsogona tuberculata*	heart-headed flathead	37296030
1218	Teleost	Plotosidae	*Euristhmus nudiceps*	naked-headed catfish	37192003
1219	Teleost	Plotosidae	*Plotosus lineatus*	striped catfish	37192002
1221	Teleost	Pomacanthidae	*Chaetodontoplus duboulayi*	scribbled angelfish	37365009
1222	Teleost	Pomacentridae	*Pristotis obtusirostris*	Gulf damsel	37372001
749	Teleost	Priacanthidae	*Priacanthus tayenus*	bigeye	37326003
1223	Teleost	Psettodidae	*Psettodes erumei*	Australian halibut	37457001
1224	Teleost	Pseudochromidae	*Pseudochromis quinquedentatus*	spotted dottyback	37313001
1225	Teleost	Samaridae	*Samaris cristatus*	cockatoo flounder	37461006
1227	Teleost	Sciaenidae	*Johnius borneensis*	sin croaker	37354007
437	Teleost	Serranidae	*Epinephelus sexfasciatus*	rock cod	37311017
577	Teleost	Serranidae	*Epinephelus quoyanus*	Honeycomb Cod / Longfin Grouper	37311040
1233	Teleost	Siganidae	*Siganus canaliculatus*	seagrass rabbitfish	37438004
1234	Teleost	Sillaginidae	*Sillago sihama*	silver whiting	37330006

226	Teleost	Soleidae	*Zebrias quagga*	zebra sole	37462004
1398	Teleost	Soleidae	*Brachirus muelleri*	tufted sole	37462007
1238	Teleost	Sphyraenidae	*Sphyraena flavicauda*	yellowtail barracuda	37382007
1240	Teleost	Synanceiidae	*Inimicus sinensis*	bearded ghoul	37287020
1241	Teleost	Synanceiidae	*Minous versicolor*	plum-striped stinger	37287021
863	Teleost	Synodontidae	*Saurida undosquamis*	brushtooth lizard fish	37118001
1245	Teleost	Synodontidae	*Synodus sageneus*	mottled lizardfish	37118004
1246	Teleost	Synodontidae	*Trachinocephalus myops*	painted saury	37118002
1248	Teleost	Terapontidae	*Pelates quadrilineatus*	eight lined grunter	37321001
1249	Teleost	Terapontidae	*Terapon theraps*	large scaled grunter	37321003
1250	Teleost	Terapontidae	*Pelates sexlineatus*	six-lined grunter-perch	37321005
1251	Teleost	Terapontidae	*Amniataba caudavittata*	yellowtail trumpeter	37321007
1252	Teleost	Tetrabrachiidae	*Tetrabrachium ocellatum*	[a frogfish]	37210010
247	Teleost	Tetraodontidae	*Torquigener pallimaculatus*	toadfish	37467009
1254	Teleost	Tetraodontidae	*Torquigener whitleyi*	[a toadfish]	37467028
1256	Teleost	Tetraodontidae	*Lagocephalus sceleratus*	giant toadfish	37467007
1257	Teleost	Tetraodontidae	*Lagocephalus spadiceus*	half smooth golden pufferfish	37467017
1258	Teleost	Tetraodontidae	*Lagocephalus lunaris*	rough golden pufferfish	37467012
1259	Teleost	Tetraodontidae	*Feroxodon multistriatus*	scribbled toadfish	37467010
1261	Teleost	Tetrarogidae	*Cottapistus cottoides*	orange-spotted waspfish	37287014
1262	Teleost	Triacanthidae	*Trixiphichthys weberi*	long nosed triple spine fish	37464001
209	Teleost	Trichiuridae	*Trichiurus lepturus*	smallhead hairtail	37440004
2094	Teleost	Carangidae	Carangidae - undifferentiated	trevallies	37337000
2077	Teleost	Hemiramphidae	Hemiramphidae - undifferentiated	garfishes	37234000
2216	Not Allocated	Pectinidae	Pectinidae – undifferentiated	scallops	23270000
2240	Not Allocated	Pteriidae	*Pinctada spp.*	pearl oyster	23236901
2710	Not Allocated	Pectinidae	*Annchlamys flabellate*	fan scallop	23270004
3227	Not Allocated		*Acaudina sp A*		
3228	Not Allocated		*Actinaria sp A*		
3229	Not Allocated		*Alcyonacea sp A*		
3230	Not Allocated		*Alcyonacea sp B*		
3231	Not Allocated		*Alepes vari*		37337067
3232	Not Allocated		*Alpheidae sp A*		

3233	Not Allocated	*Apogon timorensis*	37327077
3234	Not Allocated	*Ascidiacea sp A*	
3235	Not Allocated	*Ascidiacea sp B*	
3236	Not Allocated	*Ascidiacea sp C*	
3237	Not Allocated	*Ascidiacea sp E*	
3238	Not Allocated	*Ascidiacea sp H*	
3239	Not Allocated	*Ascidiacea sp K*	
3240	Not Allocated	*Ascidiacea sp L*	
3241	Not Allocated	*Ascidiacea sp M*	
3242	Not Allocated	*Ashtoret granulosa*	28877001
3243	Not Allocated	*Asteroidae sp A*	
3244	Not Allocated	*Asteroidae sp B*	
3245	Not Allocated	*Asteroidae sp C*	
3246	Not Allocated	*Asteroidae sp D*	
3247	Not Allocated	*Asteroidae sp E*	
3248	Not Allocated	*Asteroidae sp K*	
3249	Not Allocated	*Asteroidae sp L*	
3250	Not Allocated	*Astropecten sp A*	
3251	Not Allocated	*Astropecten sp B*	
3252	Not Allocated	*Atys naucum*	
3253	Not Allocated	*Axiidae sp A*	
3254	Not Allocated	*Axiidae sp B*	
3255	Not Allocated	*Bufonaria rana*	24170002
3256	Not Allocated	*Calappa sp A*	
3257	Not Allocated	*Caridean sp A*	
3258	Not Allocated	*Carinosquilla spinosus*	
3259	Not Allocated	*Caulastrea sp A*	
3260	Not Allocated	*Ceriantharia sp B*	
3261	Not Allocated	*Charybdis (charybdis) callianassa*	28911037
3262	Not Allocated	*Charybdis (charybdis) yaldwyni*	28911081
3263	Not Allocated	*Charybdis (charybdis)natator*	28911002
3264	Not Allocated	*Charybdis (Goniohellenus) truncata*	28911015
3265	Not Allocated	*Charybdis(charybdis) jaubertensis*	28911075

3266	Not Allocated	*Charybdis(charybdis) orientalis*	28911078
3267	Not Allocated	*Chicoreus (Triplex) cervicornis*	24200020
3268	Not Allocated	*Choerodon sp 2*	
3269	Not Allocated	*Choerodon sp A*	
3270	Not Allocated	*Clibanarius sp B*	
3271	Not Allocated	*Clibanarius sp C*	
3272	Not Allocated	*Clypeasteridae sp A*	
3273	Not Allocated	*Clypeasteridae sp B*	
3274	Not Allocated	*Clypeasteridae sp C*	
3275	Not Allocated	*Corbulidae sp A*	
3276	Not Allocated	*Crinoid sp A*	
3277	Not Allocated	*Crinoid sp B*	
3278	Not Allocated	*Crinoid sp C*	
3279	Not Allocated	*Crinoid sp D*	
3280	Not Allocated	*Crinoid sp E*	
3281	Not Allocated	*Crinoid sp F*	
3282	Not Allocated	*Crinoid sp G*	
3283	Not Allocated	*Crinoid sp H*	
3284	Not Allocated	*Crinoid sp I*	
3285	Not Allocated	*Crinoid sp J*	
3286	Not Allocated	*Crinoid sp K*	
3287	Not Allocated	*Crinoid sp L*	
3288	Not Allocated	*Crinoid sp N*	
3289	Not Allocated	*Crinoid sp P*	
3290	Not Allocated	*Crinoid sp Q*	
3291	Not Allocated	*Cryptopodia sp A*	
3292	Not Allocated	*Cynoglossus sp A*	
3293	Not Allocated	*Cypraea subviridis*	24155003
3294	Not Allocated	*Diogenidae sp A*	
3295	Not Allocated	*Diogenidae sp B*	
3296	Not Allocated	*Diogenidae sp C*	
3297	Not Allocated	*Diogenidae sp F*	
3298	Not Allocated	*Distorsio reticulata*	24174001

3299	Not Allocated	*Dosinia altenai*	23380033
3300	Not Allocated	*Dromidiopsis australiensis*	28852005
3301	Not Allocated	*Echinoid sp A*	
3302	Not Allocated	*Echinoid sp B*	
3303	Not Allocated	*Echinoid sp F*	
3304	Not Allocated	*Echinoid sp G*	
3305	Not Allocated	*Echinoid sp H*	
3306	Not Allocated	*Encrasicolina sp. A*	
3307	Not Allocated	*Euryale asperum*	25170004
3308	Not Allocated	*Gobiidae sp A*	
3309	Not Allocated	*Halimeda sp*	
3310	Not Allocated	*Halophila spinulosa*	63605003
3311	Not Allocated	*Haustellum multiplicatus*	24200018
3312	Not Allocated	*Herpetopoma atrata*	24046004
3313	Not Allocated	*Holothuria (Metriatyla) ocellata*	25416030
3314	Not Allocated	*Holothuria sp M*	
3315	Not Allocated	*Hyastenus campbelli*	28880030
3316	Not Allocated	*Hydroid sp B*	
3317	Not Allocated	*Hydroid sp A*	
3318	Not Allocated	*Hydroid sp C*	
3319	Not Allocated	*Inimicus caledonicus*	37287055
3320	Not Allocated	*Ixa sp (poss inermis)*	
3321	Not Allocated	*Jonas leuteanus*	28900002
3322	Not Allocated	*Metapenaeopsis hilarula*	28711060
3323	Not Allocated	*Metapenaeopsis sinica*	28711070
3324	Not Allocated	*Metapenaeopsis toloensis*	28711072
3325	Not Allocated	*Murex acanthostephes*	24200016
3326	Not Allocated	*Nassarius (nassarius) coronatus*	24202133
3327	Not Allocated	*Nuculidae sp A*	
3328	Not Allocated	*Octopus exannulatus*	23659024
3329	Not Allocated	*Octopus sp J*	
3330	Not Allocated	*Octopus sp K*	
3331	Not Allocated	*Ophiocomidae sp A*	

3332	Not Allocated	*Ophuroid sp A*	
3333	Not Allocated	*Ophuroid sp B*	
3334	Not Allocated	*Ophuroid sp C*	
3335	Not Allocated	*Ophuroid sp D*	
3336	Not Allocated	*Ophuroid sp E*	
3337	Not Allocated	*Ophuroid sp F*	
3338	Not Allocated	*Ophuroid sp H*	
3339	Not Allocated	*Ophuroid sp I*	
3340	Not Allocated	*Palaemonidae sp A*	
3341	Not Allocated	*Palaemonidae sp B*	
3342	Not Allocated	*Pandalidae sp A*	
3343	Not Allocated	*Paracuadina sp A*	
3344	Not Allocated	*Paramonacanthus otisensis*	37465065
3345	Not Allocated	*Parapercis diplospilus*	37390014
3346	Not Allocated	*Paraploactis intonsa*	37290010
3347	Not Allocated	*Pennatulacea sp A*	
3348	Not Allocated	*Pennatulacea sp B*	
3349	Not Allocated	*Pennatulacea sp C*	
3350	Not Allocated	*Peristrominous dolosus*	37290012
3351	Not Allocated	*Phalangipes sp (poss longipes)*	
3352	Not Allocated	*Phalangipus australiensis*	28880038
3353	Not Allocated	*Philine angasi*	24322002
3354	Not Allocated	*Photololigo spp* (damaged)	
3355	Not Allocated	*Pinnidae sp A*	
3356	Not Allocated	*Placamen calophyllum*	23380023
3357	Not Allocated	*Platylambrus sp A*	
3358	Not Allocated	*Porcellanella triloba*	28843047
3359	Not Allocated	*Portunus (Cycloachelous) granulatus*	28911028
3360	Not Allocated	*Portunus (Lupocycloporus) gracilimanus*	28911027
3361	Not Allocated	*Portunus (Monomia) argentatus*	28911032
3362	Not Allocated	*Portunus (Monomia) rubromarginatus*	28911026
3363	Not Allocated	*Portunus (Xiphonectes) hastatoides*	28911030
3364	Not Allocated	*Portunus (Xiphonectes) rugosus*	28911070

3365	Not Allocated	*Portunus (Xiphonectes) tenuipes*		28911042
3366	Not Allocated	*Prionocidaris sp A*		
3367	Not Allocated	*Pseudocolochirus violaceus*		25408031
3368	Not Allocated	*Rubble biological*		
3369	Not Allocated	*Saurida nebulosa*		37118027
3370	Not Allocated	*Scorpaenopsis brevifrons*		
3371	Not Allocated	*Scyllarus sp 1* (CSIRO)		
3372	Not Allocated	*Scyllarus sp 2* (CSIRO)		
3373	Not Allocated	Sea Urchin II (CSIRO ref)		
3374	Not Allocated	*Sepia plangon*		23607012
3375	Not Allocated	*Sepiadariidae sp A*		
3376	Not Allocated	*Sepiadariidae sp B*		
3377	Not Allocated	*Sepiolidae sp A*		
3378	Not Allocated	*Sicyonia lancifera*		28715001
3379	Not Allocated	*Sillago maculata*		37330015
3380	Not Allocated	*Sillago robusta*		37330005
3381	Not Allocated	*Spatangoida sp B*		
3382	Not Allocated	*Stellaster equestris*		25122026
3383	Not Allocated	*Stichopus sp. A*		
3384	Not Allocated	*Stolephorus sp A*		
3385	Not Allocated	*Stolephorus sp B*		
3386	Not Allocated	*Strombus (Doxander) vittatus*		24125001
3387	Not Allocated	*Strongylura leiura*		37235003
3388	Not Allocated	*Sygnathidae sp A*		
3389	Not Allocated	*Tellina (Tellinella) pulcherrima*		23355013
3390	Not Allocated	*Thalamita sp. (poss spinifera)*		
3392	Not Allocated	*Tripodichthys angustifrons*		37464007
3393	Not Allocated	*Xenophora (Xenophora) solaroides*		24145001
3394	Not Allocated	*Xenophora indica*		24145002
1407	Not Allocated	Mixed species	other	37999999

<u>TEP species Torres Strait Prawn Fishery</u>
List the TEP species that occur in the area of the sub-fishery. Highlight species that are known to interact directly with the fishery. TEP species are those species listed as Threatened, Endangered or Protected under the EPBC Act.

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

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

ERAEF species ID	Taxa	Family name	Scientific name	Common Name	CAAB code
1067	Chondrichthyan	Rhincodontidae	*Rhincodon typus*	whale shark	37014001
1436	Marine bird	Accipitridae	*Haliaeetus leucogaster*	White-bellied Sea-Eagle	40077001
1015	Marine bird	Laridae	*Sterna anaethetus*	Bridled Tern	40128023
1025	Marine bird	Laridae	*Sterna sumatrana*	Black-naped tern	40128034
1438	Marine bird	Laridae	*Anous minutus*	Black Noddy	40128001
1580	Marine bird	Procellariidae	*Calonectris leucomelas*	streaked shearwater	40041002
1610	Marine bird		*Pterodroma heraldica*	Herald Petrel	
1439	Marine mammal	Balaenidae	*Balaenoptera bonaerensis*	Antarctic Minke Whale	41112007
262	Marine mammal	Balaenopteridae	*Balaenoptera edeni*	Bryde's Whale	41112003
265	Marine mammal	Balaenopteridae	*Balaenoptera musculus*	Blue Whale	41112004
984	Marine mammal	Balaenopteridae	*Megaptera novaeangliae*	Humpback Whale	41112006
612	Marine mammal	Delphinidae	*Delphinus delphis*	Common Dolphin	41116001
860	Marine mammal	Delphinidae	*Orcaella brevirostris*	Irrawaddy dolphin	41116010
902	Marine mammal	Delphinidae	*Feresa attenuata*	Pygmy Killer Whale	41116002
934	Marine mammal	Delphinidae	*Globicephala macrorhynchus*	Short-finned Pilot Whale	41116003
937	Marine mammal	Delphinidae	*Grampus griseus*	Risso's Dolphin	41116005
970	Marine mammal	Delphinidae	*Lagenodelphis hosei*	Fraser's Dolphin	41116006
1002	Marine mammal	Delphinidae	*Orcinus orca*	Killer Whale	41116011

1007	Marine mammal	Delphinidae	*Peponocephala electra*	Melon-headed Whale	41116012
1044	Marine mammal	Delphinidae	*Pseudorca crassidens*	False Killer Whale	41116013
1076	Marine mammal	Delphinidae	*Sousa chinensis*	Indo-Pacific Humpback Dolphin	41116014
1080	Marine mammal	Delphinidae	*Stenella attenuate*	Spotted Dolphin	41116015
1081	Marine mammal	Delphinidae	*Stenella coeruleoalba*	Striped Dolphin	41116016
1082	Marine mammal	Delphinidae	*Stenella longirostris*	Long-snouted Spinner Dolphin	41116017
1083	Marine mammal	Delphinidae	*Steno bredanensis*	Rough-toothed Dolphin	41116018
1091	Marine mammal	Delphinidae	*Tursiops truncatus*	Bottlenose Dolphin	41116019
1494	Marine mammal	Delphinidae	*Tursiops aduncus*	Indian Ocean bottlenose dolphin	41116020
813	Marine mammal	Dugongidae	*Dugong dugon*	Dugong	41206001
968	Marine mammal	Physeteridae	*Kogia breviceps*	Pygmy Sperm Whale	41119001
969	Marine mammal	Physeteridae	*Kogia simus*	Dwarf Sperm Whale	41119002
1036	Marine mammal	Physeteridae	*Physeter catodon*	Sperm Whale	41119003
986	Marine mammal	Ziphiidae	*Mesoplodon densirostris*	Blainville's Beaked Whale	41120005
1098	Marine mammal	Ziphiidae	*Ziphius cavirostris*	Cuvier's Beaked Whale	41120012
324	Marine reptile	Cheloniidae	*Caretta caretta*	Loggerhead	39020001
541	Marine reptile	Cheloniidae	*Chelonia mydas*	Green turtle	39020002
822	Marine reptile	Cheloniidae	*Eretmochelys imbricata*	Hawksbill turtle	39020003
844	Marine reptile	Cheloniidae	*Lepidochelys olivacea*	Olive Ridley turtle	39020004
857	Marine reptile	Cheloniidae	*Natator depressus*	Flatback turtle	39020005
2276	Marine reptile	Crocodylidae	*Crocodylus porosus*	saltwater crocodile	39140002
613	Marine reptile	Dermochelyidae	*Dermochelys coriacea*	Leathery turtle	39021001
254	Marine reptile	Hydrophiidae	*Astrotia stokesii*	Stokes' seasnake	39125009
957	Marine reptile	Hydrophiidae	*Hydrophis elegans*	Elegant seasnake	39125021
1005	Marine reptile	Hydrophiidae	*Pelamis platurus*	yellow-bellied seasnake	39125033
1408	Marine reptile	Hydrophiidae	*Acalyptophis peronii*	Horned Seasnake	39125001
1410	Marine reptile	Hydrophiidae	*Aipysurus duboisii*	Dubois' Seasnake	39125003
1411	Marine reptile	Hydrophiidae	*Aipysurus eydouxii*	Spine-tailed Seasnake	39125004
1414	Marine reptile	Hydrophiidae	*Aipysurus laevis*	Olive Seasnake, Golden Seasnake	39125007
1416	Marine reptile	Hydrophiidae	*Disteira major*	Olive-headed Seasnake	39125011
1418	Marine reptile	Hydrophiidae	*Enhydrina schistosa*	Beaked Seasnake	39125013
1420	Marine reptile	Hydrophiidae	*Hydrelaps darwiniensis*	Black-ringed Seasnake	39125015
1422	Marine reptile	Hydrophiidae	*Hydrophis mcdowelli*	seasnake	39125025

1423	Marine reptile	Hydrophiidae	*Hydrophis ornatus*	seasnake	39125028
1424	Marine reptile	Hydrophiidae	*Lapemis hardwickii*	Spine-bellied Seasnake	39125031
1530	Marine reptile	Hydrophiidae	*Disteira kingii*	spectacled seasnake	39125010
1681	Marine reptile	Hydrophiidae	*Hydrophis atriceps*	Black-headed seasnake	39125016
1684	Marine reptile	Hydrophiidae	*Hydrophis gracilis*	Slender seasnake	39125023
1686	Marine reptile	Hydrophiidae	*Hydrophis melanosoma*	Black-banded robust seasnake	39125027
1687	Marine reptile	Hydrophiidae	*Hydrophis pacificus*	Large-headed Seasnake	39125029
1688	Marine reptile	Hydrophiidae	*Hydrophis vorisi*	A seasnake	39125030
1679	Marine reptile	Laticaudidae	*Laticauda colubrina*	Banded wide faced Sea krait	39124001
1680	Marine reptile	Laticaudidae	*Laticauda laticaudata*	Large scaled sea krait	39124002
1074	Teleost	Solenostomidae	*Solenostomus cyanopterus*	Blue-finned Ghost Pipefish, Robust Ghost	37281001
1075	Teleost	Solenostomidae	*Solenostomus paradoxus*	Harlequin Ghost Pipefish, Ornate Ghost Pipefish	37281002
52	Teleost	Syngnathidae	*Corythoichthys intestinalis*	Australian Messmate Pipefish, Banded Pipefish	37282049
54	Teleost	Syngnathidae	*Halicampus brocki*	Brock's Pipefish	37282065
55	Teleost	Syngnathidae	*Doryrhamphus janssi*	Cleaner Pipefish, Janss' Pipefish	37282059
57	Teleost	Syngnathidae	*Halicampus nitidus*	Glittering Pipefish	37282069
114	Teleost	Syngnathidae	*Acentronura breviperula*	Hairy Pygmy Pipehorse	37282035
318	Teleost	Syngnathidae	*Hippocampus spinosissimus*	Hedgehog Seahorse	
322	Teleost	Syngnathidae	*Trachyrhamphus longirostris*	Long-nosed Pipefish, Straight Stick Pipefish	37282101
359	Teleost	Syngnathidae	*Halicampus dunckeri*	Red-hair Pipefish, Duncker's Pipefish	37282066
360	Teleost	Syngnathidae	*Haliichthys taeniophorus*	Ribboned Seadragon, Ribboned Pipefish	37282007
361	Teleost	Syngnathidae	*Dunckerocampus dactyliophorus*	Ringed Pipefish	37282057
388	Teleost	Syngnathidae	*Choeroichthys brachysoma*	Pacific Short-bodied / Short-bodied pipefish	37282042
389	Teleost	Syngnathidae	*Choeroichthys suillus*	Pig-snouted Pipefish	37282046
452	Teleost	Syngnathidae	*Corythoichthys schultzi*	Schultz's Pipefish	37282052
453	Teleost	Syngnathidae	*Hippocampus jugumus*	Spiny Seahorse	37282112
454	Teleost	Syngnathidae	*Halicampus spinirostris*	Spiny-snout Pipefish	37282070
546	Teleost	Syngnathidae	*Campichthys tricarinatus*	Three-keel Pipefish	37282040
549	Teleost	Syngnathidae	*Hippocampus angustus*	Western Spiny Seahorse	37282005
563	Teleost	Syngnathidae	*Corythoichthys amplexus*	Fijian Banded Pipefish, Brown-banded Pipefish	37282047
566	Teleost	Syngnathidae	*Corythoichthys conspicillatus*	Yellow-banded Pipefish, Network Pipefish	37282032
569	Teleost	Syngnathidae	*Doryrhamphus melanopleura*	Bluestripe Pipefish	37282058
578	Teleost	Syngnathidae	*Corythoichthys ocellatus*	Orange-spotted Pipefish, Ocellated Pipefish	37282050

904	Teleost	Syngnathidae	*Festucalex cinctus*	Girdled Pipefish	37282061
938	Teleost	Syngnathidae	*Halicampus grayi*	Mud Pipefish, Gray's Pipefish	37282030
943	Teleost	Syngnathidae	*Hippichthys cyanospilos*	Blue-speckled Pipefish, Blue-spotted Pipefish	37282072
944	Teleost	Syngnathidae	*Hippichthys heptagonus*	Madura Pipefish	37282073
945	Teleost	Syngnathidae	*Hippichthys penicillus*	Beady Pipefish, Steep-nosed Pipefish	37282075
949	Teleost	Syngnathidae	*Hippocampus taeniopterus*	Spotted Seahorse, Yellow Seahorse	37282033
951	Teleost	Syngnathidae	*Hippocampus planifrons*	Flat-face Seahorse	37282078
992	Teleost	Syngnathidae	*Micrognathus andersonii*	Anderson's Pipefish, Shortnose Pipefish	37282086
1029	Teleost	Syngnathidae	*Syngnathoides biaculeatus*	Double-ended Pipehorse, Alligator Pipefish	37282100
1071	Teleost	Syngnathidae	*Solegnathus sp. 1* [in Kuiter, 2000]	Pipehorse	37282099
1089	Teleost	Syngnathidae	*Trachyrhamphus bicoarctatus*	Bend Stick Pipefish, Short-tailed Pipefish	37282006
1583	Teleost	Syngnathidae	*Bulbonaricus davaoensis*	[a pipefish]	37282038
1584	Teleost	Syngnathidae	*Choeroichthys cinctus*	[a pipefish]	37282043
1585	Teleost	Syngnathidae	*Choeroichthys sculptus*	[a pipefish]	37282045
1587	Teleost	Syngnathidae	*Corythoichthys paxtoni*	[a pipefish]	37282051
1589	Teleost	Syngnathidae	*Cosmocampus maxweberi*	[a pipefish]	37282056
1590	Teleost	Syngnathidae	*Festucalex gibbsi*	[a pipefish]	37282062
1592	Teleost	Syngnathidae	*Halicampus macrorhynchus*	[a pipefish]	37282067
1593	Teleost	Syngnathidae	*Halicampus mataafae*	[a pipefish]	37282068
1595	Teleost	Syngnathidae	*Hippichthys spicifer*	[a pipefish]	37282076
1597	Teleost	Syngnathidae	*Hippocampus bargibanti*	pygmy seahorse	37282106
1603	Teleost	Syngnathidae	*Hippocampus zebra*	[a pipefish]	37282080
1604	Teleost	Syngnathidae	*Micrognathus pygmaeus*	[a pipefish]	37282087
1605	Teleost	Syngnathidae	*Micrognathus natans*	[a pipefish]	37282089
1606	Teleost	Syngnathidae	*Microphis brachyurus*	[a pipefish]	37282090
1607	Teleost	Syngnathidae	*Nannocampus lindemanensis*	[a pipefish]	37282093
1608	Teleost	Syngnathidae	*Phoxocampus diacanthus*	[a pipefish]	37282096
1609	Teleost	Syngnathidae	*Siokunichthys breviceps*	[a pipefish]	37282097

Scoping Document S2B1. Benthic Habitats

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

This scoping list is derived from a combination of Scoping Method 1 and 2 (ERAEF methodology), as much of the existing data for the TSF is still being processed (CMAR Cleveland), therefore relies upon image data from adjacent fisheries, and habitat types identified as occurring in similar depth ranges and nested in features of adjacent bioregions. At this stage, the list of coastal margin and inner shelf habitats was generated from limited seafloor image data of inshore fringing reefs in waters ~15-50m from the Gulf of Carpentaria (Geoscience Australia Survey 276: SS04/2005 Harris 2005), literature (Pitcher *et al*. 2004a), and expert opinion (Scoping method 1).

Sparce knowledge of the outer shelf, upper and mid slope seabed habitats in the Torres Strait meant that these habitat types are inferred using Scoping method 2 (ERAEF methodology, 2006), which uses data from a CSIRO survey of deep benthic biodiversity the western WA coast (CMAR Voyage SS10/2005), and NORFANZ data for deeper waters (Williams *et al*. 2006). Scoping method 2 consequently generates a conservatively large list, as it assumes the presence of many fine-scale habitats known from adjacent or similar fishery areas nested within the coarse-scale habitat features ('geomorphic units') identified within the NPF by GIS mapping (Harris *et al*. 2003). Additionally, where habitats are known only from description or, where no specific image exists for that fishery, a representative image associated with that habitat type (same SGF score) may be referenced from other collections/ regions (i.e the SE, WA and GAB collections) as a visual example of that habitat.

A list of the benthic habitats for the Prawn Trawl Sector of the Torres Strait Fishery. Habitats encountered by trawl effort encompass both coastal margin and (shallow) inner shelf depths (18-40m generally). Outer shelf, upper and mid slope habitats are included in the boundary of the fishery, however are not subject to demersal trawling as denoted by shading.

ERA record No.	ERA Habitat #	Sub-biome	Feature/s	ERA Habitat type	SGF Score	Depth (m)	Image available	Reference image location
3767	306	coastal margin	Shelf	mud, irregular, mixed faunal community	033	0-25	N	
3768	308	coastal margin	Shelf	mud, irregular, octocorals	035	0-25	Y	GoC Image data
3769	312	coastal margin	Shelf	mud, subcrop, small sponges	052	0-25	Y	GoC Image Data
3770	314	coastal margin	Shelf	mud, subcrop, mixed faunal community	053	0-25	N	
3771	317	coastal margin	Shelf	mud, subcrop, low encrusting mixed fauna	056	0-25	N	
3772	330	coastal margin	Shelf	Gravel, directed scour, no fauna	310	0-25	Y	GoC Image data
3773	334	coastal margin	Shelf	Gravel, irregular, no fauna	330	0-25	Y	GoC Image data
3774	340	coastal margin	Shelf	Gravel, subcrop, mixed faunal community	353	0-25	Y	GoC Image data
3775	342	coastal margin	Shelf	Gravel, subcrop, octocorals	355	0-25	Y	GoC Image data
3776	345	coastal margin	Shelf	Biogenic, subcrop, no fauna	750	0-25	Y	GoC Image Data
3777	364	coastal margin	Shelf	Biogenic, subcrop, large sponges	751	0-25	Y	GoC Image Data
3778	365	coastal margin	Shelf	Biogenic, subcrop, mixed faunal community	753	0-25	Y	GoC Image Data
3779	367	coastal margin	Shelf	Biogenic, subcrop, Octocorals	755	0-25	Y	GoC Image Data
3780	369	coastal margin	Shelf	Biogenic, subcrop, small/ low encrustors	756	0-25	Y	GoC Image Data
3781	372	coastal margin	Shelf, Fringing reef	Biogenic, low outcrop, large erect sponges	761	0-25	Y	GoC Image Data
3782	373	coastal margin	Shelf, Fringing reef	Biogenic, low outcrop, mixed faunal community	763	0-25	Y	GoC Image Data
3783	374	coastal margin	Shelf, Fringing reef	Biogenic, low outcrop, octocorals	765	0-25	Y	GoC Image Data
3784	376	coastal margin	Shelf, Fringing reef	Biogenic, low outcrop, encrustors	766	0-25	Y	GoC Image Data
3785	378	coastal margin	Shelf, Fringing reef	Biogenic, low outcrop, large sponges	771	0-25	Y	GoC Image Data
3786	380	coastal margin	Shelf, Fringing reef	Biogenic, low outcrop, mixed faunal community	773	0-25	Y	GoC Image Data
3787	382	coastal margin	Shelf, Fringing reef	Biogenic, low outcrop, octocorals	775	0-25	Y	GoC Image Data
3788	384	coastal margin	Shelf, Fringing reef	Biogenic, low outcrop, encrustors	776	0-25	Y	GoC Image Data
3789	386	coastal margin	Shelf, Fringing reef	Biogenic, low outcrop, sedentary	777	0-25	Y	GoC Image Data
3790	388	coastal margin	Shelf, Fringing reef	Biogenic, high outcrop, octocorals	785	0-25	Y	GoC Image Data
3791	391	coastal margin	Shelf, Fringing reef	Biogenic, high outcrop, mixed faunal community	787	0-25	Y	GoC Image Data

3792	394	coastal margin	Shelf	mud, directed scour, seagrass	01SG	0-25	N	f
3793	395	coastal margin	Shelf	mud, wave rippled, seagrass	02SG	0-25	N	f
3794	396	coastal margin	Shelf	mud, irregular, seagrass	03SG	0-25	N	f
3795	398	coastal margin	Shelf	mud, subcrop, bivalve beds	05BV	0-25	N	g
3796	400	coastal margin	Shelf	mud, subcrop, hard corals	05HC	0-25	N	
3797	401	coastal margin	Shelf	mud, subcrop, seagrass	05SG	0-25	N	f
3798	402	coastal margin	Shelf	fine sediments, directed scour, seagrass	11SG	0-25	N	f
3799	403	coastal margin	Shelf	fine sediments, wave rippled, seagrass	12SG	0-25	N	f
3800	405	coastal margin	Shelf	fine sediments, irregular, seagrass	13SG	0-25	N	f
3801	406	coastal margin	Shelf	fine sediments, subcrop, seagrass	15SG	0-25	N	f
3802	408	coastal margin	Shelf	coarse sediments, directed scour, seagrass	21SG	0-25	N	f
3803	409	coastal margin	Shelf	coarse sediments, wave rippled, seagrass	22SG	0-25	N	f
3804	411	coastal margin	Shelf	coarse sediments, irregular, seagrass	23SG	0-25	N	f
3805	413	coastal margin	Shelf	Coarse sediments, subcrop, bivalve beds	25BV	0-25	N	g
3806	414	coastal margin	Shelf	coarse sediments, subcrop, seagrass	25SG	0-25	N	f
3807	418	coastal margin	Shelf	Gravel, irregular, seagrass	33SG	0-25	Y	f
3808	420	coastal margin	Shelf	Gravel, subcrop, hard corals	35HC	0-25	Y	GoC Image data
3809	422	coastal margin	Shelf	Biogenic, subcrop, hard corals	75HC	0-25	Y	GoC Image Data
3810	423	coastal margin	Shelf	Biogenic, subcrop, seagrass	75SG	0-25	N	f
3811	425	coastal margin	Shelf, Fringing reef	Biogenic, low outcrop, hard corals	76HC	0-25	Y	GoC Image Data
3812	426	coastal margin	Shelf, Fringing reef	Biogenic, low outcrop, seagrass	76SG	0-25	N	f
3813	428	coastal margin	Shelf, Fringing reef	Biogenic, high outcrop, hard corals	78HC	0-25	Y	GoC Image Data
3814	429	coastal margin	Shelf, Fringing reef	Biogenic, high outcrop, seagrass	78SG	0-25	N	f
3815	432	coastal margin	Shelf	Biogenic, subcrop, bivalve beds	75BV	0-25	N	g
3816	435	coastal margin	Shelf	Biogenic, low outcrop, bivalve beds	76BV	0-25	N	g
3817	299	inner shelf	Shelf	mud, flat, no fauna	000	25- 100	N	
3818	300	inner shelf	Shelf	mud, flat, low encrusting sponges	002	25- 100	N	
3819	301	inner shelf	Shelf	mud, flat, octocorals	005	25- 100	Y	GoC Image Data
3820	302	inner shelf	Shelf	mud, flat, sedentary (eg seapens)	007	25- 100	Y	GoC Image Data
3821	303	inner shelf	Shelf	mud, directed scour, no fauna	010	25- 100	Y	GoC Image Data
3822	304	inner shelf	Shelf	mud, directed scour, mixed faunal community	013	25- 100	Y	GoC Image Data
3823	305	inner shelf	Shelf	mud, directed scour, bioturbators	019	25- 100	Y	GoC Image Data
3824	307	inner shelf	Shelf	mud, irregular, mixed faunal community	033	25- 100	Y	GoC Image Data

3825	309	inner shelf	Shelf	mud, irregular, bioturbators	039	25- 100	Y	GoC Image Data
3826	310	inner shelf	Shelf	mud, subcrop, erect sponges	051	25- 100	Y	GoC Image Data
3827	311	inner shelf	Shelf	mud, subcrop, small sponges	052	25- 100	Y	GoC Image Data
3828	313	inner shelf	Shelf	mud, subcrop, mixed faunal community	053	25- 100	Y	GoC Image Data
3829	315	inner shelf	Shelf	mud, subcrop, octocorals	055	25- 100	Y	Npf Image Data
3830	316	inner shelf	Shelf	mud, subcrop, low encrusting mixed fauna	056	25- 100	Y	GoC Image Data
3831	318	Inner shelf	shelf	fine sediments, irregular, no fauna	130	25- 100	Y	GoC Image Data
3832	092	inner shelf	shelf	fine sediments, irregular, small sponges	132	25- 100	Y	GoC Image Data
3833	319	inner shelf	shelf	fine sediments, irregular, octocorals	135	25- 100	Y	GoC Image Data
3834	320	inner shelf	shelf	fine sediments, irregular, low encrustings	136	25- 100	Y	GoC Image Data
3835	321	inner shelf	shelf	fine sediments, irregular, bioturbators	139	25- 100	Y	GoC Image Data
3836	013	inner shelf	shelf	coarse sediments, flat, large sponges	201	25- 100	Y	GoC Image Data
3837	322	inner shelf	Shelf	Coarse sediments, flat, mixed faunal community	203	25- 100	Y	GoC Image Data
3838	234	inner shelf	shelf	Coarse sediments, flat, solitary epifauna	207	25- 100	Y	GoC Image Data
3839	323	inner shelf	Shelf	coarse sediments, irregular, small sponges	232	25- 100	Y	Goc Image Data
3840	324	inner shelf	Shelf	coarse sediments, irregular, octocorals	235	25- 100	Y	Goc Image Data
3841	089	inner shelf	shelf	Coarse sediments, irregular, low encrustings	236	25- 100	Y	Goc Image Data
3842	006	inner shelf	shelf	coarse sediments, subcrop, large sponges	251	25- 100	Y	GoC Image Data
3843	282	inner shelf	shelf	Coarse sediments, subcrop, mixed faunal community	253	25- 100	Y	GoC Image Data
3844	325	inner shelf	shelf	gravel, flat, large sponges	301	25- 100	Y	GoC Image Data
3845	326	inner shelf	shelf	gravel, flat, mixed faunal community	303	25- 100	Y	GoC Image Data
3846	327	inner shelf	shelf	gravel, flat, octocorals	305	25- 100	Y	GoC Image Data
3847	328	inner shelf	shelf	gravel, flat, encrustors	306	25- 100	Y	GoC Image Data
3848	329	inner shelf	shelf	gravel, flat, sedentary	307	25- 100	Y	GoC Image Data
3849	331	inner shelf	shelf	gravel/ pebble, directed scour, large sponges	311	25- 100	Y	GoC Image data
3850	001	inner shelf	shelf	gravel/ pebble, directed scour, mixed faunal community	313	25- 100	Y	GoC Image data
3851	332	inner shelf	shelf	gravel/ pebble, directed scour, octocorals	315	25- 100	Y	GoC Image data
3852	333	inner shelf	shelf	gravel/ pebble, directed scour, sedentary	317	25- 100	Y	GoC Image data
3853	242	inner shelf	Shelf	Gravel, irregular, no fauna	330	25- 100	Y	GoC Image Data
3854	335	inner shelf	Shelf	Gravel, irregular, small sponges	332	25- 100	Y	GoC Image Data
3855	336	inner shelf	Shelf	Gravel, irregular, octocorals	335	25- 100	Y	GoC Image Data
3856	337	inner shelf	Shelf	Gravel, irregular, low encrustings	336	25- 100	Y	GoC Image Data
3857	338	inner shelf	shelf	gravel/ pebble, subcrop, large sponges	351	25- 100	Y	GoC Image Data

3858	339	inner shelf	shelf	gravel/ pebble, subcrop, mixed faunal community	353	25- 100	Y	GoC Image Data
3859	341	inner shelf	shelf	gravel/ pebble, subcrop, octocorals	355	25- 100	Y	GoC Image Data
3860	343	inner shelf	shelf	gravel/ pebble, subcrop, sedentary	357	25- 100	Y	GoC Image Data
3861	344	inner shelf	Shelf	Sedimentary rock (?), subcrop, no fauna	650	25- 100	Y	GoC Image Data
3862	345	inner shelf	Shelf	Sedimentary rock (?), Subcrop, large sponges	651	25- 100	Y	GoC Image Data
3863	346	inner shelf	Shelf	Sedimentary rock (?), subcrop, mixed faunal community	653	25- 100	Y	GoC Image Data
3864	347	inner shelf	Shelf	Sedimentary rock (?), Subcrop, Octocorals	655	25- 100	Y	GoC Image Data
3865	348	inner shelf	Shelf	Sedimentary rock (?), subcrop, small/ low encrustors	656	25- 100	Y	GoC Image Data
3866	349	inner shelf	Shelf	Sedimentary Rock (?), subcrop, sedentary	657	25- 100	Y	GoC Image Data
3867	350	inner shelf	Shelf, bioherm	Sedimentary rock (?), low outcrop, large sponges	661	25- 100	Y	GoC Image Data
3868	351	inner shelf	Shelf, bioherm	Sedimentary rock (?), low outcrop, mixed faunal community	663	25- 100	Y	GoC Image Data
3869	352	inner shelf	Shelf, bioherm	Sedimentary rock (?), low outcrop, octocorals	665	25- 100	Y	GoC Image Data
3870	353	inner shelf	Shelf, bioherm	Sedimentary rock (?), low outcrop, encrustors	666	25- 100	Y	GoC Image Data
3871	354	inner shelf	Shelf, bioherm	Sedimentary rock (?), low outcrop, sedentary	667	25- 100	Y	GoC Image Data
3872	004	inner shelf	Shelf, bioherm	Sedimentary rock (?), low outcrop, large sponges	671	25- 100	Y	GoC Image Data
3873	355	inner shelf	Shelf, bioherm	Sedimentary rock (?), low outcrop, mixed faunal community	673	25- 100	Y	GoC Image Data
3874	356	inner shelf	Shelf, bioherm	Sedimentary rock (?), low outcrop, octocorals	675	25- 100	Y	GoC Image Data
3875	357	inner shelf	Shelf, bioherm	Sedimentary rock (?), low outcrop, encrustors	676	25- 100	Y	GoC Image Data
3876	358	inner shelf	Shelf, bioherm	Sedimentary rock (?), low outcrop, sedentary	677	25- 100	Y	GoC Image Data
3877	359	inner shelf	Shelf, bioherm	Sedimentary rock (?), high outcrop, mixed faunal community	683	25- 100	Y	GoC Image Data
3878	360	inner shelf	Shelf, bioherm	Sedimentary rock (?), high outcrop, octocorals	685	25- 100	Y	GoC Image Data
3879	361	inner shelf	Shelf, bioherm	Sedimentary rock (?), high outcrop, encrustors	686	25- 100	Y	GoC Image Data
3880	003	inner shelf	Shelf, bioherm	Sedimentary rock (?), high outcrop, mixed faunal community	693	25- 100	Y	GoC Image Data
3881	362	inner shelf	Shelf, bioherm	Sedimentary rock (?), high outcrop, octocorals	695	25- 100	Y	GoC Image Data
3882	363	inner shelf	Shelf, bioherm	Sedimentary rock (?), high outcrop, encrustors	696	25- 100	Y	GoC Image Data
3883	273	inner shelf	Shelf, Fringing reef, bioherm	Biogenic, subcrop, large sponges	751	25- 100	Y	GoC Image Data
3884	366	inner shelf	Shelf, Fringing reef, bioherm	Biogenic, subcrop, mixed faunal community	753	25- 100	Y	GoC Image Data
3885	368	inner shelf	Shelf, Fringing reef, bioherm	Biogenic, subcrop, octocorals	755	25- 100	Y	GoC Image Data
3886	274	inner shelf	Shelf, Fringing reef, bioherm	Biogenic, subcrop, small/ low encrustors	756	25- 100	Y	GoC Image Data
3887	370	inner shelf	Shelf, Fringing reef, bioherm	Biogenic, subcrop, sedentary	757	25- 100	Y	GoC Image Data
3888	371	inner shelf	Shelf, Fringing reef,	Biogenic, low outcrop, large sponges	761	25- 100	Y	GoC Image Data

			bioherm					
3889	275	inner shelf	Shelf, Fringing reef, bioherm	Biogenic, low outcrop, mixed faunal community	763	25- 100	Y	GoC Image Data
3890	276	inner shelf	Shelf, Fringing reef, bioherm	Biogenic, low outcrop, octocorals	765	25- 100	Y	GoC Image Data
3891	375	inner shelf	Shelf, Fringing reef, bioherm	Biogenic, low outcrop, encrustors	766	25- 100	Y	GoC Image Data
3892	377	inner shelf	Shelf, Fringing reef, bioherm	Biogenic, low outcrop, sedentary	767	25- 100	Y	GoC Image Data
3893	379	inner shelf	Shelf, Fringing reef, bioherm	Biogenic, low outcrop, large sponges	771	25- 100	Y	GoC Image Data
3894	277	inner shelf	Shelf, Fringing reef, bioherm	Biogenic, low outcrop, mixed faunal community	773	25- 100	Y	GoC Image Data
3895	381	inner shelf	Shelf, Fringing reef, bioherm	Biogenic, low outcrop, octocorals	775	25- 100	Y	GoC Image Data
3896	383	inner shelf	Shelf, Fringing reef, bioherm	Biogenic, low outcrop, encrustors	776	25- 100	Y	GoC Image Data
3897	385	inner shelf	Shelf, Fringing reef, bioherm	Biogenic, low outcrop, sedentary	777	25- 100	Y	GoC Image Data
3898	387	inner shelf	Shelf, Fringing reef, bioherm	Biogenic, high outcrop, mixed faunal community	783	25- 100	Y	GoC Image Data
3899	389	inner shelf	Shelf, Fringing reef, bioherm	Biogenic, high outcrop, octocorals	785	25- 100	Y	GoC Image Data
3900	390	inner shelf	Shelf, Fringing reef, bioherm	Biogenic, high outcrop, encrustors	786	25- 100	Y	GoC Image Data
3901	278	inner shelf	Shelf, Fringing reef, bioherm	Biogenic, high outcrop, mixed faunal community	793	25- 100	Y	GoC Image Data
3902	392	inner shelf	Shelf, Fringing reef, bioherm	Biogenic, high outcrop, octocorals	795	25- 100	Y	GoC Image Data
3903	393	inner shelf	Shelf, Fringing reef, bioherm	Biogenic, high outcrop, encrustors	796	25- 100	Y	GoC Image Data
3904	397	inner shelf	Shelf	mud, subcrop, bivalve beds	05BV	25- 100	N	g
3905	399	inner shelf	Shelf	mud, subcrop, hard corals	05HC	25- 100	Y	Npf Image Data
3906	404	Inner shelf	shelf	fine sediments, irregular, hard corals	13HC	25- 100	Y	GoC Image Data
3907	407	inner shelf	Shelf	Coarse sediments, flat, hard corals	20HC	25- 100	Y	GoC Image Data
3908	410	inner shelf	Shelf	coarse sediments, irregular, hard corals	23HC	25- 100	Y	Goc Image Data
3909	412	inner shelf	Shelf	Coarse sediments, subcrop, bivalve beds	25BV	25- 100	N	g
3910	415	inner shelf	shelf	gravel, flat, hard corals	30HC	25- 100	Y	GoC Image Data
3911	416	inner shelf	shelf	gravel/ pebble, directed scour, hard corals	31HC	25- 100	Y	GoC Image data
3912	417	inner shelf	Shelf	Gravel, irregular, Hard corals	33HC	25- 100	Y	GoC Image Data
3913	419	inner shelf	shelf	gravel/ pebble, subcrop, hard corals	35HC	25- 100	Y	GoC Image Data

3914	421	inner shelf	Shelf	Sedimentary Rock (?), subcrop, hard corals	65HC	25- 100	Y	GoC Image Data
3915	424	inner shelf	Shelf, bioherm	Sedimentary rock (?), low outcrop, hard corals	66HC	25- 100	Y	GoC Image Data
3916	427	inner shelf	Shelf, bioherm	Sedimentary rock (?), high outcrop, hard corals	68HC	25- 100	Y	GoC Image Data
3917	430	inner shelf	Shelf, bioherm	Sedimentary rock (?), high outcrop, hard corals	69HC	25- 100	Y	GoC Image Data
3918	431	inner shelf	Shelf	Biogenic, subcrop, bivalve beds	75BV	25- 100	N	g
3919	433	inner shelf	Shelf, Fringing reef, bioherm	Biogenic, subcrop, hard corals	75HC	25- 100	Y	GoC Image Data
3920	434	inner shelf	Shelf	Biogenic, low outcrop, bivalve beds	76BV	25- 100	N	g
3921	436	inner shelf	Shelf, Fringing reef, bioherm	Biogenic, low outcrop, hard corals	76HC	25- 100	Y	GoC Image Data
3922	437	inner shelf	Shelf, Fringing reef, bioherm	Biogenic, high outcrop, hard corals	78HC	25- 100	Y	GoC Image Data
3923	438	inner shelf	Shelf, Fringing reef, bioherm	Biogenic, high outcrop, hard corals	79HC	25- 100	Y	GoC Image Data
3924	017	outer shelf	shelf	fine sediments, subcrop, large sponges	151	100- 200	Y	SE Image Collection
3925	018	outer shelf	shelf	Sedimentary rock, outcrop, encrustors	696	100- 200	Y	SE Image Collection
3926	019	outer shelf	Terrace, Shelf	coarse sediments, subcrop, large sponges	251	100- 200	Y	SE Image Collection
3927	020	outer shelf	shelf	cobble, outcrop, crinoids	464	100- 200	Y	SE Image Collection
3928	022	outer shelf	shelf	Sedimentary rock, subcrop, mixed faunal community	653	100- 200	Y	SE Image Collection
3929	023	outer shelf	shelf	Sedimentary rock, outcrop, large sponges	671	100- 200	Y	SE Image Collection
3930	024	outer shelf	shelf	gravel, irregular, encrustors	336	100- 200	Y	SE Image Collection
3931	025	outer shelf	shelf	coarse sediments, wave rippled, no fauna	220	100- 200	Y	SE Image Collection
3932	026	outer shelf	shelf	coarse sediments, unrippled, encrustors	206	100- 200	Y	SE Image Collection
3933	027	outer shelf	shelf	coarse sediments, current rippled, no fauna	210	100- 200	Y	SE Image Collection
3934	028	outer shelf	shelf	cobble, unrippled, large sponges	401	100- 200	Y	SE Image Collection
3935	029	outer shelf	shelf	coarse sediments, irregular, large sponges	231	100- 200	Y	SE Image Collection
3936	030	outer shelf	shelf	coarse sediments, unrippled, mixed faunal community	203	100- 200	Y	SE Image Collection
3937	032	outer shelf	shelf	cobble, subcrop, crinoids	454	100- 200	Y	SE Image Collection
3938	065	outer shelf	canyon	Sedimentary rock, outcrop, small sponges	672	100- 200	Y	SE Image Collection
3939	100	outer shelf	Shelf	Mud, flat, sedentary (eg seapens)	007	100- 200	2	WA Image Collection
3940	101	outer shelf	shelf	coarse sediments, subcrop, small sponges	252	100- 200	N	SE Image Collection
3941	102	outer shelf	shelf	coarse sediments, wave rippled, encrustors	226	100- 200	N	SE Image Collection
3942	103	outer shelf	shelf	coarse sediments, wave rippled, small sponges	222	100- 200	N	SE Image Collection
3943	104	outer shelf	shelf	fine sediments, current rippled, bioturbators	119	100- 200	Y	SE Image Collection
3944	105	outer shelf	shelf	fine sediments, irregular, large sponges	131	100- 200	N	SE Image Collection

3945	106	outer shelf	shelf	fine sediments, irregular, no fauna	130	100- 200	N	SE Image Collection
3946	107	outer shelf	shelf	fine sediments, irregular, small sponges	132	100- 200	N	SE Image Collection
3947	108	outer shelf	shelf	fine sediments, subcrop, mixed faunal community	153	100- 200	N	SE Image Collection
3948	109	outer shelf	shelf	fine sediments, subcrop, small sponges	152	100- 200	Y	SE Image Collection
3949	110	outer shelf	shelf	fine sediments, unrippled, bioturbators	109	100- 200	Y	SE Image Collection
3950	111	outer shelf	Shelf	Fine sediments, unrippled, large/ erect sponges	101	100- 200	3	WA Image Collection
3951	112	outer shelf	shelf	fine sediments, unrippled, no fauna	100	100- 200	Y	SE Image Collection
3952	113	outer shelf	shelf	Fine sediments, unrippled, small sponges	102	100- 200	Y	Norfanz Image Collection
3953	114	outer shelf	shelf	fine sediments, wave rippled, bioturbators	129	100- 200	Y	SE Image Collection
3954	115	outer shelf	shelf	fine sediments, wave rippled, encrustors	126	100- 200	N	SE Image Collection
3955	116	outer shelf	shelf	fine sediments, wave rippled, large sponges	121	100- 200	N	SE Image Collection
3956	117	outer shelf	shelf	fine sediments, wave rippled, no fauna	120	100- 200	N	SE Image Collection
3957	118	outer shelf	shelf	fine sediments, wave rippled, sedentary	127	100- 200	N	SE Image Collection
3958	119	outer shelf	shelf	fine sediments, wave rippled, small sponges	122	100- 200	N	SE Image Collection
3959	120	outer shelf	shelf	gravel, current rippled, bioturbators	319	100- 200	N	SE Image Collection
3960	121	outer shelf	shelf	gravel, wave rippled, bioturbators	329	100- 200	Y	SE Image Collection
3961	122	outer shelf	shelf	gravel, wave rippled, encrustors	326	100- 200	N	SE Image Collection
3962	123	outer shelf	shelf	gravel, wave rippled, large sponges	321	100- 200	N	SE Image Collection
3963	124	outer shelf	shelf	gravel, wave rippled, no fauna	320	100- 200	N	SE Image Collection
3964	125	outer shelf	shelf	mud, subcrop, small sponges	052	100- 200	Y	SE Image Collection
3965	126	outer shelf	shelf	Sedimentary rock, Subcrop, large sponges	651	100- 200	Y	GAB Image Collection
3966	127	outer shelf	shelf	Sedimentary rock, subcrop, small sponges	652	100- 200	Y	SE Image Collection
3967	166	outer shelf	shelf-break	Bryozoan based commmunities	xx6	100- 200, 200- 700	N	SE Image Collection
3968	167	outer shelf	shelf-break	fine sediments, irregular, bioturbators	139	100- 200, 200- 700	N	SE Image Collection
3969	168	outer shelf	shelf-break	fine sediments, irregular, small sponges	132	100- 200, 200- 700	N	SE Image Collection
3970	169	outer shelf	shelf-break	fine sediments, unrippled, bioturbators	109	100- 200, 200- 700	N	SE Image Collection
3971	170	outer shelf	shelf-break	fine sediments, unrippled, no fauna	100	100- 200, 200- 700	N	SE Image Collection
3972	171	outer shelf	shelf-break	fine sediments, unrippled, octocorals	105	100- 200, 200- 700	N	SE Image Collection
3973	172	outer shelf	shelf-break	Igneous rock, high outcrop, no fauna	590	100- 200, 200- 700	N	SE Image Collection
3974	173	outer shelf	shelf-break	mud, unrippled, no fauna	000	100- 200, 200- 700	N	SE Image Collection
3975	174	outer shelf	shelf-break	mud, unrippled, sedentary	007	100- 200, 200- 700	N	SE Image Collection
3976	175	outer shelf	shelf-break	Sedimentary rock, subcrop, crinoids	654	100- 200, 200- 700	N	SE Image Collection
3977	176	outer shelf	shelf-break	Sedimentary rock, subcrop, small sponges	652	100- 200, 200- 700	N	SE Image Collection

3978	177	outer shelf	shelf	mud, unrippled, low encrusting sponges	002	100- 200	N	SE Image Collection
3979	178	outer shelf	shelf	mud, unrippled, bioturbators	009	100- 200	N	SE Image Collection
3980	179	outer shelf	shelf	mud, subcrop, erect sponges	051	100- 200	N	SE Image Collection
3981	180	outer shelf	shelf	mud, subcrop, low encrusting mixed fauna	056	100- 200	N	SE Image Collection
3982	181	outer shelf	shelf	fine sediments, unrippled, encrustors	106	100- 200	N	SE Image Collection
3983	183	outer shelf	shelf	fine sediments, current rippled, no fauna	110	100- 200	N	SE Image Collection
3984	184	outer shelf	shelf	fine sediments, current rippled, low/ encrusting sponges	112	100- 200	N	SE Image Collection
3985	185	outer shelf	shelf	fine sediments, irregular, low encrusting mixed fauna	136	100- 200	N	SE Image Collection
3986	187	outer shelf	shelf	fine sediments, irregular, bioturbators	139	100- 200	N	SE Image Collection
3987	188	outer shelf	shelf	fine sediments, rubble banks, low encrusting sponges	142	100- 200	N	SE Image Collection
3988	189	outer shelf	shelf	fine sediments, subcrop, mixed low fauna	156	100- 200	N	SE Image Collection
3989	190	outer shelf	shelf	coarse sediments, unrippled, no fauna	200	100- 200	N	SE Image Collection
3990	192	outer shelf	shelf	gravel/ pebble, current rippled, large sponges	311	100- 200	N	SE Image Collection
3991	193	outer shelf	shelf	gravel/ pebble, current rippled, mixed low fauna	316	100- 200	N	SE Image Collection
3992	194	outer shelf	shelf	gravel/ pebble, wave rippled, low encrusting sponges	322	100- 200	N	SE Image Collection
3993	195	outer shelf	shelf	gravel, wave rippled, encrustors	326	100- 200	N	SE Image Collection
3994	196	outer shelf	shelf	gravel, wave rippled, encrustors	346	100- 200	N	SE Image Collection
3995	197	outer shelf	shelf	cobble, unrippled, low/ encrusting mixed fauna	406	100- 200	N	SE Image Collection
3996	198	outer shelf	shelf	cobble, current rippled, low/ encrusting mixed fauna	416	100- 200	N	SE Image Collection
3997	209	Outer shelf	Terrace	Coarse sediments, Subcrop, Mixed faunal community	253	100- 200	Y	GAB Image Collection
3998	219	outer shelf	Shelf	mud, unrippled, small or large sponges	001	100- 200	Y	WA Image Collection
3999	220	outer shelf	Shelf	Mud, flat, octocorals	005	100- 200	Y	WA Image Collection
4000	223	outer shelf	Shelf	mud, current rippled, bioturbators	019	100- 200	Y	WA Image Collection
4001	224	outer shelf	Shelf	mud, wave rippled, no fauna	020	100- 200	Y	WA Image Collection
4002	225	outer shelf	Shelf	Mud, irregular, bioturbators	039	100- 200	Y	WA Image Collection
4003	226	outer shelf	Shelf	Mud, subcrop, mixed faunal community	053	100- 200	Y	WA Image Collection
4004	233	outer shelf	Shelf	Coarse sediments, unrippled, octocoral/ and bryozoans??	205	100- 200	Y	WA Image Collection
4005	246	outer shelf	Shelf	cobble/boulder (slab), outcrop, mixed low encrustors	466	100- 200	Y	WA Image Collection
4006	254	outer shelf	Shelf	Sedimentary rock (?), low outcrop, large erect sponges	661	100- 201	Y	WA Image Collection
4007	255	outer shelf	Shelf	Sedimentary rock (?) low outcrop, mixed faunal community	663	100- 200	Y	WA Image Collection
4008	258	outer shelf	Shelf	Sedimentary rock (?), low outcrop, mixed faunal community	673	100- 200	Y	WA Image Collection
4009	259	outer shelf	Shelf	Rock (sedimentary?), outcrop (low, holes and cracks etc), encrustors	676	100- 200	Y	WA Image Collection

4010	260	outer shelf	Shelf	Rock (sedimentary?), outcrop, solitary	677	100- 200	Y	WA Image Collection
4011	263	outer shelf	Shelf	Rock (sedimentary?), high outcrop, ?small sponges	682	100- 200	Y	WA Image Collection
4012	266	outer shelf	Shelf	Rock (sedimentary?),, high outcrop, large sponges	691	100- 200	Y	WA Image Collection
4013	268	outer shelf	Shelf	Sedimentary rock (?), high outcrop, mixed faunal community	693	100- 200	Y	WA Image Collection
4014	279	outer shelf	Shelf	mud, current rippled, no fauna	010	100- 200	Y	WA Image Collection
4015	280	outer shelf	Shelf	Rock (sedimentary?), high outcrop, solitary	681	100- 201	Y	WA Image Collection
4016	281	outer shelf	Shelf	Rock/ biogenic matrix, low outcrop, mixed faunal community	763	100-200	Y	WA Image Collection
4017	033	upper slope	slope	Sedimentary rock, subcrop, mixed faunal community	653	200- 700	Y	SE Image Collection
4018	034	upper slope	slope	Sedimentary rock, outcrop, encrustors	696	200- 700	Y	SE Image Collection
4019	035	upper slope	slope	Sedimentary rock, outcrop, encrustors	666	200- 700	Y	SE Image Collection
4020	036	upper slope	Slope	Sedimentary, subcrop, small encrustors (hydroids?)	656	200- 700	Y	WA Image Collection
4021	039	upper slope	slope	Sedimentary rock, outcrop, crinoids	684	200- 700	Y	SE Image Collection
4022	040	upper slope	slope	fine sediments, subcrop, sedentary	157	200- 700	Y	SE Image Collection
4023	041	upper slope	Slope	fine, irregular, bioturbators	139	200- 700	3	WA Image Collection
4024	043	upper slope	slope	coarse sediments, unrippled, low mixed encrustors	206	200- 700	Y	SE Image Collection
4025	044	upper slope	slope, canyon, Terrace	fine sediments, unrippled, bioturbators	109	200- 700	Y	SE Image Collection
4026	045	upper slope	slope	coarse sediments, unrippled, sedentary	207	200- 700	Y	SE Image Collection
4027	046	upper slope	slope	fine sediments, unrippled, no fauna	100	200- 700	Y	SE Image Collection
4028	066	upper slope	canyon	Sedimentary rock, outcrop, crinoids	694	200- 700	Y	SE Image Collection
4029	067	upper slope	canyon, slope	Sedimentary rock, subcrop, large sponges	651	200- 700	Y	SE Image Collection
4030	069	upper slope	canyon	cobble, outcrop, crinoids	464	200- 700	Y	SE Image Collection
4031	070	upper slope	canyon	Sedimentary rock, subcrop, small sponges	652	200- 700	Y	SE Image Collection
4032	071	upper slope	Shelf break, Canyon	Sedimentary, low outcrop, small encrustors	676	200- 700	3	WA Image Collection
4033	072	upper slope	Slope, Canyon	coarse sediments, irregular, bioturbators	239	200- 700	Y	SE Image Collection
4034	073	upper slope	Terrace, canyon	Fine sediments, irregular, Small encrustors / erect forms (including bryozoans)	136	200-700	Y	GAB Image Collection
4035	076	upper slope	canyon, slope	coarse sediments, irregular, low mixed encrustors	236	200- 700	Y	SE Image Collection
4036	077	upper slope	canyon, slope	fine sediments, subcrop, small sponges	152	200- 700	Y	SE Image Collection
4037	078	upper slope	Slope, canyon, Terrace	Fine sediments, unrippled, Solitary epifauna	107	200- 700	2	WA Image Collection
4038	128	upper slope	slope	Bryozoan based communities	xx6	200- 700	N	SE Image Collection
4039	129	upper slope	slope	cobble, debris flow, encrustors	446	200- 700	Y	SE Image Collection
4040	130	upper slope	slope	cobble, debris flow, no fauna	440	200- 700	Y	SE Image Collection
4041	131	upper slope	slope	cobble, debris flow, octocorals	445	200- 700	N	SE Image Collection

4042	132	upper slope	slope	cobble, debris flow, small sponges	442	200- 700	Y	SE Image Collection
4043	133	upper slope	Slope	Fine, current rippled, no fauna	110	200- 700	Y	WA Image Collection
4044	134	upper slope	slope	fine sediments, subcrop, large sponges	151	200- 700	N	SE Image Collection
4045	136	upper slope	slope	fine sediments, unrippled, encrustors	106	200- 700	Y	SE Image Collection
4046	137	upper slope	slope	Fine sediments, unrippled, small sponges	102	200- 700	Y	Norfanz Image Collection
4047	138	upper slope	slope	gravel, debris flow, encrustors	346	200- 700	Y	SE Image Collection
4048	139	upper slope	slope	gravel, debris flow, no fauna	340	200- 700	N	SE Image Collection
4049	140	upper slope	slope	mud, irregular, bioturbators	039	200- 700	Y	SE Image Collection
4050	141	upper slope	Slope	mud, unrippled, distinct infaunal bioturbators	009	200- 700	Y	WA Image Collection
4051	142	upper slope	slope	mud, unrippled, encrustors	006	200- 700	Y	SE Image Collection
4052	143	upper slope	slope	mud, unrippled, large sponges	001	200- 700	N	SE Image Collection
4053	144	upper slope	slope, Canyon	mud, unrippled, sedentary	007	200- 700	Y	SE Image Collection
4054	145	upper slope	slope, Canyon	Sedimentary, low outcrops on steep slope, large sponges	671	200- 700	2	WA Image Collection
4055	146	upper slope	slope	Sedimentary rock, low outcrop, small sponges	672	200- 700	Y	SE Image Collection
4056	148	upper slope	Terrace, slope	Sedimentary rock, Subcrop, Octocorals (gold corals / seawhips)	655	200-700	Y	GAB Image Collection
4057	202	upper slope	Terrace	Mud, Unrippled, No fauna	000	200-700	Y	GAB Image Collection
4058	216	upper slope	Canyon	Sedimentary rock, low outcrop, Octocorals (gold corals / seawhips)	675	200-700	Y	GAB Image Collection
4059	217	upper slope	Canyon	Sedimentary rock, High Outcrop, Small encrustors / erect forms (including bryozoans)	686	200-700	Y	GAB Image Collection
4060	218	upper slope	Canyon	Sedimentary rock, High Outcrop, Sedentary: e.g. seapens	687	200-700	Y	GAB Image Collection
4061	227	upper slope	Slope	Fine sediments, unrippled, sponges	101	200- 700	Y	WA Image Collection
4062	231	upper slope	Slope	Fine sediments, irregular, glass sponge (stalked)	137	200- 700	Y	WA Image Collection
4063	235	upper slope	Slope	Coarse sediments, rippled, no fauna	210	200- 700	Y	WA Image Collection
4064	236	upper slope	Slope	Coarse sand, rippled, solitary epifauna	217	200- 700	Y	WA Image Collection
4065	237	upper slope	Slope	Coarse sand, wave rippled, bryozoan turf	226	200- 700	Y	WA Image Collection
4066	238	upper slope	Slope	Coarse sediments, irregular, octocorals (matrix of solsomalia – dead corals)	235	200- 700	Y	WA Image Collection
4067	239	upper slope	Slope	Coarse sediments, subcrop, large (?) sponges	251	200- 700	Y	WA Image Collection
4068	240	upper slope	Slope	Sedimentary, subcrop, octocorals	255	200- 700	Y	WA Image Collection
4069	241	upper slope	Slope	Coarse sediments, subcrop, low encrusting community (ascidians)	256	200- 700	Y	WA Image Collection
4070	247	upper slope	slope	Boulders, low outcrop, no fauna	470	200- 700	Y	Norfanz Image Collection
4071	251	upper slope	Slope	Sedimentary, subcrop, no fauna	650	200- 700	Y	WA Image Collection
4072	256	upper slope	Slope	Sedimentary, outcrop, octocorals	665	200- 700	Y	WA Image Collection

4073	257	upper slope	Shelf break	Sedimentary, low outcrop, no fauna	670	200- 700	3	WA Image Collection
4074	261	upper slope	Slope	Sedimentary, outcrop, sedentary (anemones)	677	200- 700	Y	WA Image Collection
4075	264	upper slope	Slope	Sedimentary, high outcrop, octocoral	683	200- 700	Y	WA Image Collection
4076	265	upper slope	Slope	Sedimentary rock (mudstone?), high outcrop, no fauna	690	200- 700	3	WA Image Collection
4077	267	upper slope	Slope	Sedimentary rock (mudstone?), high outcrop, small sponges	692	200- 700	Y	WA Image Collection
4078	269	upper slope	Slope	Sedimentary, outcrop, octocorals	695	200- 700	Y	WA Image Collection
4079	270	upper slope	Slope	Sedimentary, high outcrop, solitary epifauna	697	200- 700	Y	WA Image Collection
4080	284	upper slope	slope	Coarse sediments, unrippled, large sponges	201	200- 700	Y	Norfanz Image Collection
4081	285	upper slope	slope	Coarse sediments, unrippled, octocorals	205	200- 700	Y	Norfanz Image Collection
4082	286	upper slope	slope	Cobble/ boulder, debris, sedentary	447	200- 700	Y	Norfanz Image Collection
4083	287	upper slope	slope	slabs and boulders, low outcrop, octocorals	475	200- 700	Y	Norfanz Image Collection
4084	288	upper slope	slope	Igneous Rock (?), low outcrop, octocorals	565	200- 700	Y	Norfanz Image Collection
4085	289	upper slope	slope	Igneous Rock (?), low outcrop, mixed faunal community	573	200- 700	Y	Norfanz Image Collection
4086	290	upper slope	slope	Igneous Rock (?), high outcrop, no fauna	590	200- 700	Y	Norfanz Image Collection
4087	291	upper slope	slope	Igneous Rock (?), high outcrop, mixed faunal community	593	200- 700	Y	Norfanz Image Collection
4088	292	upper slope	slope	Sedimentary Rock , subcrop, sedentary	657	200- 700	Y	Norfanz Image Collection
4089	293	upper slope	slope	Rock/ biogenic matrix, low outcrop, mixed faunal community	763	200- 700	Y	Norfanz Image Collection
4090	049	mid-slope	slope	Igneous rock, high outcrop, crinoids	594	700- 1500	Y	SE Image Collection
4091	050	mid-slope	slope	cobble, debris flow, encrustors	446	700- 1500	Y	SE Image Collection
4092	051	mid-slope	slope	cobble, outcrop, no fauna	460	700- 1500	Y	SE Image Collection
4093	052	mid-slope	slope	Sedimentary rock, outcrop, octocorals	675	700- 1500	Y	SE Image Collection
4094	053	mid-slope	slope	Igneous rock, low outcrop, sedentary	567	700- 1500	Y	SE Image Collection
4095	054	mid-slope	slope	Sedimentary rock, outcrop, crinoids	694	700- 1500	Y	SE Image Collection
4096	055	mid-slope	slope	Sedimentary rock, unrippled, sedentary	607	700- 1500	Y	SE Image Collection
4097	056	mid-slope	slope, canyons, seamounts	Sedimentary rock, outcrop, mixed faunal community	673	700- 1500	Y	SE Image Collection
4098	057	mid-slope	slope	fine sediments, subcrop, bioturbators	150	700- 1500	Y	SE Image Collection
4099	058	mid-slope	slope	cobble, unrippled, small sponges	402	700- 1500	Y	SE Image Collection
4100	059	mid-slope	Seamount, Slope	coarse sediments, irregular,low encrusting	236	700- 1500	Y	SE Image Collection
4101	060	mid-slope	slope	cobble, outcrop, crinoids	464	700- 1500	Y	SE Image Collection
4102	061	mid-slope	slope	fine sediments, irregular, bioturbators	139	700- 1500	Y	SE Image Collection
4103	062	mid-slope	slope	coarse sediments, unrippled, octocorals	205	700- 1500	Y	SE Image Collection
4104	063	mid-slope	slope	fine sediments, unrippled, octocorals	105	700- 1500	Y	SE Image Collection

4105	064	mid-slope	slope	Sedimentary slab and mud boulders, outcrop, crinoids	464	700- 1500	Y	SE Image Collection
4106	080	mid-slope	seamount, Terrace	Sedimentary rock, outcrop, encrustors	676	700- 1500	Y	SE Image Collection
4107	081	mid-slope	seamount	Sedimentary rock, unrippled, no fauna	600	700- 1500	Y	SE Image Collection
4108	084	mid-slope	seamount, canyon	Sedimentary rock, outcrop, sedentary	677	700- 1500	Y	SE Image Collection
4109	085	mid-slope	seamount	Sedimentary rock, unrippled, encrustors	606	700- 1500	Y	SE Image Collection
4110	150	mid-slope	slope	coarse sediments, current rippled, no fauna	210	700- 1500	N	SE Image Collection
4111	151	mid-slope	slope	coarse sediments, current rippled, octocorals	215	700- 1500	N	SE Image Collection
4112	152	mid-slope	slope	coarse sediments, current rippled, sedentary	217	700- 1500	N	SE Image Collection
4113	153	mid-slope	slope	coarse sediments, unrippled, no fauna	200	700- 1500	N	SE Image Collection
4114	154	mid-slope	slope	cobble, debris flow, crinoids	444	700- 1500	N	SE Image Collection
4115	155	mid-slope	slope	slabs/ boulders, debris flow, octocorals	445	700- 1500	Y	SE Image Collection
4116	156	mid-slope	Slope	Fine, unripped, no obvious fauna	100	700-1500	Y	WA Image Collection
4117	156	mid-slope	Terrace	Fine sediments, Unrippled, No fauna	100	700-1500	Y	GAB Image Collection
4118	157	mid-slope	Slope	Igneous rock, high outcrop, octocoral	595	700-1500	Y	WA Image Collection
4119	158	mid-slope	slope	mud, current rippled, bioturbators	019	700- 1500	N	SE Image Collection
4120	159	mid-slope	Slope	Mud, irregular, bioturbators	039	700-1500	Y	WA Image Collection
4121	160	mid-slope	slope	mud, irregular, sedentary	037	700- 1500	N	SE Image Collection
4122	161	mid-slope	slope	mud, unrippled, small sponges	002	700- 1500	N	SE Image Collection
4123	162	mid-slope	slope	Sedimentary rock, debris flow, crinoids	644	700- 1500	N	SE Image Collection
4124	163	mid-slope	Terrace	Sedimentary rock, High Outcrop, Octocorals	695	700-1500	Y	GAB Image Collection
4125	164	mid-slope	slope	Sedimentary rock, subcrop, crinoids	654	700- 1500	Y	SE Image Collection
4126	207	mid-slope	Terrace	Coarse sediments, directed scour, Small encrustors / erect forms (including bryozoans)	216	700-1500	Y	GAB Image Collection
4127	208	mid-slope	Seamount	Coarse sediments, Highly irregular, Mixed faunal community	233	700-1500	Y	GAB Image Collection
4128	210	mid-slope	Seamount	Cobble/ boulder, Debris flow / rubble banks, Sedentary: e.g. seapens	447	700-1500	Y	GAB Image Collection
4129	211	mid-slope	Seamount	Igneous / metamorphic rock, Subcrop, Small encrustors	556	700-1500	Y	GAB Image Collection
4130	212	mid-slope	Seamount	Igneous / metamorphic rock, Subcrop, Sedentary: e.g. seapens	557	700-1500	Y	GAB Image Collection
4131	213	mid-slope	Seamount	Igneous / metamorphic rock, Low Outcrop, Octocorals	575	700-1500	Y	GAB Image Collection
4132	214	mid-slope	Seamount	Igneous / metamorphic rock, Low Outcrop, Small encrustors	576	700-1500	Y	GAB Image Collection
4133	215	mid-slope	Seamount	Igneous / metamorphic rock, Low Outcrop, Sedentary	577	700-1500	Y	GAB Image Collection
4134	221	mid-slope	Slope	Mud, irregular, crinoids	005	700-1500	Y	WA Image Collection
4135	222	mid-slope	Slope	Mud, flat, solitary	007	700-1500	Y	WA Image Collection

4136	228	mid-slope	Slope	Fine, unrippled, solitary	107	700-1500	Y	WA Image Collection
4137	230	mid-slope	Slope	fine sediments, irregular, no fauna	130	700-1500	Y	WA Image Collection
4138	232	mid-slope	Slope	Fine sediments, subcrop, octocorals	155	700-1500	Y	WA Image Collection
4139	243	mid-slope	Slope	Gravel, irregular, low encrustings	336	700-1500	2	WA Image Collection
4140	244	mid-slope	Slope	Igneous rock/boulder, rubble bank, none	440	700-1500	Y	WA Image Collection
4141	245	mid-slope	Slope	boulders and slabs, subcropping, octocorals	455	700-1500	Y	WA Image Collection
4142	248	mid-slope	Slope	Igneous rock, rubble bank, no fauna	540	700-1500	Y	WA Image Collection
4143	249	mid-slope	Seamount	Igneous rock, rubble bank, octocorals	545	700-1500	Y	WA Image Collection
4144	250	mid-slope	Seamount	Igneous rock, low outcrop, no fauna	570	700-1500	Y	WA Image Collection
4145	252	mid-slope	Slope	Sedimentary, subcrop, small encrustors	656	700-1500	2	WA Image Collection
4146	253	mid-slope	Slope	rock (conglomerate/sedimentary), subcrop, bioturbators	659	700-1500	Y	WA Image Collection
4147	262	mid-slope	Slope	sedimentary/mudstone, high outcrop, no fauna	680	700-1500	Y	WA Image Collection
4148	294	mid-slope	slope	Fine sediments, unrippled, bioturbators	109	700- 1500	Y	Norfanz Image Collection
4149	295	mid-slope	slope	Fine sediments, subcrop, encrustors	156	700- 1500	Y	Norfanz Image Collection
4150	296	mid-slope	slope	Coarse sediments, irregular, no fauna	230	700- 1500	Y	Norfanz Image Collection
4151	297	mid-slope	slope	Coarse sediments, subcrop, no fauna	250	700- 1500	Y	Norfanz Image Collection
4152	298	mid-slope	slope	Coarse sediments, low outcrop, no fauna	260	700- 1500	Y	Norfanz Image Collection

Scoping Document S2B2. Pelagic Habitats

A list of the pelagic habitats for the Prawn trawl Sector of the Torres Strait Fishery. Shading denotes habitats occurring within the jurisdictional boundary of the fishery that are not subject to effort from demersal trawling.

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
P14	North Eastern Pelagic Province - Coastal	0 – 200		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 within the Torres Strait Prawn Fishery (indicated by X). Shaded cells indicate all communities within the province.

Demersal community	Cape	North Eastern	North Eastern Transition	Central Eastern	Central Eastern Transition	South Eastern Transition	Central Bass	Tasmanian	Western Tas Transition	Southern	South Western Transition	Central Western	Central Western Transition	North Western	North Western Transition	Timor	Timor Transition	Heard & McDonald Is	Macquarie Is
Inner Shelf 0 – 110m [1,2]		x																	
Outer Shelf 110 – 250m [1,2,4]																			
Upper Slope 250 – 565m [3,4]																			
Mid–Upper Slope 565 – 820m [3,5]																			
Mid Slope 820 – 1100m [3,5]																			
Lower slope/ Abyssal > 1100m [6]																			
Reef 0 -110m [7, 8]		x																	
Reef 110-250m [8]																			
Seamount 0 – 110m																			
Seamount 110- 250m																			
Seamount 250 – 565m																			
Seamount 565 – 820m																			
Seamount 820 – 1100m																			
Seamount 1100 – 3000m																			

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

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

Scoping Document S2C2. Pelagic Communities

Pelagic communities that overlie demersal communities occurring within the jurisdictional area of the Torres Strait Prawn Fishery (indicated by x) although fishing activity may not necessarily occur in all. 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 0-200 m[1]					x			
Oceanic (1) 0 – 600m								
Oceanic (2) >600m								
Seamount oceanic (1) 0 – 600m								
Seamount oceanic (2) >600m								
Oceanic (1) 0 – 200m								
Oceanic (2) 200-600m								
Oceanic (3) >600m								
Seamount oceanic (1) 0 – 200m								
Seamount oceanic (2) 200 – 600m								
Seamount oceanic (3) >600m								
Oceanic (1) 0-400m								
Oceanic (2) >400m								
Oceanic (1) 0-800m								
Oceanic (2) >800m								
Plateau (1) 0-600m								
Plateau (2) >600m								
Heard Plateau 0-1000m								
Oceanic (1) 0-1000m								
Oceanic (2) >1000m								
Oceanic (1) 0-1600m								
Oceanic (2) >1600m								

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

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

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

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

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

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

Scoping Document S3 Components and Sub-components Identification of Objectives

Component	Core Objective	Sub-component	Example Operational Objectives	Example Indicators	Rationale
	"What is the general goal?"	*As shown in sub-component model diagrams at the beginning of this section.*	*"What you are specifically trying to achieve"*	*"What you are going to use to measure performance"*	*Rationale flagged as 'EMO' where Existing Management Objective in place, or 'AMO' where there is an existing AFMA Management Objective in place for other Commonwealth fisheries (assumed that squid fishery will fall into line).*
Target Species	Avoid recruitment failure of the target species Avoid negative consequences for species or population sub-components	1. Population size	1.1 No trend in biomass 1.2 Maintain biomass above a specified level 1.3 Maintain catch at specified level 1.4 Species do not approach extinction or become extinct	Biomass, numbers, density, CPUE, yield	1.1 add in rationale for each objective 1.2 1.3 1.4
		2. Geographic range	2.1 Geographic range of the population, in terms of size and continuity does not change outside acceptable bounds	Presence of population across the GAB	2.1
		3. Genetic structure	3.1 Genetic diversity does not change outside acceptable bounds	Frequency of genotypes in the population, effective population size (N_e), number of spawning units	3.1

Component	Core Objective	Sub-component	Example Operational Objectives	Example Indicators	Rationale
		4. Age/size/sex structure	4.1 Age/size/sex structure does not change outside acceptable bounds (e.g. more than X% from reference structure)	Biomass, numbers or relative proportion in age/size/sex classes Biomass of spawners Mean size, sex ratio	4.1
		5. Reproductive Capacity	5.1 Fecundity of the population does not change outside acceptable bounds (e.g. more than X% of reference population fecundity) 2 Recruitment to the population does not change outside acceptable bounds	Egg production of population Abundance of recruits	5.1 5.2
		6. Behaviour /Movement	6.1 Behaviour and movement patterns of the population do not change outside acceptable bounds	Presence of population across space, movement patterns within the population (e.g. attraction to bait, lights)	6.1
Byproduct and Bycatch	Avoid recruitment failure of the byproduct and bycatch species Avoid negative consequences for species or population sub-components	1. Population size	1.1 No trend in biomass 1.2 Species do not approach extinction or become extinct 1.3 Maintain biomass above a specified level 1.4 Maintain catch at specified level	Biomass, numbers, density, CPUE, yield	1.1 1.2 1.3 1.4

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

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

Component	Core Objective	Sub-component	Example Operational Objectives	Example Indicators	Rationale
		5. Reproductive Capacity	5.1 Fecundity of the population does not change outside acceptable bounds (e.g. more than X% of reference population fecundity) Recruitment to the population does not change outside acceptable bounds	Egg production of population Abundance of recruits	5.1
		6. Behaviour /Movement	6.1 Behaviour and movement patterns of the population do not change outside acceptable bounds	Presence of population across space, movement patterns within the population (e.g. attraction to bait, lights)	6.1
		7. Interactions with fishery	7.1 Survival after interactions is maximised 7.2 Interactions do not affect the viability of the population or its ability to recover	Survival rate of species after interactions Number of interactions, biomass or numbers in population	7.1 7.2
Habitats	Avoid negative impacts on the quality of the environment Avoid reduction in the amount and quality of habitat	1. Water quality	1.1 Water quality does not change outside acceptable bounds	Water chemistry, noise levels, debris levels, turbidity levels, pollutant concentrations, light pollution from artificial light	1.1
		2. Air quality	2.1 Air quality does not change outside acceptable bounds	Air chemistry, noise levels, visual pollution, pollutant concentrations, light pollution from artificial light	2.1

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

2.2.4 Hazard Identification (Step 4)

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

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

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

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

Scoping Document S4. Hazard Identification Scoring Sheet

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

Fishery Name: Torres Strait Prawn Fishery
Sub-fishery Name:
Date: 9 June 2006

Direct impact of Fishing	*Fishing Activity*	Score (0/1)	Documentation of Rationale
Capture	Bait collection	0	No bait collection occurs
	Fishing	1	Capture of organisms due to gear deployment, retrieval and actual fishing.
	Incidental behaviour	1	Occasional recreational line fishing by crew in down time. Fish may be retained, or may sustain damage if hooked or landed but then released due to being undersized or of undesirable species for consumption.
Direct impact without capture	Bait collection	0	No bait collection occurs
	Fishing	1	Organisms may come into contact with TED or net; benthic species may be damaged by ground chain moving over them. Juvenile prawns may be damaged and die as a result of passing through the meshes of the net.
	Incidental behaviour	1	Occasional recreational line fishing by crew in down time. Hooks may remain in the animals if they break free, and will interfere with future feeding.
	Gear loss	1	Uncommon but may occur
	Anchoring/ mooring	1	Occurs during daylight throughout the fishery.
	Navigation/steaming	1	Continuous searching and trawling during the night, often steaming between locations during the day.
Addition/ movement of biological material	Translocation of species (boat launching, reballasting)	1	May occur incidentally via boat hulls as vessel move to and from the adjacent NPF and ECOT fisheries and home ports. Translocation may also occur through net and anchor entanglement by organisms. Translocation of Asian green mussel is a known risk. There has been occurrence of this species in Cairns which is either the home port or transit port for most of the TSPF endorsed vessels. Known introduced species (barnacle, nudibranch and algae) already occur in the adjacent NPF area. Many vessels also endorsed for NPF and ECOT.
	On board processing	1	Occasional discarding of unwanted sections of byproduct species after on-board processing. i.e. squid guts.
	Discarding catch	1	Discarding is common – mainly bycatch and to a much less extent, undersized target and byproduct species.
	Stock enhancement	0	Does not occur
	Provisioning	0	Does not occur
	Organic waste disposal	1	Disposal of organic wastes (food scraps, sewage) from boats.

Direct impact of Fishing	*Fishing Activity*	Score (0/1)	Documentation of Rationale
Addition of non-biological material	Debris	1	Rubbish accidentally washed overboard
	Chemical pollution	1	Oil spills, anti-fouling chemicals, cleaning chemicals, metabisulphate used to prevent black spot in the target catch.
	Exhaust	1	Exhaust as a result of diesel and other engines during fishing operations.
	Gear loss	1	Uncommon but can occur
	Navigation/ steaming	1	The navigation and steaming of vessels will introduce noise (engine noise and echo-sounders) and visual stimuli into the environment.
	Activity/ presence on water	1	Vessel activity will introduce noise and visual stimuli into the environment
Disturb physical processes	Bait collection	0	Does not occur
	Fishing	1	The trawl gear (boards, sleds & ground chain) may disturb sediments on the seafloor
	Boat launching	0	Does not occur
	Anchoring/ mooring	1	Anchoring/mooring may affect the physical processes in the area where anchors and chains contact the seafloor.
	Navigation/ steaming	1	Vessels may disturb sediments in shallow water
External Hazards (specify the particular example within each activity area)	Other capture fishery methods	1	Other fisheries occur in the same area (e.g. diving for TRL, BDM, trochus and pearl shell, commercial and recreational line fishing and indigenous fishing for fish, turtle and dugong, illegal longlining)
	Aquaculture	1	Pearl farms and sponge farming is also being investigated – translocation of shell could result in translocation of disease. Impact of cages (suspended just below the sea surface) on the marine environment. The pearl farms are outside of the area fished but within the Torres Strait. The proposed sponge farms would be close to reefs adjacent to inhabited islands.
	Coastal development	1	Although there is only limited coastline adjacent to the northern and southern ends of the fishery, there is the potential for sewage discharge and dumping from the island communities located within the area of the fishery.
	Other extractive activities	0	None at present. There is an agreed moratorium between Australia and PNG on oil, gas and mineral exploration with the Torres Strait Protected Zone.
	Other non-extractive activities	1	Shipping and a proposed gas pipeline between PNG and Australia.
	Other anthropogenic activities	1	Recreational boating and fishing leading to coral damage when anchoring, possible collisions with turtles and dugongs. Shipping and possible oil spills.

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

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

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

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

2.2.5 Bibliography (Step 5)

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

Key documents can be found on the Torres Strait PZJA web page at www.pzja.gov.au and include the following:

- Torres Strait Protected Zone Joint Authority (PZJA) Management Paper
- PZJA Fisheries Management Notices
- Torres Strait Prawn Bycatch action plan 2005
- Torres Strait Prawn Fishery Implementation report 2005
www.afma.gov.au/information/publications/fishery/baps/docs/torres_bap_final.pdf
- Management Advisory Committee minutes, and
- Torres Strait Prawn handbook

www.pzja.gov.au/resources/publications/handbook.htm (updated April 2006)

Other publications that may provided information include

- BRS Fishery Status Reports
- Strategic Plans

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

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

In this case, 20 out of 26 possible internal activities were identified as occurring in this fishery. Five out of 6 external activities were identified. Thus, a total of 25 activity-component scenarios will be considered at Level 1. This results in 125 total scenarios (of 160 possible) to be developed and evaluated using the unit 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)

2.3.1 Level 1 (SICA) Documents 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	3	5	population size	tiger prawn	1.2	3	3	2	Fishing occurs in 20% of the designated management area of the TSPF for about 9 months each year. Population size likely to be affected before major changes in other sub-components; tiger prawns are the primary target species due to their higher commercial value =>intensity moderate as fishing is generally focused on suitable habitat over a broader spatial scale =>consequence moderate as the tiger prawn stock is considered fully fished so may be the most vulnerable target species =>confidence high as we have good biomass estimates and stock assessment models	I
	Incidental behaviour	1	3	5	population size	tiger prawn	1.2	1	1	2	Occasional line fishing by crew while at anchor during the day. Population size likely to be affected before major changes in other sub-components; tiger prawns are the primary target species due to their higher commercial value =>intensity negligible as hand-lining occurs in only a few anchoring locations =>consequence negligible as hand-lining by crew is expected to have a negligible impact on prawns as they are not known to be caught by line =>confidence high as it is extremely unlikely that incidental behaviour will affect tiger prawn population size.	I
Direct impact without capture	Bait collection	0									Does not occur	I
	Fishing	1	3	5	population size	tiger prawn	1.2	2	2	2	Small commercial prawn species may be damaged or died as a result of passing through the meshes of the net. Juvenile tiger prawns most at risk as tiger prawns are the primary target species due to their higher commercial value. Population size likely to be affected before major changes in other sub-components =>intensity minor as most fishing occurs in areas that harbour adult prawns that	I

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
											are fully retained by the net mesh =>consequence minor; capture of the adult stock is the major impact of fishing on the population size, with minimal damage expected to juveniles in contact with the nets =>confidence high as we have good data on the size and migration of tiger prawns in the TSPF.	
	Incidental behaviour	1	3	5	population size	tiger prawn	1.2	1	1	2	Occasional line fishing by crew while at anchor during the day. Population size likely to be affected before major changes in other sub-components; tiger prawns are the primary target species due to their higher commercial value => intensity negligible as hand-lining occurs in only a few anchoring locations =>consequence negligible as hand-lining by crew is expected to have a negligible impact on prawns as they are not known to be caught by line =>confidence high as it is extremely unlikely that incidental behaviour without capture will affect tiger prawn population size.	I
	Gear loss	1	3	5	population size	tiger prawn	1.2	1	1	2	Fishing occurs in 20% of the designated management area of the TSPF for about 9 months each year. Population size likely to be affected before major changes in other sub-components; tiger prawns are the primary target species due to their higher commercial value =>Intensity negligible as gear loss is rare and interaction of Brown tiger prawn with gear remote =>consequence negligible as impact unlikely to be measurable =>Confidence high as it is known that very little gear is lost, and interaction with Brown tiger prawn is considered unlikely.	I
	Anchoring/ mooring	1	3	5	population size	tiger prawn	1.2	1	1	2	Fishing occurs in 20% of the designated management area of the TSPF for about 9 months each year. Population size likely to be affected before major changes in other sub-components; tiger prawns are the primary target species due to their higher commercial value =>intensity negligible, although anchoring occurs daily it generally occurs at anchorages adjacent to island or reefs. There is only occasional anchoring on the trawl grounds during good weather =>consequence negligible as the spatial scale of the impact of an anchor on the trawl grounds is negligible =>Confidence high as it is unlikely that tiger prawns would be negatively affected by anchoring/mooring.	I
	Navigation/ steaming	1	3	5	population size	tiger prawn	1.2	3	1	2	Fishing occurs in 20% of the designated management area of the TSPF for about 9 months each year. Population size likely to be affected before major changes in other sub-components; tiger prawns are the primary target species due to their higher commercial value =>intensity moderate as vessels are trawling and steaming all night and often part of the day. =>consequence negligible as prawns	I

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
											are demersal therefore negligible chance of direct impact =>confidence high was we know that tiger prawns are demersal are rarely if ever found near the surface of the water	
Addition/ movement of biological material	Translocation of species	1	3	5	population size	tiger prawn	1.2	1	3	1	Translocation of species may occur throughout the TS fishery area, through hull fouling, net or anchor entanglement. Translocated organisms have the potential to establish as the majority of fishing areas and ports used are of similar depths and habitat. Many TSP vessels are also endorsed to fish in the NPF and ECOT areas, where the presence of international shipping routes and some introduced species (three species of introduced marine organisms are presently confirmed in the NPF-[Megabalanus tintinnabulum (barnacle), Aeolidiella indica (nudibranch), and Caulerpa taxifolia (algae)], establish a precedence for translocation to occur. The bivalve, black-striped mussel, recently eradicated from Darwin harbour, similarly remains a potentially serious threat to the TSPF. Translocation of species is most likely to affect the population size of target species, possibly by introducing a foreign competitor or through transmission of disease, but also directly or indirectly through changing trophic linkages. No mitigating measures are currently in place. =>Intensity: considered negligible at present. =>Consequence: moderate as there is the potential for impacts to alter population size. =>Confidence scored as low as is not known to what extent trawling in the TS may contributes to the spread of species. No data exists to confirm or refute this risk within the TS fishery.	I
	On board processing	1	3	5	population size	tiger prawn	1.2	1	1	2	Prawns are frozen whole on Australian TSPF vessels, while PNG vessels do head some of their prawn product but to date only conduct very limited level of fishing in PNG waters of the TSPZ =>intensity negligible =>consequence negligible as any prawn predators (sharks & dolphins) attracted by the discarded heads follow the vessel on the surface rather than the nets on the sea bed =>confidence high as it is logical that the impact on prawn stocks would be low due to the low level of onboard processing.	I
	Discarding catch	1	3	5	population size	tiger prawn	1.2	3	3	2	Discarding of bycatch occurs extensively throughout the fished region => most likely to affect population size of tiger prawns if scavengers and predators (e.g. sharks and trevally) are attracted to prawn habitat and in turn prey upon prawns =>Intensity and consequence moderate as discarding is widespread and prawn predators (e.g. sharks trevallies) are known to be attracted to discards	I

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
											=>Confidence scored as high as the effects of discarding of bycatch is well documented in the TSPF.	
	Stock enhancement	0									Does not occur	I
	Provisioning	0									Does not occur	I
	Organic waste disposal	1	3	5	behaviour/ movement	tiger prawn	6.1	1	1	2	Disposal of organic waste material (food scraps, sewage) is most likely to impact on the behaviour and movement of prawns (e.g. attracted to food scraps) =>intensity negligible as there are only small number of vessels over a large spatial area =>consequence negligible as these events are small, localised and scattered =>confidence high as the consequence is constrained by logical consideration	I
Addition of non-biological material	Debris	1	3	5	behaviour/ movement	tiger prawn	6.1	1	1	2	Debris could impact the movement/ behaviour of tiger prawns =>intensity negligible as fishing vessels are under MARPOL convention and required to store and return all non-biological waste to port or unload it to supply vessels =>consequence negligible as interaction with debris from fishing vessels is highly unlikely =>confidence high consequence is constrained by logical consideration.	I
	Chemical pollution	1	3	5	population size	tiger prawn	1.2	1	2	1	Chemical pollution for fishing vessels occurs as oil spills, for anti-fouling, clean chemicals etc; Chemical pollution poses greatest potential risk for the population of brown tiger prawn if the seagrass areas are affected =>Intensity negligible as boats operating under MARPOL =>consequences minor as oil spills could impact the seagrass beds used by tiger prawns which would impact on recruitment but oil spills from fishing vessels would be fairly limited and localised =>confidence low as limited data effects of chemicals	I
	Exhaust	1	3	5	behaviour/ movement	tiger prawn	6.1	1	1	2	Exhaust from running engines occurs over a large range/scale =>intensity negligible because exhaust considered to have low impact on target species, more likely to have a short term impact air quality =>consequence negligible as target species are on the sea bed so their behaviour/movement are unlikely to be impacted =>Confidence high as the consequence is constrained by logical consideration	I
	Gear loss	1	3	5	behaviour/ movement	tiger prawn	6.1	1	1	2	Fishing occurs in 20% of the designated management area of the TSPF for about 9 months each year. Population size likely to be affected before major changes in other sub-components; tiger prawns are the primary target species due to their higher commercial value =>Intensity negligible as gear loss is rare and	I

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
											interaction of Brown tiger prawn with gear remote =>consequence negligible as impact unlikely to be measurable =>Confidence high as it is known that very little gear is lost, and interaction with Brown tiger prawn is considered unlikely.	
	Navigation/ steaming	1	3	5	behaviour/ movement	tiger prawn	6.1	1	1	2	Navigation / steaming occurs over a large range / scale and introduces noise and visual stimuli into the environment =>intensity negligible as it is unlikely to have a measurable/ detectable impact on target species =>consequences negligible because unlikely to impact on the behaviour / movement of target species =>confidence high as considered unlikely that navigation / steaming would impact on the behaviour/movement of demersal prawns	I
	Activity/ presence on water	1	3	5	behaviour/ movement	tiger prawn	6.1	1	1	2	Activity/ presence occurs over a large range / scale and introduces noise and visual stimuli into the environment =>intensity negligible as it is unlikely to have a measurable/ detectable impact on target species =>consequences negligible because unlikely to impact on the behaviour / movement of target species =>confidence high as considered unlikely that activity/ presence would impact on the behaviour/movement of demersal prawns	I
Disturb physical processes	Bait collection	0									Does not occur	I
	Fishing	1	3	5	behaviour/ movement	tiger prawn	6.1	2	2	1	The trawl gear interacts with the sea bed. Fishing occurs in 20% of the designated management area of the TSPF for about 9 months each year =>intensity minor, although the fishing gear does disturb the sea bed and sediment this disturbance would be small compared with the disturbance to sediments created by the strong tidal currents the prevail in TS =>consequences minor as disturbance of sediment not likely to affect behaviour /movements =>confidence low as little available data on changes in prawn behaviour due to sea bed disturbance	I
	Boat launching	0										I
	Anchoring/ mooring	1	3	5	behaviour/ movement	tiger prawn	6.1	1	1	2	Fishing occurs in 20% of the designated management area of the TSPF for about 9 months each year =>intensity negligible as the spatial scale of the impact of an anchor on the sea bed is negligible, although anchoring occurs daily it generally occurs at anchorages adjacent to island or reefs. There is only occasional anchoring on the trawl grounds during good weather =>consequence negligible as is considered unlikely that anchor disturbance would impact on the behaviour/movement of prawns =>Confidence high by logical constraint	I

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
	Navigation/steaming	1	3	5	population size	tiger prawn	1.2	1	2	1	Fishing occurs in 20% of the designated management area of the TSPF for about 9 months each year =>intensity negligible as physical impacts of steaming would only occur in very shallow waters i.e. sediment disturbance =>consequence minor as disturbance of sediment not likely to affect population size =>confidence low as no available data	I
External Impacts (specify the particular example within each activity area)	Other fisheries	1	4	6	population size	tiger prawn	1.2	3	1	2	Other fisheries occur in the area (TRL, BDM, pearl shell etc) these fisheries are largely dive and lines fisheries therefore would have little impact on tiger prawn stocks =>intensity moderate as there is regular effort through the area of the fishery =>consequence negligible as these fisheries do not capture prawns as bycatch =>confidence high as it is considered unlikely that dive and line fisheries could impact on prawn stocks	E
	Aquaculture	1	3	6	population size	tiger prawn	1.2	1	1	2	There are pearl farms in TS but not within the area of prawn trawling. Sponge farming is being investigated and proposed for reefs close to inhabited islands =>intensity negligible as activities are small and localised =>consequences negligible as in is consider unlikely that these activities would impact on brown tiger prawn stocks =>confidence high as there is no obvious way that pearl farming or sponge aquaculture could impact prawn stocks	E
	Coastal development	1	4	6	population size	tiger prawn	1.2	1	1	1	No coastline within the fishery and only limited developed on inhabited islands within the fishery =>intensity negligible as only limited and localised possibility of impacts from sewage discharge and dumping of rubbish =>consequences negligible as unlikely to affect target species populations =>confidence low as there is no data	E
	Other extractive activities	0									Does not occur	E
	Other non-extractive activities	1	4	6	population size	tiger prawn	1.2	3	3	1	Torres Strait has major international shipping lanes through the fishery - possibility of oil spills and introduced pest =>intensity moderate as it a high risk area for shipping with a high traffic level =>consequences moderate as oil spills could impact the seagrass beds used by tiger prawns which would impact on recruitment =>confidence low as there is limited data no the long term impacts of oil spills or introduced pests no tiger prawn stocks	E

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
	Other anthropogenic activities	1	4	6	population size	tiger prawn	1.2	2	1	2	Recreational / traditional fishing and boating could impact the environment =>intensity minor as current level of this activity are low and impacts would be localised =>consequences negligible as it is unlikely that these activities would impact tiger prawn stocks =>confidence high the impact of recreational fishing on prawn populations is constrained by logical considerations	E

L1.2 - Byproduct and Bycatch Component;

Direct impact of fishing	Fishing Activity	Presence (1) Absence (0)	Spatial scale of Hazard (1-6)	Temporal scale of Hazard (1-6)	Sub-component	Unit of analysis	Operational objective (S2.1)	Intensity Score (1-6)	Consequence Score (1-6)	Confidence Score (1-2)	Rationale	Internal / External
Capture	Bait collection	0									Does not occur	I
	Fishing	1	3	5	population size	Sharks & rays (small)	1.2	3	3	1	Fishing occurs in 20% of the designated management area of the TSPF for about 9 months each year. Elasmobranchs in general are more susceptible to overfishing than boney fishes. Elasmobranch bycatch has generally been reported as “multi-family grouping” or “Squatinidae-undifferentiated”. Of the elasmobranch species recorded in the TSPF saw sharks (TEP species), wobbegongs and rays are likely to be of most concern due to their high susceptibility and little information is available to estimate their recovery. =>intensity moderate; fishing is generally focused on suitable habitat over a broader spatial scale => consequence moderate as a precautionary measure although there is no data to suggest these species are impacted by trawl fishing in the TSPF =>confidence low as data on these species is limited	I
	Incidental behaviour	1	3	5	population size	Reef fish e.g. coral trout	1.2	1	1	2	Occasional line fishing by crew while at anchor during the day; some of the species they take e.g. coral trout, may be at risk of overfishing in TS =>intensity negligible as hand-lining occurs in only a few anchoring locations =>consequence negligible as the amount of finfish that can be on board the vessel is restricted 20 kg and there are generally 2 weeks between unloads, this level of catch would have a negligible impact on fin fish stocks =>confidence high due to the restrictions on catch levels which are checked by the Boating and Fisheries Patrol	I
Direct impact without capture	Bait collection	0									Does not occur	I
	Fishing	1	3	5	population size	Sharks & rays (large)	1.2	3	3	1	Sharks and rays larger than ~1m were known to be caught during prawn fishing and are now exclude from the catch by the use of TEDs. It is assumed that this has increased their survival rate, but no data is available to confirm this. =>intensity moderate; fishing is generally focused on suitable habitat over a broader spatial scale. =>consequence moderate as a precautionary measure although there is no data to suggest these species are impacted by trawl fishing in the TSPF =>confidence low as there is limited data on survival of these species after passing through the TED. Video footage of TED in operation would be required to confidently assess this risk.	I

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
	Incidental behaviour	1	3	5	population size	Sharks	1.2	1	1	1	Occasional line fishing by crew while at anchor during the day; sharks are often take the line and break off or are cut off with hooks remaining in there mouth; this could lead to death and impact the shark populations =>intensity negligible as hand-lining occurs in only a few anchoring locations =>consequence negligible as it is considered unlikely that this activity will result in significant shark mortality =>confidence low is there is no data on the effect of this activity on shark mortality	I
	Gear loss	1	3	5	population size	Sharks & rays	1.2	1	1	2	Sharks and rays may tangle in the gear resulting in mortality =>Intensity negligible as gear loss is rare =>consequence negligible as lost nets will be largely buried in the sediment and have little ghost fishing impact as the mesh size is small, therefore impact unlikely to be detectable at the scale of the stock =>Confidence high as it is known that very little gear is lost	I
	Anchoring/ mooring	1	3	5	behaviour/ movement	Small sharks & rays	6.1	1	1	2	Anchoring/ mooring could impact behaviour/ movement =>intensity negligible, although anchoring occurs daily it generally occurs at anchorages adjacent to island or reefs. There is only occasional anchoring on the trawl grounds during good weather =>consequence negligible as the spatial scale of the impact of an anchor on the trawl grounds is negligible =>Confidence high as it is unlikely that any product or bycatch species would be negatively affected by anchoring/mooring.	I
	Navigation/ steaming	1	3	5	behaviour/ movement	Sharks & rays	6.1	3	1	2	Behaviour/ movement may be impacted =>intensity moderate as vessels are trawling and steaming all night and often part of the day =>consequence negligible as just steaming/ navigation are unlikely to affect shark behaviour =>confidence high as we know that sharks are mainly attracted to fishing vessels by discards	I
Addition/ movement of biological material	Translocation of species	1	3	5	population size	Sharks & rays	1.2	1	3	1	Translocation of species may occur throughout the TS fishery area, through hull fouling, net or anchor entanglement. Translocated organisms have the potential to establish as the majority of fishing areas and ports used are of similar depths and habitat. Many TSP vessels are also endorsed to fish in the NPF and ECOT areas, where the presence of international shipping routes and some introduced species (three species of introduced marine organisms are presently confirmed in the NPF-[Megabalanus tintinnabulum (barnacle), Aeolidiella indica (nudibranch), and Caulerpa taxifolia (algae)], establish a precedence for translocation to occur. The bivalve, black-striped mussel, recently eradicated	I

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
											from Darwin harbour, similarly remains a potentially serious threat to the TSPF. Translocation of species is most likely to affect the population size of bycatch species, possibly by introducing a foreign competitor or through transmission of disease, but also directly or indirectly through changing trophic linkages. No mitigating measures are currently in place. =>Intensity: considered negligible at present. =>Consequence: moderate as there is the potential for impacts to alter population size. =>Confidence scored as low as is not known to what extent trawling in the TS may contributes to the spread of species. No data exists to confirm or refute this risk within the TS fishery.	
	On board processing	1	3	5	behaviour/ movement	Sharks	6.1	1	1	2	Impacts behaviour/ movement of sharks as they are attracted to feed on the discards =>intensity negligible prawns are frozen whole on Australian TSPF vessels, PNG vessels do head some of their prawn product but to date have only conduct very a limited level of fishing in PNG waters of the TSPZ =>consequence negligible as impacts are localised and temporary =>confidence high as sharks are observed leaving the vessels when discarding has finished	I
	Discarding catch	1	3	5	population size	Sharks	1.2	2	1	2	Sharks are attracted to feed on the discards, on rare occasions there is shark mortality from striking the propeller =>intensity minor as these occurrences are rare. =>consequence negligible as impacts on population unlikely to be detectable at the scale of the stock =>confidence high as this is type of impact is known to be rare.	I
	Stock enhancement	0									Does not occur	I
	Provisioning	0									Does not occur	I
	Organic waste disposal	1	3	5	behaviour/ movement	Sharks	6.1	1	1	2	Disposal of organic waste material (food scraps, sewage) is most likely to impact on the behaviour and movement of pelagic animals species close to the fishing vessels (e.g. attracted to food scraps) =>intensity negligible as there are only small number of vessels over a large spatial area =>consequence negligible as these events are small, localised and scattered =>confidence high as the consequence is constrained by logical consideration	I
Addition of non-biological material	Debris	1	3	5	population size	Sharks & rays	1.2	1	2	2	Debris could impact the survival of some species through entanglement or ingestion =>intensity negligible as fishing vessels are under MARPOL convention and required to store and return all non-biological waste to port or unload it to supply vessels =>consequence minor as interaction with debris from fishing vessels is highly unlikely => confidence high consequence is constrained	I

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
											by logical consideration.	
	Chemical pollution	1	3	5	population size	Sharks & rays	1.2	1	2	1	Chemical pollution for fishing vessels occurs as oil spills, for anti-fouling, clean chemicals etc. Chemical pollution poses greatest potential risk for the population of elasmobranchs =>Intensity negligible as boats operating under MARPOL =>consequences minor as chemical pollution from fishing vessels could result in additional mortality in populations already at risk but would be fairly limited and localised =>confidence low as limited data on effects of chemicals on survival of pelagic animals	I
	Exhaust	1	3	5	population size	Sharks & rays	1.2	1	1	2	Exhaust from running engines occurs over a large range/scale =>intensity negligible because exhaust considered to have low impact on marine species, more likely to have a short term impact on air quality =>consequence negligible as target species are on the sea bed so their behaviour/movement are unlikely to be impacted =>Confidence high as the consequence is constrained by logical consideration	I
	Gear loss	1	3	5	population size	Sharks & rays	1.2	1	1	2	Population size likely to be affected before major changes in other sub-components =>Intensity negligible as gear loss is rare. =>consequence negligible as impact unlikely to be detectable at the scale of the stock =>Confidence high as it is known that very little gear is lost.	I
	Navigation/ steaming	1	3	5	behaviour/ movement	Sharks & rays	6.2	3	1	2	Behaviour/ movement may be impacted due to sounders/sonar =>intensity moderate as vessels are trawling and steaming all night and often part of the day =>consequence negligible as it is considered unlikely that sounders/sonar would affect shark behaviour =>confidence high as we know that shark behaviour is influence more by other activities e.g. discarding	I
	Activity/ presence on water	1	3	5	behaviour/ movement	Sharks & rays	6.2	1	1	2	Activity/ presence occurs over a large range / scale and introduces noise and visual stimuli into the environment =>intensity negligible as it is unlikely to have a measurable/ detectable impact on sharks =>consequences negligible because unlikely to impact on the behaviour / movement =>confidence high as considered unlikely that activity/ presence would impact on the behaviour/movement of sharks	I
Disturb physical processes	Bait collection	0									Does not occur	I
	Fishing	1	3	5	behaviour/ movement	Sharks & rays	6.2	2	2	1	The trawl gear interacts with the sea bed. Fishing occurs in 20% of the designated management area of the TSPF for about 9 months each year	I

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
											=>intensity minor, although the fishing gear does disturb the sea bed and sediment this disturbance would be small compared with the disturbance to sediments created by the strong tidal currents the prevail in TS =>consequences minor as disturbance of sediment not likely to affect behaviour /movements =>confidence low as little available data on changes in elasmobranch behaviour due to sea bed disturbance	
	Boat launching	0									Does not occur	I
	Anchoring/ mooring	1	3	5	behaviour/ movement	Sharks & rays	6.2	1	1	2	Fishing occurs in 20% of the designated management area of the TSPF for about 9 months each year =>intensity negligible as the spatial scale of the impact of an anchor on the sea bed is negligible, although anchoring occurs daily it generally occurs at anchorages adjacent to island or reefs. There is only occasional anchoring on the trawl grounds during good weather =>consequence negligible as is considered unlikely that anchor disturbance would impact on the behaviour/movement of elasmobranchs =>Confidence high by logical constraint	I
	Navigation/steaming	1	3	5	population size	Sharks & rays	6.2	1	2	1	Fishing occurs in 20% of the designated management area of the TSPF for about 9 months each year =>intensity negligible as physical impacts of steaming would only occur in very shallow waters i.e. sediment disturbance =>consequence minor as disturbance of sediment not likely to affect population size =>confidence low as no available data	I
External Impacts (specify the particular example within each activity area)	Other fisheries	1	4	6	population size	Sharks & rays	1.2	3	3	1	Other fisheries occur in the area (TRL, BDM, pearl shell etc). These fisheries are largely dive and lines fisheries, the line fisheries may be taking elasmobranchs as product or discards therefore could be impacting the populations =>intensity moderate as there is regular effort through the area of the fishery =>consequence moderate as there is the potential for other fisheries to have a cumulative impact on elasmobranch stocks =>confidence low - limited data on impacts of other fisheries in TS	E
	Aquaculture	1	3	6	population size	Sharks & rays	1.2	1	1	2	There are pearl farms in TS but not within the area of prawn trawling. Sponge farming is being investigated and proposed for reefs close to inhabited islands =>intensity negligible as activities are small and localised =>consequences negligible as in is consider unlikely that these activities would impact on elasmobranch stocks =>confidence high as there is no obvious way that pearl farming or sponge aquaculture could impact elasmobranch stocks	E

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
	Coastal development	1	4	6	population size	Sharks & rays	1.2	1	1	1	No coastline within the fishery and only limited developed on inhabited islands within the fishery =>intensity negligible as only limited and localised possibility of impacts from sewage discharge and dumping of rubbish =>consequences negligible as unlikely to elasmobranch populations =>confidence low as there is no data	E
	Other extractive activities	0									Does not occur	E
	Other non-extractive activities	1	4	6	population size	Sharks & rays	1.2	3	3	1	Torres Strait has major international shipping lanes through the fishery - possibility of oil spills and introduced pest =>intensity moderate as is a high risk area for shipping with a high traffic level =>consequences moderate as oil spills and introduced species may impact the mortality of elasmobranchs =>confidence low as there is limited data no the long term impacts of oil spills or introduced pests on elasmabranchs	E
	Other anthropogenic activities	1	4	6	population size	Sharks & rays	1.2	2	3	1	Recreational / traditional fishing and boating could impact the environment =>intensity minor as current level of this activity are low and impacts would be localised =>consequences scored as moderate as these activities could impact elasmobranch stocks =>confidence low due to lack of data	E

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	3	5	population size	sea snakes	1.2	3	3	1	Sea snakes and sygnathids populations are likely to be of most concern, survival of sea snakes after trawling has been estimated as 49%, these taxa were rarely identified to species level and catch rates were very low in the research surveys conducted to date, the risk to these species is dependent on the relative proportions of the populations taken by trawling, however this is unknown => intensity moderate as fishing occurs in 20% of the designated management area of the TSPF for about 9 months => consequence moderate as a precautionary measure although the available data suggests that catch rates are low in the TSPF =>confidence low as data on these species is limited	I
	Incidental behaviour	1	3	5	population size	sea snakes	1.2	1	1	2	Occasional line fishing by crew while at anchor during the day; they may accidentally catch a TEP species => intensity negligible as hand-lining occurs in only a few anchoring locations => consequence negligible as it is unlikely a TEP species (e.g. sea snake, turtle, dugong) would be caught on a handline =>confidence high as a logically constrained	I
Direct impact without capture	Bait collection	0									Does not occur	I
	Fishing	1	3	5	population size	turtles	1.2	2	1	2	Turtles may be damaged by the TED => intensity minor as data from the period prior to TEDs indicates that catch rates were low relative to the level of trawling activity => consequences negligible as data from the period prior to TEDs indicates high mortality rate for landed turtles, and that in the TSPF 66% were flatbacks which have a higher survival, there are no indications that the TED damage the turtle =>confidence high as there is good data on turtles and TED effectiveness	I
	Incidental behaviour	1	3	5	population size	sea snakes	1.2	1	1	2	Occasional line fishing by crew while at anchor during the day => intensity negligible as hand-lining occurs in only a few anchoring locations => consequence negligible as it is considered unlikely that this activity will result in any interaction with TEP species =>confidence high as a logically constrained	I
	Gear loss	1	3	5	population size	turtles	1.2	1	1	2	turtles may tangle in the gear resulting in mortality => Intensity negligible as gear loss is rare => consequence negligible as interaction with lost gear highly unlikely therefore impact unlikely to be measurable => Confidence high as it is	I

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
											known that very little gear is lost	
	Anchoring/ mooring	1	3	5	behaviour/ movement	turtles	6.2	1	1	2	Anchoring/ mooring could impact behaviour/ movement turtle behaviour => intensity negligible, although anchoring occurs daily there are only a small number of vessels over a large spatial scale =>consequence negligible as anchoring is not considered to impact on turtle behaviour =>Confidence high as it is logically constrained	I
	Navigation/ steaming	1	3	5	population size	turtles	1.2	1	1	2	Steaming / trawling vessels could strike a turtle causing mortality => intensity negligible as fishing vessels are generally moving relatively slowly therefore probability of boat strike is low => consequence negligible as the impact of boat strikes on population is unlikely to be detectable as other sources of mortality are much higher => confidence high as logically constrained, and no evidence of turtle boat-strikes by trawlers	I
Addition/ movement of biological material	Translocation of species	1	3	5	population size	turtles	1.2	1	3	1	Translocation of species may occur throughout the TS fishery area, through hull fouling, net or anchor entanglement. Translocated organisms have the potential to establish as the majority of fishing areas and ports used are of similar depths and habitat. Many TSP vessels are also endorsed to fish in the NPF and ECOT areas, where the presence of international shipping routes and some introduced species (three species of introduced marine organisms are presently confirmed in the NPF-[Megabalanus tintinnabulum (barnacle), Aeolidiella indica (nudibranch), and Caulerpa taxifolia (algae)], establish a precedence for translocation to occur. The bivalve, black-striped mussel, recently eradicated from Darwin harbour, similarly remains a potentially serious threat to the TSPF. Translocation of species is most likely to affect the population size of TEP species, possibly by introducing a foreign competitor or through transmission of disease, but also directly or indirectly through changing trophic linkages. No mitigating measures are currently in place. =>Intensity: considered negligible at present. =>Consequence: moderate as there is the potential for impacts to alter population size. =>Confidence scored as low as is not known to what extent trawling in the TS may contributes to the spread of species. No data exists to confirm or refute this risk within the TS fishery.	I
	On board processing	1	3	5	behaviour/ movement	dolphins	6.2	1	1	2	Dolphins attracted to feed =>Intensity negligible prawns are frozen whole on Australian TSPF vessels, PNG vessels do head some of their prawn product but to date have only conduct very limited level of fishing in PNG waters of the	I

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
											TSPZ =>consequence negligible as dolphins tend to leave the vicinity of the fishing vessels once discarding has finished =>confidence high as the level of on board processing is known to be low	
	Discarding catch	1	3	5	behaviour/ movement	Terns	6.2	3	4	2	Discarding is common after each shot throughout the fishery; most likely to affect behaviour /movement of tern =>Intensity moderate as discarding of high volumes of bycatch occurs throughout the season on the trawl grounds =>Consequence major as the terns continuously follow trawlers to feed on discards and may become dependent on trawlers for food. This has the potential to impact the tern population dynamics, and may take some weeks to return to normal behaviour at the close of the fishing season=>Confidence high as scavenging by terns behind trawlers is common, and the activity is extended over the 9-month season.	I
	Stock enhancement	0									Does not occur	I
	Provisioning	0									Does not occur	I
	Organic waste disposal	1	3	5	behaviour/ movement	dolphins	6.2	1	1	2	Disposal of organic waste material (food scraps, sewage) is most likely to impact on the behaviour and movement of pelagic animals species close to the fishing vessels (e.g. attracted to food scraps) => intensity negligible as there are only small number of vessels over a large spatial area => consequence negligible as these events are small, localised and scattered => confidence high as the consequence is constrained by logical consideration	I
Addition of non-biological material	Debris	1	3	5	population size	dolphins	1.2	1	2	2	Debris could impact the survival of some species through entanglement or ingestion => intensity negligible as fishing vessels are under MARPOL convention and required to store and return all non-biological waste to port or unload it to supply vessels => consequence minor as interaction with debris from fishing vessels is highly unlikely => confidence high consequence is constrained by logical consideration.	I
	Chemical pollution	1	3	5	population size	dugong	1.2	1	2	1	Chemical pollution for fishing vessels occurs as oil spills, for anti-fouling, clean chemicals etc. Chemical pollution poses greatest potential risk for the population of dugong if the seagrass areas are affected => Intensity negligible as boats operating under MARPOL => consequences minor as oil spills could impact the seagrass beds used by dugong which would impact on the population but oil spills from fishing vessels would be fairly limited and localised => confidence low as limited data effects of chemicals	I

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
	Exhaust	1	3	5	population size	dolphins	6.2	1	1	2	Exhaust from running engines occurs over a large range/scale => intensity negligible because exhaust considered to have low impact on marine species, more likely to have a short term impact on air quality => consequence negligible as exhaust unlikely to cause mortality therefore impact unlikely to be detectable at the scale of the stock => Confidence high as the consequence is constrained by logical consideration	I
	Gear loss	1	3	5	population size	turtles	1.2	1	1	2	Population size likely to be affected before major changes in other sub-components. => Intensity negligible as gear loss is rare. => consequence negligible as impact unlikely to be detectable at the scale of the stock => Confidence high as it is known that very little gear is lost.	I
	Navigation/ steaming	1	3	5	behaviour/ movement	dolphins	6.2	3	1	2	Behaviour/ movement may be impacted => intensity moderate as vessels are trawling and steaming all night and often part of the day => consequence negligible as just steaming/ navigation are unlikely to impact on dolphin behaviour => confidence high as we know that dolphins are mainly attracted to fishing vessels by discards	I
	Activity/ presence on water	1	3	5	behaviour/ movement	dolphins	6.2	1	1	2	Activity/ presence occurs over a large range / scale and introduces noise and visual stimuli into the environment => intensity negligible as it is unlikely to have a measurable/ detectable impact on dolphins => consequences negligible because unlikely to impact on the behaviour / movement => confidence high as considered unlikely that activity/ presence would impact on the behaviour/movement of dolphins	I
Disturb physical processes	Bait collection	0									Does not occur	I
	Fishing	1	3	5	behaviour/ movement	sea snakes	6.2	1	1	1	The trawl gear interacts with the sea bed. Fishing occurs in 20% of the designated management area of the TSPF for about 9 months each year => intensity negligible, although the fishing gear does disturb the sea bed and sediment this disturbance would be small compared with the disturbance to sediments created by the strong tidal currents the prevail in TS => consequences negligible as sediment disturbance not likely to affect behaviour /movements => confidence low as little available data on changes in sea snake behaviour due to sea bed disturbance	I
	Boat launching	0									Does not occur	I

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
	Anchoring/ mooring	1	3	5	behaviour/ movement	turtles	6.2	1	1	2	Anchoring/ mooring could impact behaviour/ movement turtle behaviour => intensity negligible, although anchoring occurs daily it there are only a small number of vessels over a large spatial scale => consequence negligible as anchoring is not considered to impact on turtle behaviour => Confidence high as it is logically constrained	I
	Navigation/steaming	1	3	5	behaviour/ movement	dolphins	6.2	3	1	2	Behaviour/ movement may be impacted due to sounders/sonar => intensity moderate as vessels are trawling and steaming all night and often part of the day => consequence negligible as it is considered unlikely that sounders/sonar would negatively affect dolphin behaviour => confidence high as we know that shark behaviour is influence more by other activities e.g. discarding	I
External Impacts (specify the particular example within each activity area)	Other fisheries	1	4	6	population size	dugong	1.2	3	4	2	Dugong are taken by traditional hunting => intensity moderate as there is regular effort through the area of the fishery => consequences major as overfishing of dugong is a current concern => confidence high - as there is good data on dugong stocks	E
	Aquaculture	1	3	6	population size	dugong	1.2	1	1	2	There are pearl farms in TS but not within the area of prawn trawling. Sponge farming is being investigated and proposed for reefs close to inhabited islands => intensity negligible as activities are small and localised => consequences negligible as in is consider unlikely that these activities would impact on any TEP species => confidence high as there is no obvious way that pearl farming or sponge aquaculture would impact TEP species	E
	Coastal development	1	4	6	population size	dugong	1.2	1	1	1	No coastline within the fishery and only limited developed on inhabited islands within the fishery => intensity negligible as only limited and localised possibility of impacts from sewage discharge and dumping of rubbish => consequences negligible as unlikely to impact TEP populations => confidence low as there is no data	E
	Other extractive activities	0									Does not occur	E
	Other non-extractive activities	1	4	6	population size	dugong	1.2	3	3	1	Torres Strait has major international shipping lanes through the fishery - possibility of oil spills and introduced pest => intensity moderate as it a high risk area for shipping with a high traffic level. => consequences moderate as oil spills and introduced species may impact the mortality of TEP species => confidence low as there is limited data no the long term impacts of oil spills or introduced pests on TEP species	E

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
	Other anthropogenic activities	1	4	6	population size	dugong	1.2	2	3	1	Recreational / traditional fishing and boating could impact the environment => intensity minor as current level of this activity are low and impacts would be localised => consequences scored as moderate as these activities could impact TEP species => confidence low due to lack of data	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									Does not occur	I
	Fishing	1	3	5	Habitat structure and function	fine sediments, irregular, octocorals, inner shelf	5.1	3	4	2	Fishing occurs in 20% of the designated management area of the TSPF for about 9 months each year. Trawling at night in waters generally 18-40m deep. Shot length is 2.5 -4 hours and relative gear selectivity creates bycatch issues in this fishery. Gear footprint is large, due to relatively large, heavy nets with high mobility.=> Intensity moderate, highly localised fishing over suitable prawn habitat (generally muddy sediments) may result in severe localised structural modification of susceptible epifaunal and infaunal habitats. =>Consequence major for some habitats in these depths, as encounter with demersal trawl gears will result in removal and damage of erect, rugose and inflexible octocorals associated with soft muddy substrata. Regeneration times of fauna will vary between species, however in inner shelf depths (25-100m), may be reasonably rapid as fauna are likely to be well adapted to frequent and considerable disturbance regimes (e.g. strong currents, runoff, cyclones). More structurally complex forms/ communities may take many years-decades to recover. =>Confidence high. Data on resilience and recovery rates available for some species from this region.	I
	Incidental behaviour	1	3	5	Habitat structure and function	coarse sediments, irregular, hard corals, inner shelf	5.1	2	1	2	Crew often line fish for reef fish when anchored, occurs daily throughout the fishery. =>Intensity minor, anchoring may occur in few restricted locations, however effect of incidental behavior on benthos expected to be low intensity. =>Consequence Incidental behavior considered to have negligible impact on seafloor habitat structure directly. =>Confidence high, constrained by logic.	I
Direct impact	Bait collection	0									Does not occur	I

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
without capture	Fishing	1	3	5	Habitat structure and function	fine sediments, irregular, octocorals, inner shelf	5.1	3	3	2	Octocorals which survive passing of a Prawn Trawl shot, due to their apparent flexibility or strong subsurface attachment, are likely to sustain some degree of damage to contacted polyps. =>Intensity moderate - shots 2.5-4 hours, highly localised interanualy. =>Consequence moderate. Post encounter fate of fauna unknown, regeneration times of damaged tissues will vary between species, however in inner shelf depths (25-100m), can be expected to be reasonably rapid as fauna are likely to be well adapted to frequent and considerable disturbance regimes (e.g. strong currents, runoff, cyclones). More structurally complex forms/ communities may take > 1 year to recover. =>Confidence high. Data on resilience and recovery rates available for some species from this region.	I
	Incidental behaviour	1	3	5	Habitat structure and function	coarse sediments, irregular, hard corals, inner shelf	5.1	2	1	2	Crew often line fish for reef fish when anchored, occurs daily throughout the fishery. =>Intensity minor, anchoring may occur in few restricted locations, however effect of incidental behavior on benthos expected to be low intensity. =>Consequence Incidental behavior considered to have negligible impact on seafloor habitat structure directly. =>Confidence high, constrained by logic.	I
	Gear loss	1	3	5	Habitat structure and function	Biogenic, low outcrop, hard corals, coastal margin	5.1	1	1	2	Fishing occurs in 20% of the designated management area of the TSPF for about 9 months each year Gear loss rare, but may lost bits. Trawling over low relief muddy sediments interspersed with patches of biogenic encrusted/ coral outcrops and wonky holes but snagging unlikely if terrain known and hard patches avoided. =>Intensity negligible across the spatial scale of the fishery, lost gear is most likely highly localised. =>Consequence negligible. Attempted retrieval may lead to damage of fragile or erect faunas. Lost gear may change habitat structure by virtue of creating new structure, which remains to eventually become habitat, impact unlikely to be measurable. =>Confidence high as it is known that very little gear is lost.	I

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
	Anchoring/ mooring	1	3	5	Habitat structure and function	coarse sediments, irregular, hard corals, coastal margin depths	5.1	1	2	1	Anchoring occurs regularly throughout the fishery, over a 9 month period, mainly in <25m depths. Anchoring may occur on sandy substratum or coral reefs. Attached/ sessile fauna may be damaged by physical contact with anchor, during anchoring and retrieval. =>Intensity negligible across scale of fishery. =>Consequence minor over scale of fishery, considered to affect only a very small percentage of the area of the habitat overall, however may be potentially severe at localised scales if fishers anchor in same reef locations. =>Confidence low as unknown effect on NPF habitat caused by Anchoring/ mooring.	I
	Navigation/ steaming	1	3	5	Water quality	Northern Coastal pelagic provinces.	1.1	1	1	2	Navigation/ steaming associated with fishing activity occurs in 20% of the designated management area of the TSPF for about 9 months each year. Navigation/steaming considered to influence water quality by disrupting the water column. =>Intensity Negligible, considered unlikely that there would be detectable impacts on pelagic habitat water quality. =>Consequence therefore Negligible. =>Confidence high because negative interactions between Navigation/steaming and pelagic habitat were considered unlikely to be detectable.	I
Addition/ movement of biological material	Translocation of species	1	3	5	Habitat structure and function	Biogenic, low outcrop, seagrass, coastal margin	5.1	1	4	1	Translocation of species may occur throughout the TSPF, through ballast water or hull fouling, and more likely to establish in shallower waters. Translocated species most likely to affect compromised habitats in terms of structure and function, by altering pelagic and sediment processes, and displacing species. =>Intensity negligible at present, although fishing vessels regularly move between the TSPF and the adjacent NPF and ECOTF they do not carry ballast water. =>Consequence major as there is the potential for impacts to alter habitat dynamics. =>Confidence low as little data exists on the translocation of species by prawn trawlers in the TSPF, NPF and ECOT fisheries.	I
	On board processing	1	3	5	Substrate quality	muddy sediments, bioturbators, inner shelf	3.1	1	1	2	Onboard processing occurs after each shot throughout the fishery, although high grading minimal due to freezer capacity. Prawns are frozen whole on Australian TSPF vessels, PNG	I

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
											vessels do head some of their prawn product but to date have only a limited level of fishing in PNG waters of the TSPZ. Discarding from processing most likely to affect substrate quality if discarded material reaches and accumulates on benthos. =>Intensity negligible, on board processing occurs, but no impact on habitat. =>Consequence negligible as there is generally low volumes of discarding from processing. =>Confidence high, known low rate of discarding associated with on board processing.	
	Discarding catch	1	3	5	Substrate quality	mud, directed scour, bioturbators, coastal margin	3.1	3	3	2	Discarding of catch (mainly bycatch and small amounts of undersized target and byproduct species) throughout the fishery. Large volumes of solid biomass dumped in shallow waters may accumulate over fine sediments, altering substrate quality via changed biogeochemical processes and sediment ecology. Habitat ecology will be modified by the attraction of scavengers and predators. =>intensity moderate as discarding occurs for extended period over each evening of fishing and over the extent of the fished area. =>Consequence moderate, fishery discards high volumes of diverse bycatch in localised accumulations which may take long periods to breakdown. => Confidence: high. Australian based Refs on fate of discards include: Wassenberg and Hill (1990), Harris and Poiner (1990), Hill and Wassenberg (1990)	I
	Stock enhancement	0										I
	Provisioning	0										I
	Organic waste disposal	1	3	5	Water quality	Northern Coastal pelagic provinces.	1.1	2	1	2	Fishing occurs throughout the TSPF for about 9 months each year so organic waste disposal possible over this scale. Disposal of organic waste poses greatest potential threat to the water quality of the Northern Coastal pelagic habitats. =>Intensity minor, each disposal event probably only of low volume and considered to affect a small area. =>Consequence negligible as impact likely to be undetectable within hours as scavenging species expected to rapidly take up waste. =>Confidence high,	I

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
											constrained by logic.	
Addition of non-biological material	Debris	1	3	5	Habitat structure and function	Northern Coastal pelagic provinces, and all benthic habitats.	5.1	2	2	2	Addition of debris possible over the scale of the fishery. Debris poses greatest risk to the structure and function of all pelagic and benthic habitats of the Torres Strait coastal zone habitats. =>Intensity difficult to predict however, minor if MARPOL rules strictly adhered to, and overall volume of debris is small (greatest volumes of debris within these zones likely to come from all sources outside of this fishery e.g. foreign fishing vessels, gillnetters, other fishers in TSPF grounds). =>Consequence minor, habitat quality compromised. =>Confidence in the consequence was high, constrained by logic.	I
	Chemical pollution	1	3	5	Water quality	Northern Coastal pelagic provinces.	1.1	2	1	1	Fishing occurs throughout the TSPF for about 9 months each year so chemical pollution, such as oil spills, for anti-fouling, cleaning chemicals etc possible over this scale. Chemical pollution poses greatest potential threat to the water quality of the Northern coastal pelagic habitats. =>Intensity minor because although the hazard could occur over a large range/scale, pollution considered to only impact a small area. =>Consequence negligible as the effects of chemical pollution are likely to be rapidly undetectable if volume small, and affect surface conditions briefly until winds, waves action dissipate chemical pollution. =>Confidence low. Chemical pollution was considered to occur inadvertently but frequency and volumes unknown	I
	Exhaust	1	3	5	Water quality	Northern Coastal pelagic provinces.	1.1	1	2	1	Exhaust emissions possible over the entire scale of the fishery. Exhaust emissions impact the water quality of the Northern coastal pelagic habitats, floating pollutants such as oil may remain at the surface posing greatest threat to sea snakes, turtles and seabirds. =>Intensity negligible because although the hazard could occur over a large range/scale, exhaust considered to only impact a small localised area. =>Consequence minor as exhaust	I

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
											is unlikely to have a significant impact on the pelagos for long. =>Confidence low as the effects of exhaust on seasnakes, turtles and seabirds is unknown.	
	Gear loss	1	3	5	Habitat structure and function	Biogenic, low outcrop, hard corals, inner shelf	5.1	1	1	2	Gear lost infrequently over 9 month fishing season. Retrieval is usually attempted and possible in shallow depths, if contact with sediments (i.e. wonky holes), less likely if snag on hard grounds. Lost gear may change habitat structure by virtue of creating new structure, which remains to eventually become habitat. =>Intensity gear loss negligible across the spatial scale of the fishery, therefore alteration of habitat structure from lost gear conceivably minimal. =>Consequence negligible, impact unlikely to be measurable. =>Confidence high, large volumes of gear lost infrequently.	I
	Navigation/ steaming	1	3	5	Water quality	Northern Coastal pelagic provinces.	1.1	1	1	1	Navigation/ steaming occurs throughout the TSPF for about 9 months each year. Noise and visual stimuli introduced into the environment because of steaming likely to alter the pelagic habitat for the duration of the vessel presence. Stimuli cease with cessation of activities. =>Intensity negligible because it occurs over a large range and detection of impact unlikely. =>Consequence negligible impacts unlikely to be measurable for pelagic species interactions. =>Confidence scored low as effect on pelagic habitats of noise and visual stimuli not known.	I
	Activity/ presence on water	1	3	5	Water quality	Northern Coastal pelagic provinces.	1.1	3	2	1	The TSPF pelagic environment will be impacted by noise and visual stimuli associated with activity/presence of fishing vessels throughout the TS for about 9 months each year. Noise, light, and water column disturbance associated with fishing operations likely to reduce the pelagic habitat quality for the duration of the shot. Stimuli cease with cessation of activities. =>Intensity moderate as there may be aggregation of fishing vessels targeting Prawns. =>Consequence minor since additions (e.g. noise, boat movements) will disperse rapidly upon cessation. =>Confidence scored as low because the effects of activity/presence on pelagic habitats unknown.	I

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
Disturb physical processes	Bait collection	0									Does not occur	I
	Fishing	1	3	5	Substrate quality	fine sediments, irregular, mixed faunal community, inner shelf	3.1	2	2	1	Substratum processes of fine sediment based habitats will be most disturbed by contact with Prawn trawl gear. Silty sediments in particular will be resuspended in water column, with threat of translocation in strong current zones, alteration of sediment architecture for shallow infaunal species by mechanical action of gear on seafloor, and smothering of suspension feeding communities within the range of the gear activity. =>Intensity minor, highly localised effects, resettlement may take hours to days. =>Consequence minor, area prone to greater effects by natural disturbance phenomena. Length of recovery time for infaunal habitat may depend on depth of disturbance, and intrinsic resilience to natural disturbance. Recovery times of processes from substratum disturbance will vary between sediment habitats and associated species, however may be expected to be < annual in TS waters. =>Confidence low, data required.	I
	Boat launching	0									Does not occur	I
	Anchoring/ mooring	1	3	5	Habitat structure and function	Biogenic, subcrop, mixed faunal community, coastal margin	5.1	2	2	1	Anchoring/ mooring possible over the spatial and temporal scale of the TSPF. Physical contact with anchor may disturb substratum in the process and damage biogenic reef forms in a more persistent way, particularly in frequently used sites. Risk of sediment suspension low as likely to anchor on 'hard' structures or coarse sands. =>Intensity minor, anchoring over relatively short timeframes. =>Consequence minor as anchoring considered to affect only a very small percentage of the area of the habitat that is likely to have a reasonably rapid regenerative capacity. =>Confidence low because it is unknown to what degree Anchoring/ mooring has affected physical processes in mooring grounds of the TS.	I
	Navigation/steaming	1	3	5	Water quality	Northern Coastal pelagic provinces.	1.1	1	1	1	Navigation/ steaming associated with searching for Prawns in the TSPF occurs over 9 months each year. =>Intensity	I

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
											negligible, activity occurs over a large range and detection of impact on pelagos unlikely. =>Consequence negligible. Water quality altered by turbulence unlikely to sustain measurable or persistent change. Stimuli cease with cessation of activities. =>Confidence low, effects of water column disturbance on pelagic habitats not known.	
External Impacts (specify the particular example within each activity area)	Other fisheries	1	4	6	Habitat structure and function	Biogenic, subcrop, mixed faunal community, coastal margin	5.1	3	3	1	Other fisheries operating within the TSPF managed region with potential to impact benthic habitats include mainly dive and line fisheries; TSRL, trochus, BDM, pearl, Mackeral, Reef Line. =>Intensity moderate as there is regular effort through the area of the fishery, and other methods interact to varying degrees with substratum and faunal communities. =>Consequence moderate as both hard and soft grounds are targeted, degree of habitat impact not quantified, nor enough known about habitat potential to recover given frequent anthropogenic disturbance. Cumulative effects on Habitat structure and function are a concern for all habitats, particularly those which may possess long-lived, fragile and endemic species. =>Confidence low, requires data on cumulative effects in TSPF.	E
	Aquaculture	1	3	6	Habitat structure and function	fine sediments, irregular, seagrass, coastal margin	5.1	1	1	1	There are pearl farms in TS but not within the area of prawn trawling. Sponge farming is being investigated and proposed for reefs close to inhabited islands. =>intensity negligible as activities are small and localised. =>Consequences negligible at this stage, depending on species used (i.e. native to area?), but this would need to be monitored closely if using introduced species. =>Confidence low as unclear how this will impact habitats at current stage.	E
	Coastal development	1	4	6	Habitat structure and function	coarse sediments, irregular, seagrass, coastal margin	5.1	1	2	1	No coastline within the fishery and only limited developed on inhabited islands within the fishery. Most susceptible habitats likely to be seagrass communities. =>Intensity negligible as only limited and localised possibility of impacts from sewage discharge and dumping of rubbish. =>Consequences minor if seagrass distributions known and managed. =>Confidence low	E

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
											as there is no data regarding effects of current level of coastal development.	
	Other extractive activities	0									Does not occur	E
	Other non-extractive activities	1	4	6	Habitat structure and function	Northern Coastal pelagic provinces.	5.1	3	**3**	2	Torres Strait has major international shipping lanes through the fishery, shipping occurs throughout the year throughout the TSPF. Possibility of oil spills, introduced pests, collision with slow moving surface dependent species (e.g. turtles, dugongs). Greatest threat to pelagic habitat function, as slow moving species may collide with vessels (turtles). =>Intensity moderate as shipping occurs throughout the TSPF at high traffic level, and is concentrated in a number of ports. =>Consequence moderate for species such as dugong as impact of collision results in injury which may lead to mortality in threatened population. =>Confidence high in frequency of this occurrence is reasonably high.	E
	Other anthropogenic activities	1	4	6	Habitat structure and function	coarse sediments, irregular, hard corals, coastal margin depths	5.1	3	2	1	Recreational / traditional boating, fishing and commercial tourism occurs throughout the year in the TSPF. Greatest potential risk of damage/ removal for the fragile, erect faunal communities associated with productive fishing grounds (e.g. seagrass, hard corals, etc), which become popular recreational locations in waters < 25m. =>Intensity moderate as boating occurs throughout the TSPF and is likely to be concentrated around a number of locations. =>Consequence minor as most interactions of this nature likely to be pelagic. =>Confidence low as it may be difficult to measure the extent of recreational activity impact against a background of natural variation e.g. seasonal disturbance.	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										I
	Fishing	1	3	5	Species composition	North Eastern Transition Inner Shelf	1.1	3	2	1	Fishing occurs in 20% of the designated management area of the TSPF for about 9 months each year; tiger prawns are primary target species however large amounts of bycatch fish species are also caught therefore impacting overall composition of community. =>intensity moderate as fishing is generally focused on suitable prawn habitat over a broader spatial scale =>consequence minor; the level effort in this fishery is lower than that in the NPF where Stobutzki *et al* (2003) were unable to detect differences in species composition or relative abundances of bycatch species between closed and open areas of Groote community, Current CRC Task 1.5 obtaining similar results for TS =>confidence low-no data on community composition	I
	Incidental behaviour	1	3	5	Species composition	North Eastern Transition Inner Shelf	1.1	1	1	2	Occasional line fishing by crew while at anchor during the day. =>intensity negligible as hand-lining occurs in only a few anchoring locations =>consequence negligible as hand-lining by crew is expected to have a negligible impact community composition =>confidence high - logical consideration	I
Direct impact without capture	Bait collection	0									does not occur	I
	Fishing	1	3	5	Species composition	North Eastern Transition Inner Shelf	1.1	2	2	1	Bycatch is high & diverse - escapement of fish through meshes might lower post-capture survival therefore overall species composition might be affected particularly in certain size ranges. =>Intensity minor =>consequence minor - Stobutzki *et al* (2002) unable to detect differences in species composition or relative abundances of bycatch species between closed and open areas of Groote community as a direct of indirect result of fishing. =>confidence low as data unavailable for direct impacts without capture	I
	Incidental behaviour	1	3	5	Species composition	North Eastern Transition Inner Shelf	1.1	1	1	2	Occasional line fishing by crew while at anchor during the day. =>intensity negligible as hand-lining occurs in only a few anchoring locations =>consequence negligible as hand-lining by crew is expected to have a negligible impact community composition =>confidence high -	I

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
											logical consideration	
	Gear loss	1	3	5	Species composition	North Eastern Transition Inner Shelf	1.1	1	1	2	Gear loss is rare but might entangle fish and ghost fish =>Intensity negligible =>consequence negligible as lost nets will be largely buried in the sediment and have little ghost fishing impact as the mesh size is small, therefore impact unlikely to be detectable at the scale of the stock =>Confidence high as it is known that very little gear is lost	I
	Anchoring/ mooring	1	3	5	Species composition	North Eastern Transition Inner Shelf	1.1	1	1	2	Although anchoring occurs daily it generally occurs at anchorages adjacent to island or reefs. There is only occasional anchoring on the trawl grounds during good weather =>Intensity negligible, =>Consequence negligible as the spatial scale of the impact of an anchor on the trawl grounds is negligible =>Confidence high as it is unlikely that community species would be negatively affected by anchoring/mooring.	I
	Navigation/ steaming	1	3	5	Species composition	Northern - Coastal East Cape York	1.1	1	1	1	No impacts by pelagic community members with vessels are recorded. =>intensity negligible =>consequence negligible =>confidence low, no data	I
Addition/ movement of biological material	Translocation of species	1	3	5	Species composition	North Eastern Transition Inner Shelf	1.1	1	3	1	Translocation of species may occur throughout the TS fishery area, through hull fouling, net or anchor entanglement. Translocated organisms have the potential to establish as the majority of fishing areas and ports used are of similar depths and habitat. Many TSP vessels are also endorsed to fish in the NPF and ECOT areas, where the presence of international shipping routes and some introduced species (three species of introduced marine organisms are presently confirmed in the NPF- [Megabalanus tintinnabulum (barnacle), Aeolidiella indica (nudibranch), and Caulerpa taxifolia (algae)], establish a precedence for translocation to occur. The bivalve, black-striped mussel, recently eradicated from Darwin harbour, similarly remains a potentially serious threat to the TSPF. Translocation of species is most likely to change the species composition and trophic structure of the community, directly or indirectly through changing trophic linkages possibly by introducing a foreign competitor or through transmission of disease. No mitigating measures are currently in place. =>Intensity: considered negligible at present. =>Consequence: moderate as there is the potential for impacts to alter population size. =>Confidence scored as low as is not known to what extent trawling in	I

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
											the TS may contributes to the spread of species. No data exists to confirm or refute this risk within the TS fishery.	
	On board processing	1	3	5	Distribution of community	North Eastern Transition Inner Shelf	3.1	1	1	2	Prawn predators (sharks & dolphins) attracted by discarded heads follow the vessel however prawns are frozen whole on Australian TSPF vessels, PNG vessels do head some of their prawn product but to date have only conduct very a limited level of fishing in PNG waters of the TSPZ =>intensity negligible =>consequence negligible as any effects on distribution will be temporary =>confidence high -logical	I
	Discarding catch	1	3	5	Distribution of community	Northern - Coastal East Cape York	3.1	3	2	2	Discarding of catch (mainly bycatch and small amounts of undersized target and byproduct species) attracts scavengers (mainly sharks and dolphins) =>intensity moderate as discarding occurs for extended period over each evening of fishing and over the extent of the fished area =>consequences minor discarding occurs while the vessel is steaming or the vessel is trawling and scavengers feed on or near the surface immediately behind the vessel and changes are temporary =>confidence high as the effects of discarding are well documented	I
	Stock enhancement	0									Does not occur	I
	Provisioning	0									Does not occur	I
	Organic waste disposal	1	3	5	Distribution of community	Northern - Coastal East Cape York	3.1	1	1	2	Disposal of organic waste material (food scraps, sewage) is most likely to impact on the distribution of community members e.g. scavengers =>intensity negligible as there are only small number of vessels over a large spatial area =>consequence negligible as these events are small, localised and scattered and effects on distribution are temporary =>confidence high -logical consideration	I
Addition of non-biological material	Debris	1	3	5	Species composition	Northern - Coastal East Cape York	1.1	1	1	2	Debris could impact the species composition if community members ingested debris causing death =>intensity negligible as fishing vessels are under MARPOL convention and required to store and return all non-biological waste to port or unload it to supply vessels =>consequence negligible as interaction with debris from fishing vessels is highly unlikely =>confidence high consequence is constrained by logical consideration.	I

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
	Chemical pollution	1	3	5	Species composition	Northern - Coastal East Cape York	1.1	1	1	1	Chemical pollution for fishing vessels occurs as oil spills, for anti-fouling, clean chemicals etc. Chemical pollution poses greatest potential risk for the species composition if causes death by ingestion =>Intensity negligible as boats operating under MARPOL and oil spills from fishing vessels would be fairly limited and localised =>consequences negligible =>confidence low as limited data effects of chemicals and reported incidences of chemical spills unknown	I
	Exhaust	1	3	5	Distribution of community	Northern - Coastal East Cape York	3.1	1	1	2	Exhaust from running engines occurs over a large range/scale =>intensity negligible because exhaust considered to have low impact on to have a short term impact air quality =>consequence negligible as birds only potential species likely to be impacted and their mobility reduces likelihood =>Confidence high as the consequence is constrained by logical consideration	I
	Gear loss	1	3	5	Distribution of community	North Eastern Transition Inner Shelf	3.1	1	1	2	Gear loss is rare but lost nets will be largely buried in the sediment causing habitat changes and possibly distribution of community. =>Intensity negligible. =>consequence negligible as impact unlikely to be measurable =>Confidence high, it is known that little gear loss occurs.	I
	Navigation/ steaming	1	3	5	Distribution of community	Northern - Coastal East Cape York	3.1	1	1	2	Navigation / steaming occurs over a large range / scale and introduces noise and visual stimuli into the environment =>intensity negligible as it is unlikely to have a measurable/ detectable impact on distribution of community =>consequences negligible =>confidence high- logical	I
	Activity/ presence on water	1	3	5	Distribution of community	Northern - Coastal East Cape York	3.1	1	1	2	Activity/ presence occurs over a large range / scale and introduces noise and visual stimuli into the environment =>intensity negligible as it is unlikely to have a measurable/ detectable impact on species distribution in pelagic community =>consequences negligible because unlikely to impact on the distribution of species =>confidence high as considered unlikely that activity/ presence would impact on the behaviour/movement of demersal prawns	I
Disturb physical processes	Bait collection	0									Does not occur	I
	Fishing	1	3	5	Distribution of community	North Eastern Transition Inner Shelf	3.1	2	2	1	The trawl gear interacts with the sea bed. Fishing occurs in 20% of the designated management area of the TSPF for about 9 months each year =>intensity minor, although the fishing gear does disturb the sea bed and sediment this disturbance would be small compared with the disturbance	I

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
											to sediments created by the strong tidal currents the prevail in TS =>consequences minor as disturbance of sediment not likely to affect distribution of community from habitat disturbance =>confidence low as little available data	
	Boat launching	0										I
	Anchoring/ mooring	1	3	5	Distribution of community	North Eastern Transition Inner Shelf	3.1	2	2	1	Fishing occurs in 20% of the designated management area of the TSPF for about 9 months each year. Distribution of community most likely to be affected as anchoring occurs on reefs where damage to habitat may result in alteration of species distributions. Risk of sediment suspension low as likely to anchor on 'hard' structures or coarse sands. =>Intensity minor, anchoring over relatively short timeframes. =>Consequence minor as anchoring considered to affect only a very small percentage of the area of the habitat. =>Confidence low, it is unknown to what degree Anchoring/ mooring has affected physical processes in mooring grounds of the TS.	I
	Navigation/steaming	1	3	5	Distribution of community	Northern - Coastal East Cape York	3.1	1	2	1	Fishing occurs in 20% of the designated management area of the TSPF for about 9 months each year => Disturbances of physical processes such as turbulence was considered most likely to affect distribution of community=> pelagic species most likely to be affected and consequence unlikely to be detectable and minor => Confidence was scored as low due as effects unknown.	I
External Impacts (specify the particular example within each activity area)	Other fisheries	1	4	6	Functional group composition	North Eastern Transition Inner Shelf	2.1	3	3	1	Other fisheries occur in the area (TRL, BDM, pearl shell etc) these fisheries are largely dive and lines fisheries =>intensity moderate as there is regular effort through the area of the fishery =>consequence moderate - although catches are diverse throughout the fisheries and relatively small, overfisihng on dugong is likely to be impacting functional group composition =>confidence low Although it is considered unlikely that dive and line fisheries could impact greatly on community composition, impact of invertebrate species unknown	E
	Aquaculture	1	3	6	Species composition	North Eastern Transition Inner Shelf	1.1	1	1	2	There are pearl farms in TS but not within the area of prawn trawling. Sponge farming is being investigated and proposed for reefs close to inhabited islands =>intensity negligible as activities are small and localised =>consequences negligible as it is considered unlikely that these	E

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
											activities would impact community composition unless by way of translocation of diseases =>confidence high as there is no obvious way that pearl farming or sponge aquaculture could impact prawn stocks	
	Coastal development	1	4	6	Species composition	North Eastern Transition Inner Shelf	1.1	1	1	1	No coastline within the fishery and only limited developed on inhabited islands within the fishery =>intensity negligible as only limited and localised possibility of impacts from sewage discharge and dumping of rubbish =>consequences negligible as unlikely to affect species composition =>confidence low as there is no data	E
	Other extractive activities	0									Does not occur	E
	Other non-extractive activities	1	4	6	Species composition	Northern - Coastal East Cape York	1.1	3	3	1	Torres Strait has major international shipping lanes through the fishery - possibility of oil spills and introduced pest =>intensity moderate as it a high risk area for shipping with a high traffic level =>consequences moderate as oil spills could impact species composition particularly of TEP species such as dugong =>confidence low as there is limited data no the long term impacts of oil spills or introduced pests	E
	Other anthropogenic activities	1	4	6	Species composition	Northern - Coastal East Cape York	1.1	2	2	1	Recreational / traditional fishing and boating could impact the environment =>intensity minor as current level of this activity are low and impacts would be localised =>consequences minor as it is unlikely that changes in species composition detectable. =>confidence low, no data	E

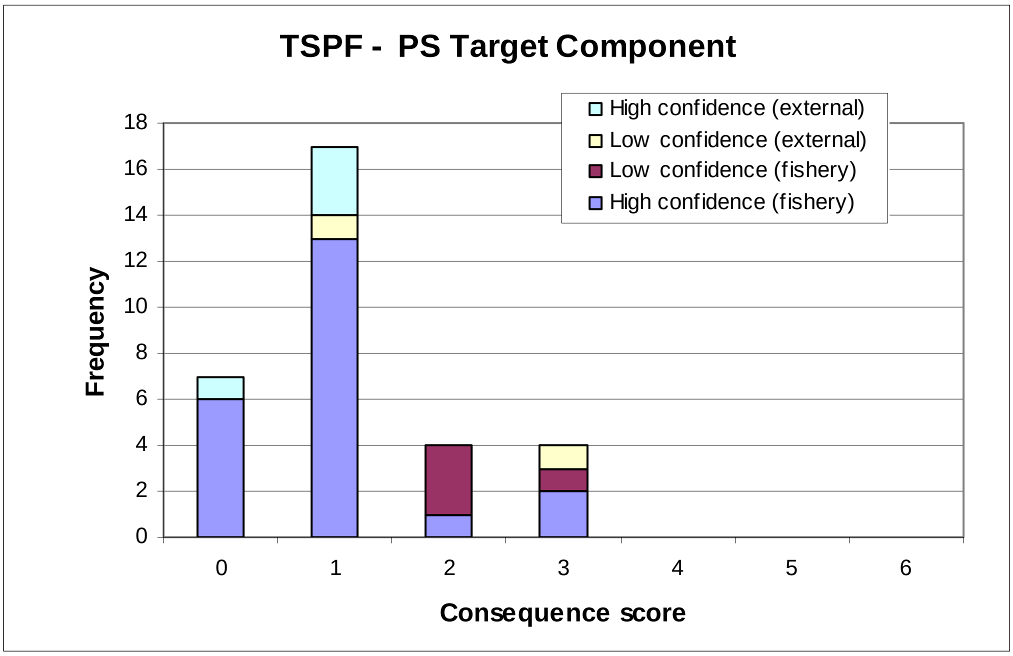
2.3.11 Summary of SICA results

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 (shaded), and differentiating those that did so with high confidence (in bold).

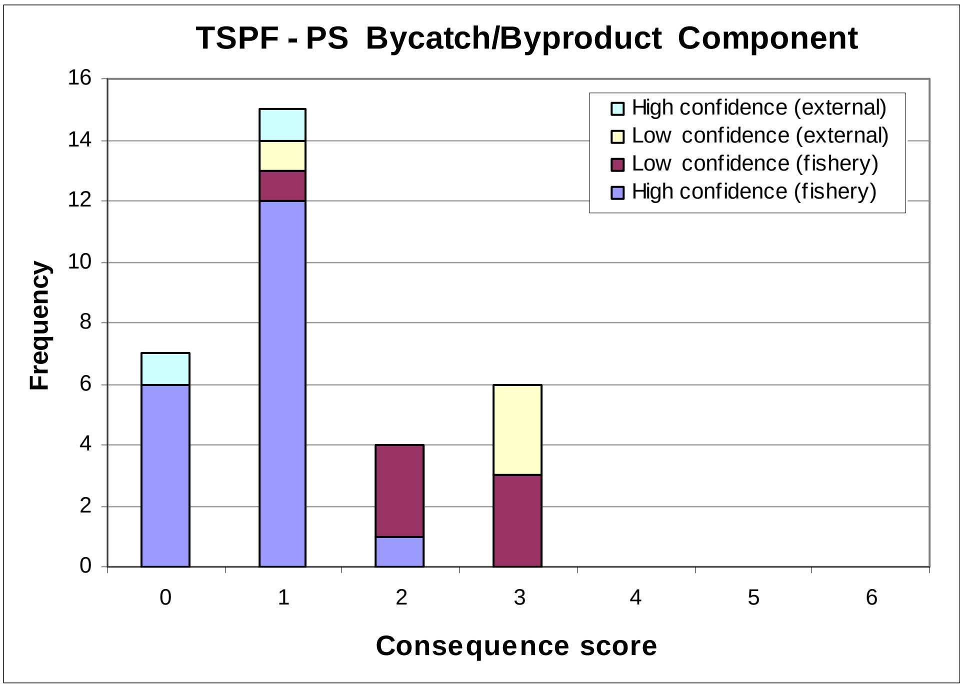
Level 1 (SICA) Document L1.6. Summary table of consequence scores for all activity/component combinations.

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

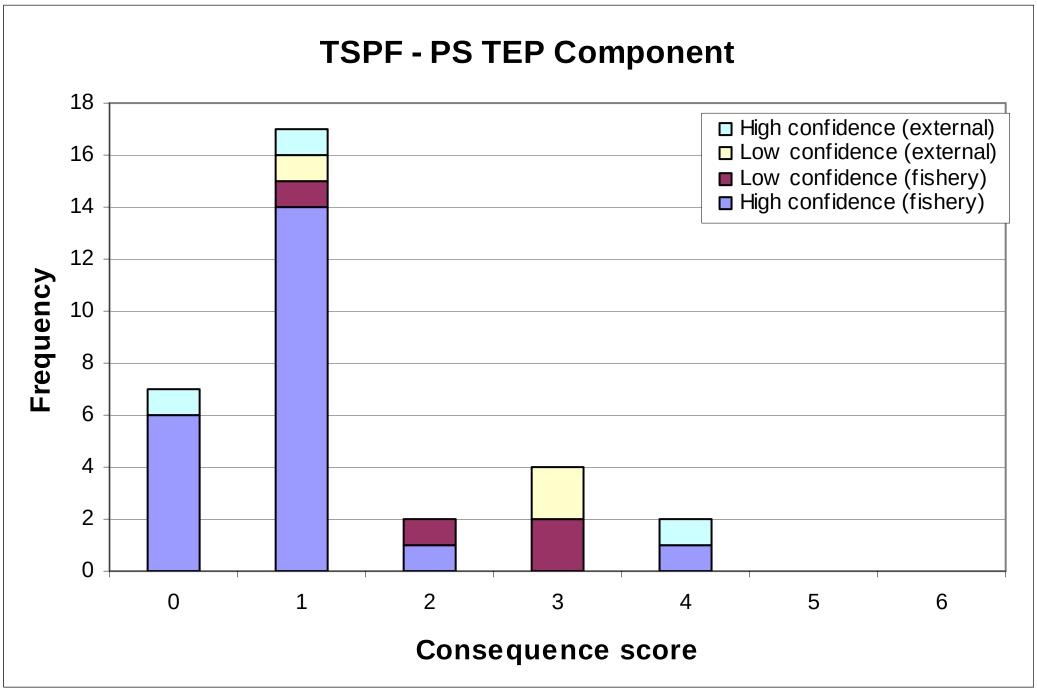
Target species: Frequency of consequence score differentiated between high and low confidence.



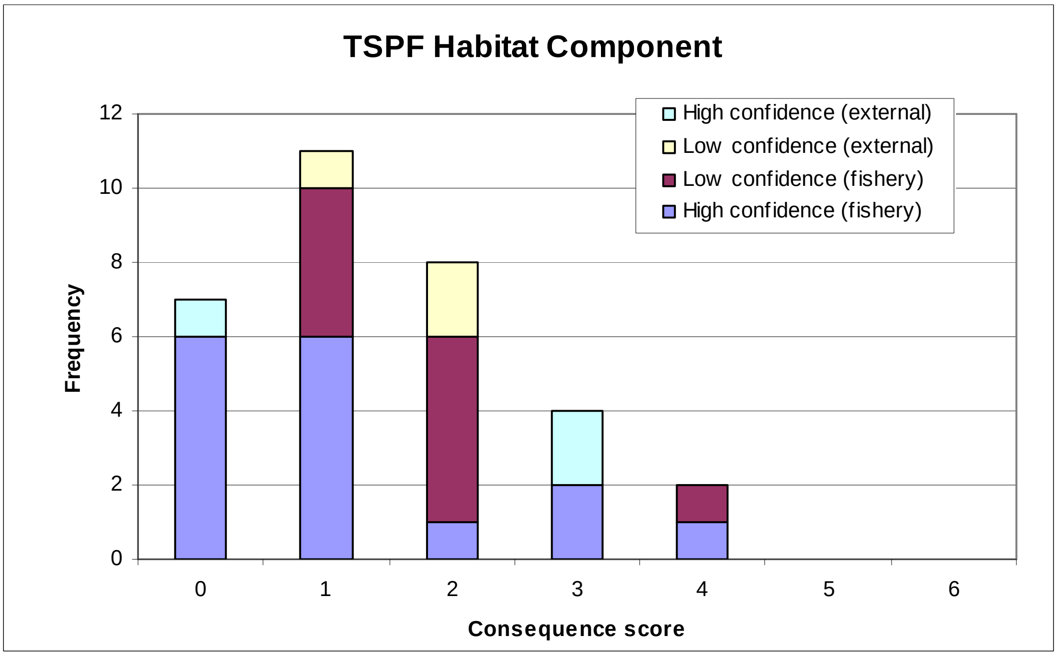
Byproduct and bycatch species: Frequency of consequence score differentiated between high and low confidence



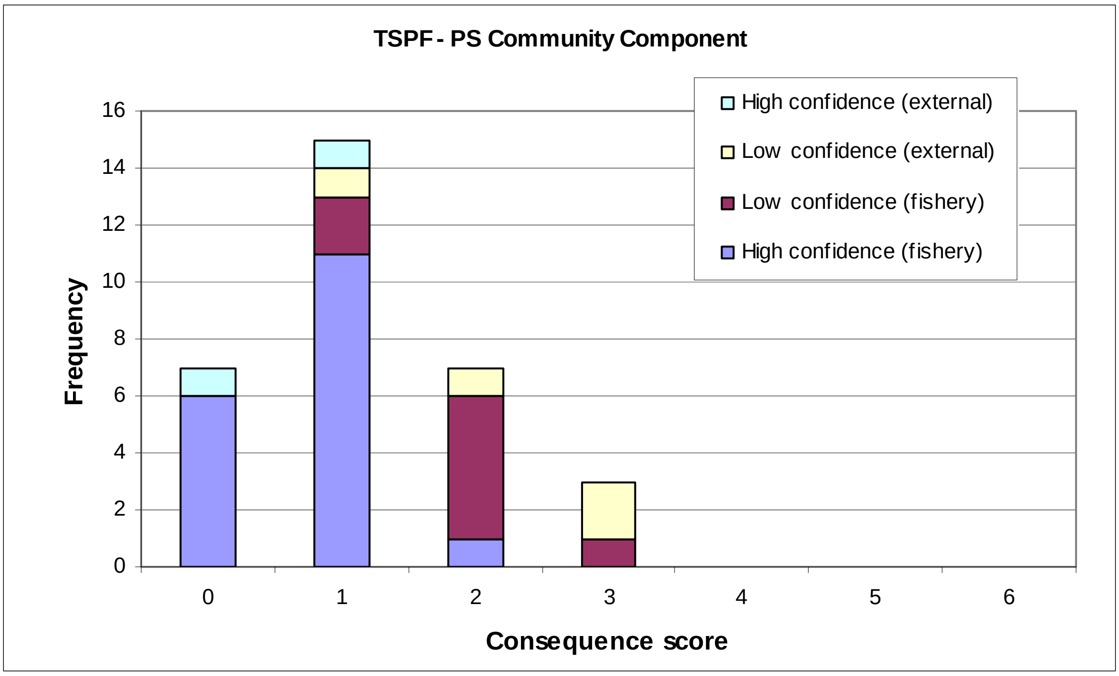
TEP species: Frequency of consequence score differentiated between high and low confidence (SICA excel workbook)



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



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



2.3.12 Evaluation/discussion of Level 1

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

- Fishing capture (Target, Bycatch/byproduct, TEP and Habitat components)
- Fishing without capture (Bycatch/byproduct and Habitat)
- Translocation of species (Target, Bycatch/byproduct, TEP, Habitat and Communities components), and
- Discarding catch (Target, TEP and Habitat).

These remaining internal hazards where assessed at low confidence for the Byproduct and TEP components, but at high confidence for the Target and Habitat components. The exception was the Translocation hazard, which was assessed at low confidence for all components.

Three internal hazards were scored as a major hazard (consequence level 4): Habitat component impact of Fishing capture and Translocation of species; and TEP component impact of Discarding.

The following external hazards contained consequence scores of three or above:

- Other fisheries (Bycatch/byproduct, TEP species, Habitat and Communities)
- Other non-extractive activities (all five components)
- Other anthropogenic activities (Bycatch/byproduct and TEP species).

There are a number of external hazards in the fishery that are likely to be as important, or more important, than those identified from the fishery itself. Translocation of pest species or a major oil spill caused by international shipping potentially poses a greater threat to the Torres Strait environment than the activities associated with the Torres Strait Prawn Fishery. Dugong, turtle and elasmobranches are probably the most at risk TEP species in Torres Strait. Illegal fishing by foreign fishing vessels and traditional fishing activities in Torres Strait could have a much greater impact on these species than the TSPF.

Target

In the case of the target species, fishing (direct capture) was considered to have a moderate impact (consequence level 3) on the brown tiger prawn stocks as the current stock assessments suggest that this species was fully fished during the 1990's. In recent years (2004-05) the level of fishing effort has declined below the estimate of E_{msy} for brown tiger prawns due to a combination of low prawn prices and high fuel costs while catch rates have increased and the annual tiger prawn catch remained stable. The November 2005 reduction in allocated fishing days and voluntary surrender of allocated fishing days to give effect to the cross-boarder fishing arrangements now limits effort in the fishery to E_{msy} (9,200 days for 2006). Fishing effort by Australian operators is currently restricted to 6867 days for 2006.

Discarding of bycatch was also considered to have a moderate impact on the Target component. Discarding of bycatch occurs extensively throughout the fished region, and is known to attract predators. These predators will in turn prey upon the resident prawn population. The effects of discarding of bycatch are well documented in the TSPF.

Translocation was noted as a low confidence but moderate risk activity, with the potential to affect target species population size by introducing a foreign competitor or through transmission of disease, but also directly or indirectly through changing trophic linkages. This risk is increased by the endorsement of TS vessels in other adjacent fisheries, the use of ports known to harbour introduced species (Darwin and Cairns), and the presence of introduced species in the adjacent NPF area. These issues similarly give rise to the moderate risk scores in the Bycatch/byproduct, TEP and Community components also.

Bycatch/byproduct

In the case of bycatch/byproduct species fishing, both capture and direct impact without capture are considered to have a moderate (consequence level 3) impact. Elasmobranches, in general, are considered more susceptible to overfishing than bony fish, but there is likely to be a range of sensitivities among the species (Walker 1998; Stevens *et al*. 2000). Of the species recorded in the TSPF aside from pristids (sawfish), the benthic species (wobbegongs and rays) are likely to be of most concern due to their high susceptibility and little information available to estimate their recovery. The mobility of elasmobranch species also means that they may be impacted by several fisheries (Stobutzki TSFAG Prawn Workshop Report 2001). The consequence were scored as moderate as a precautionary measure although there is no data to suggest these species are impacted by trawl fishing in the TSPF. Our confidence in this assessment is low as data on these species is limited.

Sharks and rays larger than ~1m are excluded from the catch by Turtle Excluder Devices (TEDs), therefore it could be assumed that this has increased their survival rate, however this may not be the case as they may be damaged by contact with a TED. As a precautionary measure, although there is no data to suggest these species are impacted by trawl fishing, the consequence was scored as moderate. Confidence in this assessment is low as there is limited data on survival of these species after passing through the TED.

TEP
In the case of TEP species sea snakes were considered the species mostly likely to be of concern as the survival of sea snakes after trawling has been estimated as 49% (Wassenberg *et al*. 2001). The risk to these species is dependent on the relative proportion of the population taken by trawling, however this is unknown. In the research surveys conducted in Torres Strait the catch rates of sea snakes has been very low and these taxa were rarely identified to species level. The consequence was scored as moderate as a precautionary measure although the available data suggests that sea snake catch rates are low in the TSPF. The confidence in this assessment is low as data on these species is limited. The existing observer program in the TSPF should be used to obtain data on the catch rates and species of sea snakes that occur in the commercial catch.

The discarding of bycatch was assessed as a major hazard (consequence level 4) impacting the TEP Tern species through modification of behaviour and movement. Discarding of high volumes of bycatch occurs after each trawl shot, throughout the nine-month season on the fishing grounds. Scavenging behaviour by terns behind trawlers is a common activity. They are known to continuously follow trawlers to feed on these discards, and may become dependent on discarding as a food source. This in turn has the potential to impact the population dynamics of the terns, and may take some weeks after the close of the season for normal foraging behaviour to return.

Habitat
The Habitat component was assessed to be at major risk of impact by the fishing capture activity, and moderate risk without capture. The prawn trawl-gear footprint is large, and the highly localised nature of the operations may result in severe localised structural modification of susceptible epifaunal and infaunal habitats, with damage and removal particularly of erect, rugose and inflexible octocorals associated with soft muddy substrata. Octocorals that are not removed by prawn trawl gear are also likely to encounter some degree of damage. Although inner shelf habitats may recover relatively quickly, the more structurally complex forms may take many years to recover. These habitat risks were assessed with high confidence due to the availability of data for some species within the Torres Strait region.

Addition/Movement of biological material was assessed as a moderate risk to Habitats through the hazard presented by catch discarding. Accumulation of large volumes of solid biomass, particularly in shallow waters, will alter the substrate quality via changed biogeochemical processes and sediment ecology, and further modify the habitat by the attraction of scavengers and predators. This hazard was assessed at high confidence based on documented data within the Torres Strait and tropical region (Harris and Poiner 1990, Hill and Wassenberg 1990, Wassenberg and Hill 1990)

Translocation of species, particularly through hull fouling, was assessed as a major risk (risk score 4) to Habitat structure and function. Species translocated may establish throughout the Torres Strait Prawn Fishery area, but are particularly likely to affect shallower habitats where they pose a hazard to previously compromised area, by altering pelagic and sediment processes, and displacing existing species. Fishing vessels regularly move between the TSPF and the adjacent NPF and ECOTF water. This hazard was assessed at low confidence as little data exists on the translocation of species by prawn trawlers, but the potential risk associated with this hazard has major consequence due to the potential to alter habitat dynamics.

2.3.13 Components to be examined at Level 2

No Level 2 analysis has been conducted for the Torres Strait Prawn Fishery. Level 1 assessment for the 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 Torres Strait Prawn Fishery as part of the Stage 2 ERAEF 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 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).

<u>Species</u>

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.

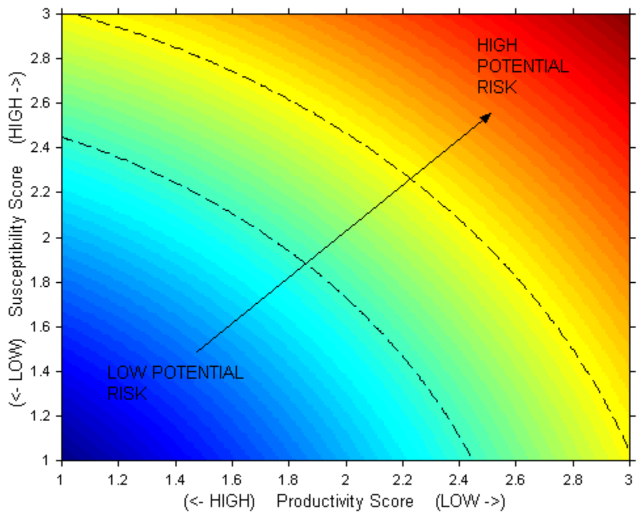


Figure 13. The axes on which risk to the ecological units is plotted. The *x*-axis includes attributes that influence the productivity of a unit, or its ability to recover after impact from fishing. The *y*-axis includes attributes that influence the susceptibility of the unit to impacts from fishing. 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 (2006).

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

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

Observer data and observer expert knowledge are important sources of information in the PSA analyses, particularly for the bycatch and TEP components. The level of observer data for this fishery is regarded as low. In 2005 AFMA initiated an industry/Government joint-funded observer program to collected data on target species, bycatch and interactions with TEP species, but prior to this, no observer reporting occurred.

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 specie s 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

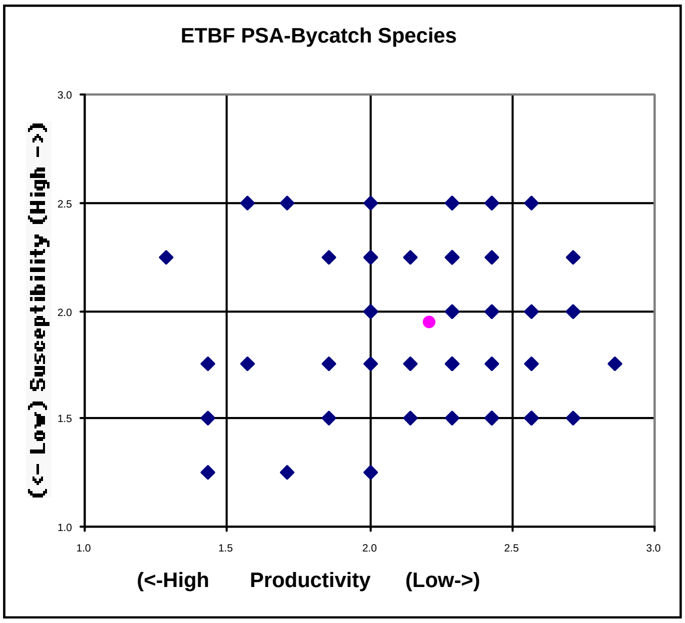
A summary of the habitats considered at Level 2 is presented below, and is sorted by the overall risk score (high, medium, low), by sub-biome, and by SGF score (Habitat type).

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	Rational e

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)**.

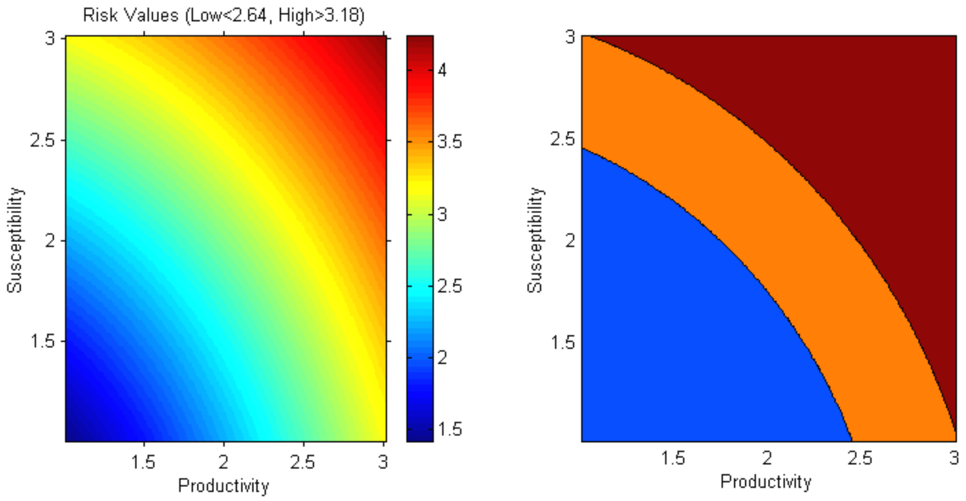


Figure 17. Overall risk values in the PSA plot. Left panel. Colour map of the distribution of the euclidean overall risk values. Right panel. The PSA plot contoured to show the low risk (blue), medium risk (orange) and high risk (red) values.

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.

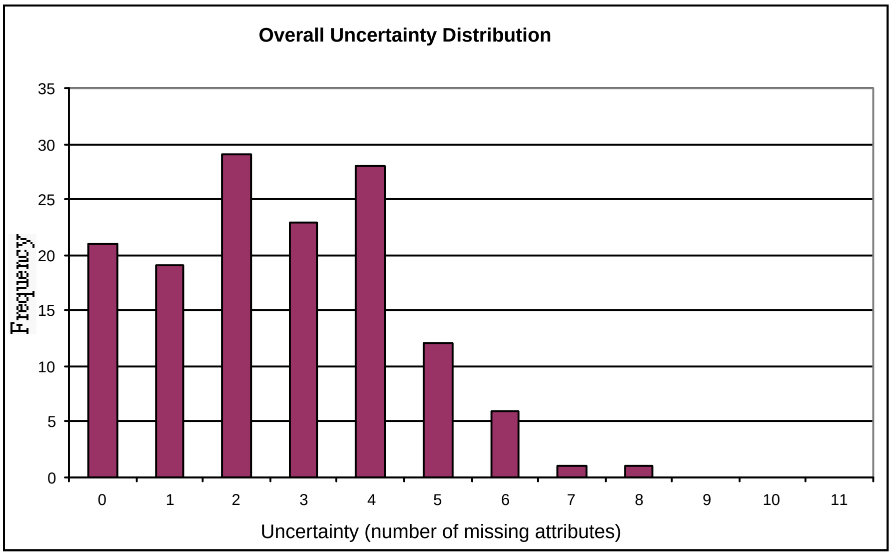
Summary of the success of obtaining information on the set of productivity and susceptibility attributes for the species. Where information on an attribute was missing the highest score was used in the PSA.

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	Encounter ability		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.

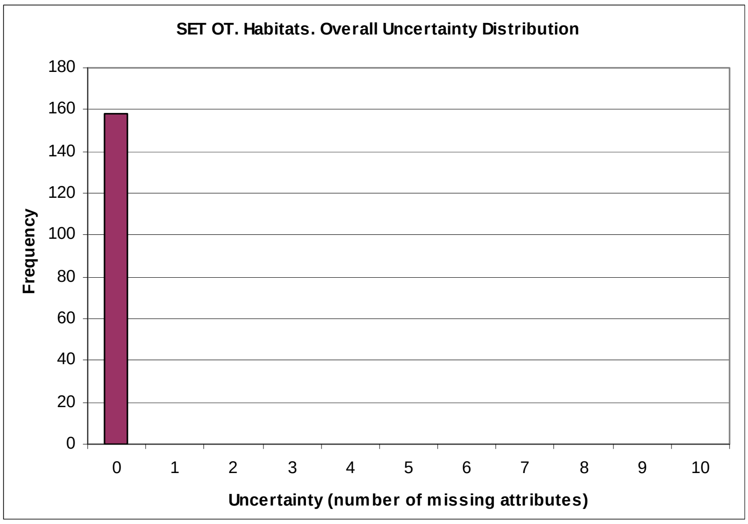
Results Overall uncertainty distribution in PSA workbook ranking graphs worksheet

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 were used in the habitat PSA. All attributes were scored according to Habitat attribute tables 9-27. Only attributes that could be ranked were 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

<u>Correlation between attributes</u>
In situations where attributes are strongly correlated only one of them should be included in the final PSA (Turnbull *et al*., 2001).

Species component:
The attributes selected for productivity were often strongly correlated (as per correlation matrix below for productivity). The strongest productivity attribute correlation was between fecundity and reproductive strategy. This is why the attributes for productivity are averaged, as they are all in turn correlated with the intrinsic rate of increase (see *ERAEF: Methodology* document for more details). In contrast the susceptibility attributes were less correlated, which is to be expected as they measure independent aspects of this dimension, and are multiplied to obtain the overall susceptibility score. The strongest susceptibility correlation was between encounterability and selectivity, while the rest were very weak (see matrix below).

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

	Age at maturity	Max age	Fecundity	Max size	Min size at maturity	Reproductive strategy	Trophic level
Age at maturity	X						
Max age		X					
Fecundity			X				
Max size				X			
Min size at maturity					X		
Reproductive strategy						X	
Trophic level							X

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

	Availability	Encounterability	Selectivity	Post-capture mortality
Availability	X			
Encounterability		X		
Selectivity			X	
Post-capture mortality				X

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.

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

Productivity Correlation Matrix	Regeneration of fauna	Natural disturbance
Regeneration of fauna	X	
Natural disturbance	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.

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

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 species unit.

Productivity and Susceptibility Values for Habitat units.

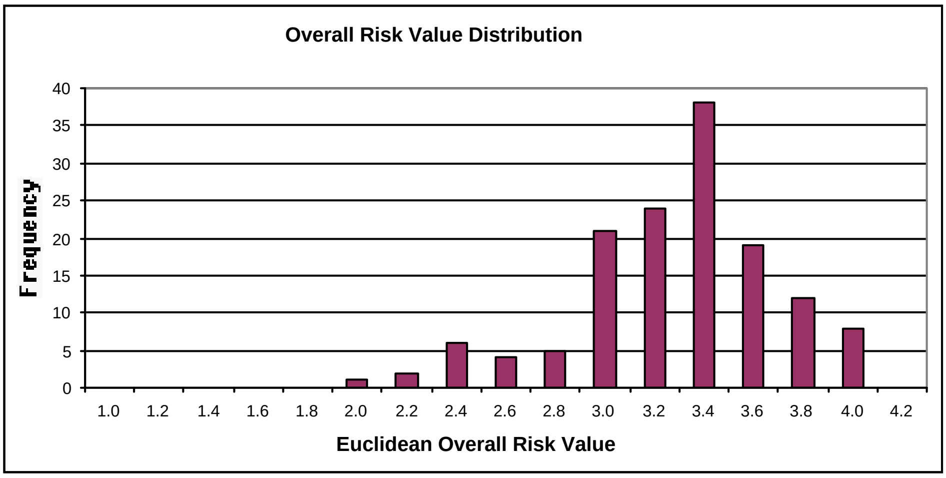
The average productivity score for all habitats was [X ± Y] (mean ± SD of scores calculated using n-1 attributes) and the mean susceptibility score was X (as per summary of average productivity and susceptibility scores as below). Individual scores are shown in Summary of PSA results (above). The small/large 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 habitat 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 *Summary of PSA results* (above). 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

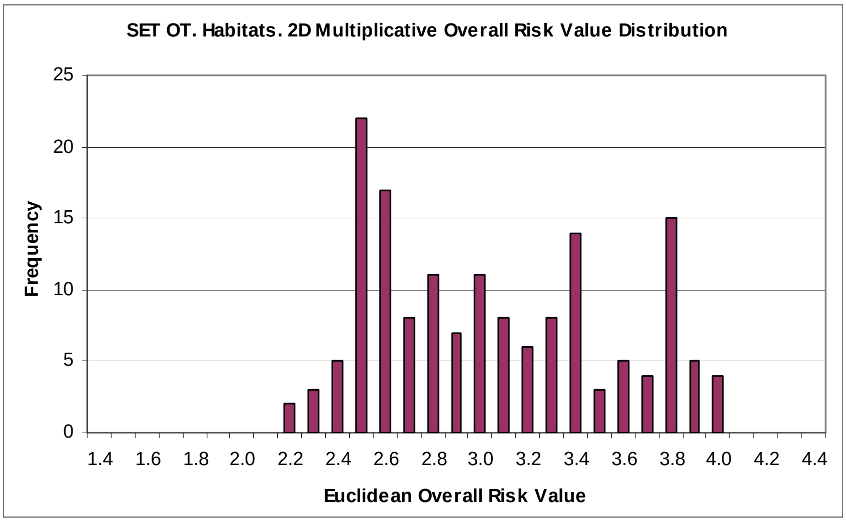
Frequency distribution of the overall risk values generated for the [X units] in the [fishery sub-fishery] PSA.



<u>Overall Risk Values for Habitats</u>

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**.**

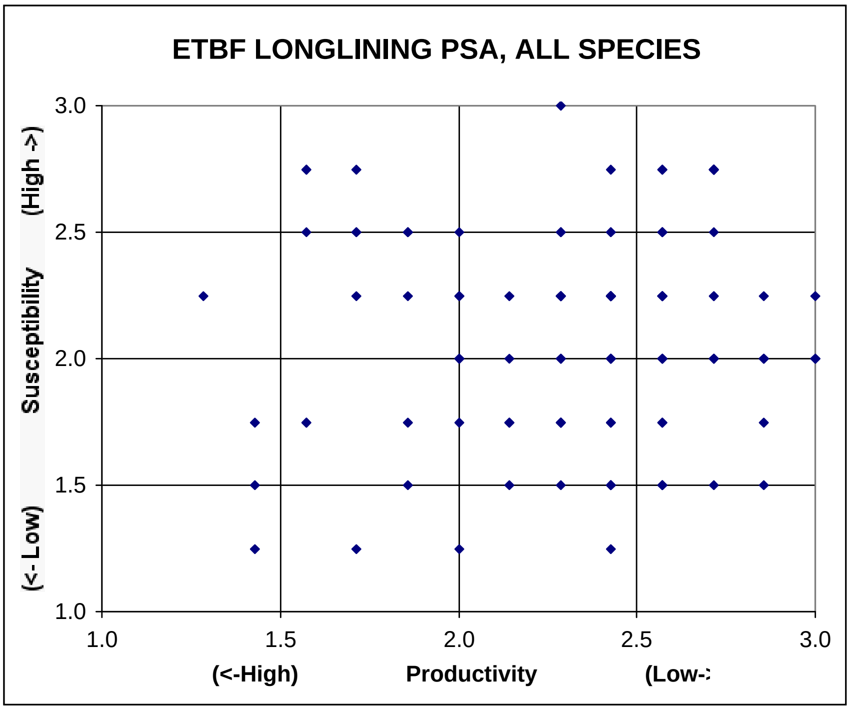
Frequency distribution of the overall risk values generated for the [X] habitat types in the [fishery sub-fishery] PSA.



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 (Paste frequency distribution histogram from workbook ranking sheet here. Example below)

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.

2.4.6 Evaluation of the PSA results (Step 6)

No PSA has been produced for the Torres Strait Prawn Fishery during Stage 2 of the ERAEF process.

Species components:
<u>Overall</u>

<u>Results</u>

<u>Discussion</u>

Habitat components:
<u>Overall</u>

<u>Results:</u>

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.

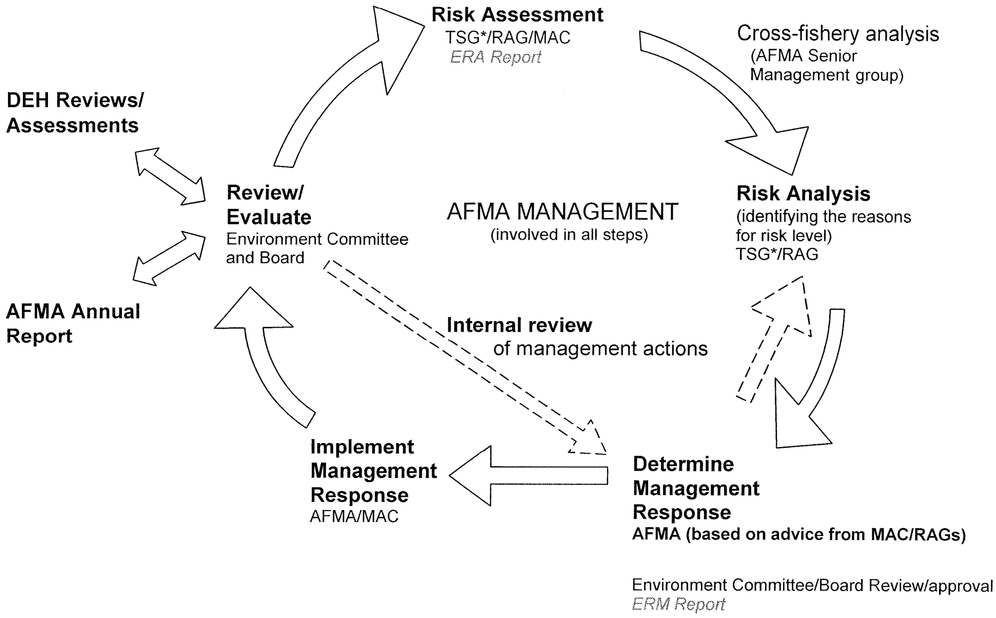
For example, if in a Level 2 analysis of habitat types, two of seven habitat types were determined to have risk from the sub-fishery, only those two habitat types would be considered at Level 3.

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

Level 3 analyses have not been undertaken for species, habitats or communities associated with the Torres Strait Prawn Fishery as part of this ERAEF process.

3. General discussion and research implications

The Torres Strait Prawn Fishery (TSPF) is an international multi-species prawn fishery that operates in the eastern section of the Torres Strait Protected Zone and the Australian “Outside but near” area. The fishery includes regions within PNG waters (north of the Fisheries Jurisdiction Line), Australian waters (south of the Fisheries Jurisdiction Line within the TSPZ), the Australian outside but near area (the area between the TSPZ and the ECOTF) and the Australian Territorial Waters around Pearce Cay and Bramble. All trawling occurs on the continental shelf in waters between 12 and 88 metres depth. There are currently 61 licensed vessels, although 7 are inactive, with a current cap of 9,200 fishing days effort, of which 6,867 are avialible to the Australian operators and the remainder set aside to meet the PNG treaty obligations.

Prawn Fishing operations occur between March 1 and December 1, and use Otter trawl gear, mainly with a quad gear configuration as opposed to the predominant twin gear used in the Norhtern Prawn Fishery. Mesh size and ground chain weight restrictions apply and all nets must be fitted with an approved TED’s and BRD’s. Ten target species are caught with the main species being Brown tiger, Blue endeavour and Red spot king prawns. All by- catch is discarded.

There are no quotas set for the TSPF. The fishery is managed through input controls; limited entry, effort restrictions, vessel and gear restrictions, and a system of seasonal spatial and temporal closures apply. An Observer Program was initiated in 2005 to collected data on target species, bycatch and interactions with TEP species. No previous Observer data is available for this fishery.

Most TSPF vessels are also endorsed to fish the ECOTF, and some are endorsed to fish in the NPF. As such, vessels move between fisheries during the season. In the past product was generally unloaded to, and supplies obtained from, mother ships with some vessels only returning to port at the end of the season. This trend however is changing and more vessels are traveling between Torres Strait and Cairns during the season to unload and obtain supplies to reduce mother shipping costs.

3.1 Level 1

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

- Fishing capture (Target, Bycatch/byproduct, TEP and Habitat components)
- Fishing without capture (Bycatch/byproduct and Habitat)
- Translocation of species (Target, Bycatch/byproduct, TEP, Habitat and Communities components), and
- Discarding catch (Target, TEP and Habitat).

These remaining internal hazards where assessed at low confidence for the Byproduct and TEP components, but at high confidence for the Target and Habitat components. The exception was the Translocation hazard, which was assessed at low confidence for all components.

Three internal hazards were scored as a major hazard (consequence level 4): Habitat component impact of Fishing capture, and Translocation; and TEP component impact of Discarding.

Significant external hazards included:

- Other fisheries (Bycatch/byproduct, TEP species, Habitat and Communities)
- Other non-extractive activities (all five components)
- Other anthropogenic activities (Bycatch/byproduct and TEP species).

3.2 Level 2

Level 2 assessment has not been carried out for the Torres Strait Prawn Fishery as part of the Stage 2 ERAEF process.

3.3 Key Uncertainties / Recommendations for Research and Monitoring

In assessing risk to byproduct, bycatch and TEP species, it is not possible to assess absolute risk without supplementary information on either abundance or total mortality rates, and such data are not available for the vast majority of these species. However it may be possible to draw inferences from information that may be available for some species, either from catch records of occurrence from other fisheries, from fishery independent survey data, or from examination of trends in CPUE from observer data. Such data should be sought and examined for the high risk species identified in this analysis.

To address the risk of Translocation of species, it is recommended that current industry or management initiatives be considered, through consulting:

- Department of Agriculture, Fisheries and Forestry (DAFF) “National system for prevention and management of marine pest incursions” document, (scheduled for release in October 2006);
- Food and Agriculture Organisation (1995) precautionary approach documents; and/or
- Bureau of Rural Sciences (BRS) recommendations for risk reduction with regard to introduced marine pests (Summerson and Curran 2005).

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

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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
April 2007	Query from AFMA	Given the high translocation scores in the CSF, and the similarity in conditions for the TS and NPF, Translocation scores for the TSP need to be reviewed.	All ecological components were reassessed for Translocation risk. Due to the endorsement of TSP vessels in the NPF and ECOT, the presence of 3 introduced species already established in the NPF *Megabalanus tintinnabulum* (barnacle), *Aeolidiella indica* (nudibranch), and *Caulerpa taxifolia* (algae)], the recent need to eradicate black-striped mussel from the Darwin harbour, and the use by TSP vessels of Cairns port (also known to harbour introduced species), it was considered that the potential for translocation was a moderate risk to the TSPF. The Habitat component was previously scored at major risk. The remaining components have now been re-scored at moderate risk.

See section 2.1 for Stakeholder involvement

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 Torres Strait Prawn fishery.

Appendix C: SICA consequence scores for ecological components

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

(Modified from Fletcher *et al*. 2002)

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