Northern Territory Trepang Fishery

Ecological risk assessment

2021

NORTHERN TERRITORY GOVERNMENT

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Acronyms	Full form
CITES	Convention on the International Trade in Endangered Species of Wild Flora and Fauna
DITT	Department of Industry, Tourism and Trade
EBFM	Ecosystem-Based Fisheries Management
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
ERA	Ecological Risk Assessment
ESD	Ecologically Sustainable Development
Fisheries Act	*Northern Territory Fisheries Act 1988*
Fisheries Regulations	*Northern Territory Fisheries Regulations 1992*
NT	Northern Territory
TEPS	Threatened, Endangered and Protected Species
The Fishery	Trepang Fishery

Contents

List of figures

List of tables

1 Executive Summary

This report summarises the outcomes of an Ecological Risk Assessment (ERA) conducted on the Northern Territory (NT) Trepang Fishery in February 2021 ("trepang" being the historical name used to refer to dried sea cucumber). The assessment was undertaken to identify the ecological risks posed by the Fishery in order to inform the future management of the NT sea cucumber resource.

This report provides background information on the Fishery as well as information used to inform the ERA process. Risks associated with the Fishery were first assessed through an independent expert workshop and then circulated to stakeholders for consideration.

Seventeen components relating to the fishery were identified and assessed to enable future management decisions to be targeted at the correct unit of management (i.e. the biological or ecological unit). The fishery was found to present a 'negligible risk' to the majority of components examined, with the exception of ecosystem function which was identified as 'low risk' and Sandfish identified as 'moderate risk'.

2 Introduction

The impacts of the NT Trepang Fishery on the broader marine environment have been assessed on five occasions since 2004 (DAWE, 2020). These assessments, while very thorough, did not explicitly document the likelihood and consequence of particular events occurring. This report is the first ERA on the NT Trepang Fishery. This assessment follows the National Ecologically Sustainable Development reporting framework, 'How to' Guide of Fletcher et al. (2002).

The Department of Industry, Tourism and Trade (DITT) utilises an Ecosystem-Based Fisheries Management (EBFM) approach to consider relevant ecological, social, economic and governance issues, in accordance with *Guidelines for implementing the Northern Territory Fisheries Harvest Strategy Policy*[1]. ERAs are undertaken periodically to assess the impacts of a fishery's activity on all different components of the marine environment in which they operate. The ERA process identifies not only contemporary risks of harvesting activities on species by all fishery sectors but also the broader impacts of the activities on the environment (general ecosystem). Outcomes of risk assessments are used to inform EBFM-based harvest strategies and to prioritise Departmental monitoring, research and management activities (Fletcher et al. 2010; Fletcher, 2015).

The principles of Ecologically Sustainable Development (ESD) are the basis of aquatic resource management in the NT. The *Northern Territory Fisheries Act 1988*[2] (Fisheries Act) describes ESD as "the use, conservation, development and enhancement of the community's resources so that ecological processes, on which life depends, are maintained and the total quality of life, now and in the future, can be increased". The Fisheries Division of DITT is responsible for the management of fish and fisheries under the Fisheries Act. The outcomes of the ERA support ESD by providing a basis to address identified impacts on target species, bycatch, habitats and potential indirect impacts on the broader ecosystem (Fletcher, 2002).

This report provides background information on the Fishery, including a summary of the management history, the risk assessment methodologies used, as well as the rationale behind the assigned risk levels in the Fishery. These risk ratings will be used to inform the management of the Fishery with the ultimate aim of continued ecologically sustainable development of the resource.

[1] https://industry.nt.gov.au/__data/assets/pdf_file/0009/386442/fisheries-harvest-strategy-policy-guidelines.pdf
[2] https://legislation.nt.gov.au/en/Legislation/FISHERIES-ACT-1988

3 Background

3.1 Management history of the Trepang Fishery

Northern Australian Trepang fisheries date back to the early 1700s, when Macassans from Celebes (Sulawesi Island group, Indonesia) visited northern Australia to fish for sea cucumbers. The history of the Fishery is outlined in Table 1.

Table 1. Chronology of management of the Trepang Fishery.

Date	Management Arrangements
1907	The South Australian Government ceased issuing licences to Macassans, possibly due to the emergence of a local industry. Landing reports, although scant, suggest that the catch was many times higher than current levels.
Mid 1900s	A lower level of commercial exploitation continued within the Fishery. Little fishing activity was observed, with virtually no reported exports. Commercial fishers were generally European Australians assisted by Aboriginal people who inhabited the remote coastlines.
1992	Increasing interest led to the re-opening of the Fishery. Under the *Northern Territory Fisheries Regulations 1992*[3] (Fisheries Regulations) the Trepang Fishery was declared as the area extending seaward from the high water mark of the coastline to an imaginary line 3 nautical miles seaward from the baseline. Six licences were issued. Two management areas were established: east of Cape Grey to the Queensland border and west of Cape Grey to the Western Australian border.
1999	The introduction of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) requires an approval for the export of trepang (Part 13A).
2004	A catch trigger limit set at 640 tonnes. The first assessment of the Fishery against Part 13A of the EPBC Act was undertaken and resulted in the Fishery being declared an approved Wildlife Trade Operation (WTO). The WTO accreditation permits the export of sea cucumbers. The assessment made a number of recommendations including development of sustainable yield estimates for the Fishery and implementation of management measures (such as trigger limits) to mitigate the risk of localised depletion.
2007	A second assessment of the Fishery was undertaken, which included the introduction of an annual trigger limit of 300 t. The annual trigger limit was introduced as an interim measure while further information was gathered to determine accurate sustainable yield estimates. At this time, a trigger limit of 300 t was considered significantly precautionary but practical.

[3] https://legislation.nt.gov.au/en/Legislation/FISHERIES-REGULATIONS-1992

Date	Management Arrangements
2015	Following a proposal to extend the area of the Fishery, an independent review recommended a staged approach to expanding the boundary of Fishery. Initial stages were to extend the boundary of the fishing area out to the Australian Fishing Zone (200 nm). From 15 June to 31 December a research permit (section 17 permit under the Fisheries Act) was issued to determine stock distribution and sustainable harvest for sea cucumber in waters of the NT from 3 nautical miles (nm) to 200 nm.
2016	Grid-catch limits were implemented to the Fishery as a measure to mitigate localised depletion, creating a total allowable catch of 246 t amongst 32 grids. Grid-based catch limits were determined by the average catch over the last 20 years, excluding nil efforts. The most recent assessment in 2016 resulted in the Fishery being declared an approved WTO and exempt from the export regulations of the EPBC Act for a period of 10 years, until 2026.

3.2 Description of the Fishery

The NT Trepang Fishery operates in waters extending seaward from the high water mark to an imaginary line 3 nm seaward from the baseline (i.e. the NT coastline and surrounding islands). The majority of fishing effort is spread along Arnhem Land coast, with the primary harvest areas being Cobourg Peninsula and Groote Eylandt.

The Fishery reports catch by grids (recording latitude and longitude), traditionally a 60 x 60 nm grid, which equates to one degree of latitude by one degree of longitude. There are 32 grids within the Fishery, with each grid having specified catch limits (seen in Figure 1). Sea cucumber catches have only been reported from 18 of the 32 grids that constitute the Fishery.

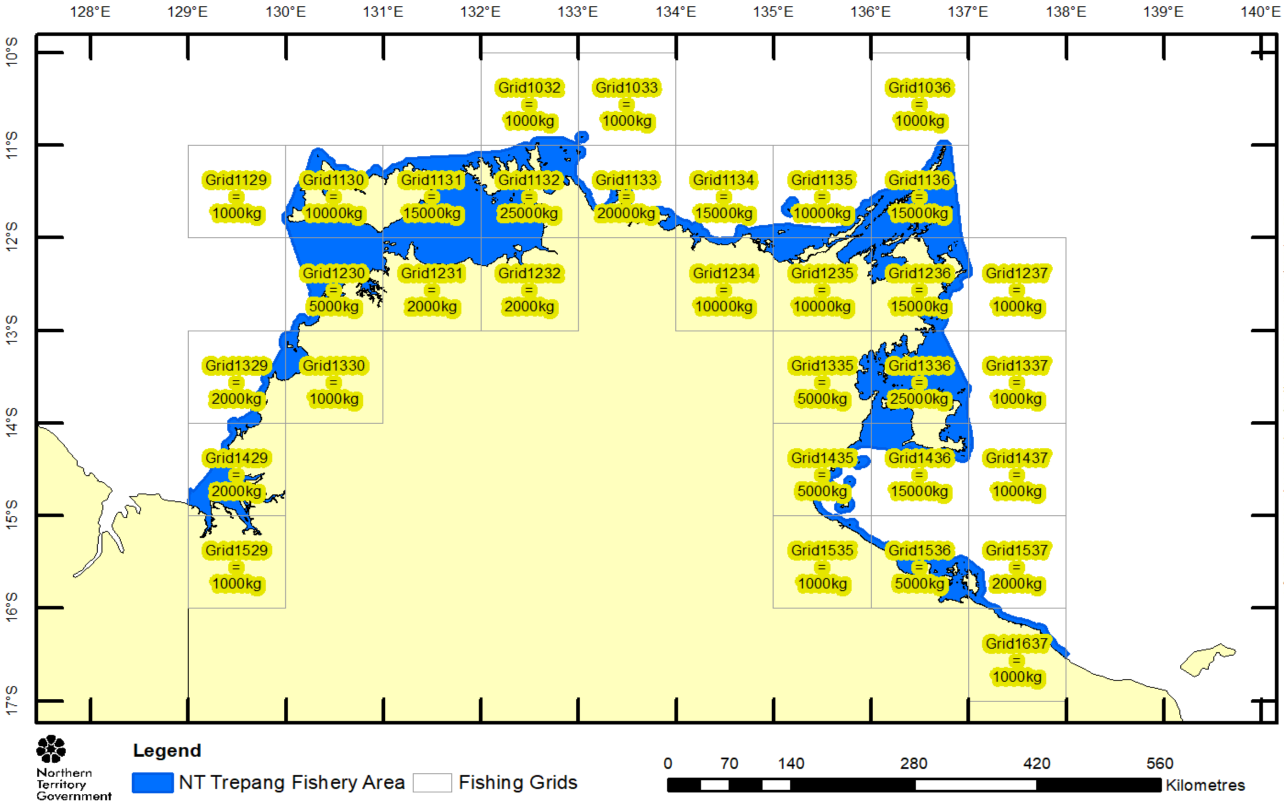

Figure 1. Area of the Trepang Fishery in the Northern Territory showing grid locations and catch limits.

3.2.1 Fishing method

Licensees are permitted to hand harvest, which includes the use of SCUBA (Self-Contained Underwater Breathing Apparatus) and hookah. Any other method of collection is prohibited under Regulation 137 of the Fisheries Regulations.

Commercial operators can use a maximum of nine assistants under the licence of which only four can be divers. Licences can use up to four tenders (not exceeding seven metres in length) from a mothership.

3.2.2 Resource sharing

The National Recreational and Indigenous Fishing Survey (Henry & Lyle 2003), which was conducted by the Fisheries Research and Development Corporation during 2001, estimated the recreational and indigenous harvest of sea cucumber in the Territory to be negligible, with nil reports from either sector. There are no bag limits or other restrictions on sea cucumber take for non-commercial fishers.

3.2.3 Retained species

The Trepang Fishery is a multi-species fishery which allows the harvest of six species of sea cucumbers (seen in Table 2). The Fishery primarily targets Sandfish (*Holothuria scabra*). Over the last 10 years, Sandfish have contributed 100 per cent of the total harvest of all sea cucumbers by commercial operators.

Table 2. Target species in the Trepang Fishery.

Common name	Scientific name
Sandfish	*Holothuria scabra*
Lollyfish	*Holothuria atra*
Black Teatfish	*Holothuria whitmaei*
White Teatfish	*Holothuria fuscogilva*
Deepwater Redfish	*Actinopyga echinites*
Prickly Redfish	*Thelenota ananas*

3.2.4 Non-retained species

There is no reported bycatch due to the highly selective nature of hand harvesting.

3.2.5 Threatened, Endangered and Protected Species

There have been no reported interactions with Threatened, Endangered and Protected Species (TEPS) due to the highly selective method of harvesting in the Fishery. Fishers are required to report all TEPS interactions through mandatory daily catch and effort log book returns.

3.2.6 Conservation Status

3.2.6.1 Convention on International Trade in Endangered Species of Wild Flora and Fauna Listing

The Convention on International Trade in Endangered Species of Wild Flora and Fauna (CITES) lists White Teatfish (*H. fuscogilva)* and Black Teatfish (*H. whitmaei)*. The effort to regulate trade across borders requires international cooperation to safeguard particular species from over-exploitation.

The only record of CITES listed species being harvested in NT waters was through the use of research permits that enabled exploratory diving outside the boundary of the Fishery in 2015. Under these research permits, it was been reported that Black and White Teatfish were harvested. There have been no teatfish reported as catch within the Fishery for the last 10 years.

3.2.6.2 IUCN Red List

The International Union for Nature Conservation (IUCN) Red List of Threatened Species is an international list which provides information of species taxonomy, conservation status and distribution. A comprehensive assessment of sea cucumber was undertaken in 2010, resulting in 16 species being classified as threatened. Six of these species, which the Fishery is licensed to collect, are listed on the IUCN Red List as either endangered or vulnerable. IUCN classifications are based on a global status of species including developing countries where over exploitation is common. Sea cucumber populations around mainland Australia are not endangered or vulnerable and this is reflected in IUCN assessments of these populations.

3.3 Legislation

The Fisheries Act provides the broad statutory framework to conserve and manage the aquatic resources of the NT. In the administration of the Fisheries Act, the Minister responsible for Fisheries must pursue the following objectives, outlined in section 2A:

a) to manage the aquatic resources of the Territory in accordance with the principles of ecologically sustainable development, whether managing a single fish species or an ecosystem, to ensure the promotion of appropriate protection of fish and fish habitats;

b) to protect the environment, people and economy of the Territory from the introduction and spread of aquatic pests and diseases;

c) to maintain a stewardship of aquatic resources that promotes fairness, equity and access to aquatic resources by all stakeholder groups, including:

   (i) Indigenous people; and
   (ii) commercial operators and aquaculture farmers; the commercial fishing, aquaculture and fishing tourism industries; and
   (iii) amateur fishers; and
   (iv) others with an interest in the aquatic resources of the Territory; and

d) to promote the optimum utilisation of aquatic resources to the benefit of the community.

Subordinate to the Fisheries Act are the Fisheries Regulations that detail the amateur and commercial controls for the Trepang Fishery.

3.4 Current management controls

The commercial sector of the Trepang Fishery is managed using a combination of input and output based management controls. Controls for the Trepang Fishery are contained within the Fisheries Regulations and through licence conditions. Commercial licence controls are detailed in Table 3.

3.4.1 Commercial

Table 3. Summary of current management controls in the commercial sector of the Trepang Fishery.

Management tool		Instrument
Catch-grid limits	• Individual catch limit per grid equating to the total allowable catch of 246 t whole weight (kg).	Licence condition
Limited entry	• Number of commercial licences capped at six.	Fisheries Regulations
Spatial restrictions	• Licensees are restricted to waters within 3 nm of high water mark • Grid-based catch limits (32 grids).	Fisheries Regulations Licence conditions

Management tool		Instrument
Method restrictions / Permitted gear	• Harvesting by hand collection only • Limitations on the number of assistants under each licence with a maximum of nine assistants, including four divers. • A maximum of four tenders are permitted under a licence.	Fisheries Regulations Licence conditions
Minimum size targets	Size limits for target species: • Sandfish: 16cm • Lollyfish: 15cm • Black Teatfish: 26cm • White Teatfish: 32cm • Deepwater Redfish: 12cm • Prickly Redfish: 30cm	Licence conditions

3.4.2 Recreational and Fishing Tour Operator

There are no known records of recreational fishers or Fishing Tour Operator clients harvesting sea cucumber within the NT. Consequently, there are no possession limits or other restrictions imposed on the take of sea cucumber by recreational or Fishing Tour Operator clients.

3.4.3 Aboriginal

3.4.3.1 Customary take

Under section 53 of the Fisheries Act, Aboriginal people, who have traditionally used the resources of an area of land or water in a traditional manner, are entitled to continue using those resources in that manner.

3.4.3.2 Commercial

Commercial participation by the Aboriginal sector is through either the purchase of a licence in a commercial Fishery, or an Aboriginal Coastal Licence. Aboriginal Coastal Licences are a low cost, small scale commercial fishing licence available to Aboriginal people living on Aboriginal land. Proposed changes to the Fisheries Regulations will provide the opportunity for Aboriginal Coastal Licensees to harvest and sell managed species, including trepang. The take of trepang by Aboriginal Coastal Licensees will be managed through licence conditions and assessed on a case-by-case basis through an application to the Director of Fisheries.

3.4.4 Aquaculture

3.4.4.1 Ranching

Ranching is the release of cultured juveniles into unenclosed marine and estuarine environments for harvest at a larger size. Ranching is designed to be a ‘put and take’ operation where the released animals are not considered to be part of the wild sea cucumber stock or expected to contribute to spawning biomass, although this may occur when harvest size exceeds size at first maturity or when not all the released animals are harvested.

Under the DITT 'Fisheries Enhancement, Ranching and Restocking Policy' ranching is classified as an aquaculture venture, with only small scale trials currently underway in the NT. As such, ranching was not assessed as part of this ERA.

3.4.4.2 Stock enhancement

Stock enhancement is the release of cultured juveniles into wild populations(s) to augment the natural supply of juveniles and optimise harvests by overcoming recruitment limitation.

DITT has received interest from parties to explore stock enhancement in the NT, however at the time of this assessment there was no stock enhancement taking place in the Fishery. If this activity was to occur in the Fishery, a specific risk assessment would be undertaken to assess potential risks posed by stock enhancement. As such, stock enhancement was not assessed as part of this ERA.

3.4.5 Marine Protected Areas

There are two marine protected areas that overlap with the Fishery, the Garig Gunak Barlu National Park and the Limmen Bight Marine Park.

The Garig Gunak Barlu National Park extends over water and land, encapsulating the former Garig National Park and Cobourg Marine Park. The sanctuary extends to the low water mark and includes the intertidal zone and waters covering the peninsula, whilst the Marine Park extends seaward from the low water mark. Areas where hand harvesting of sea cucumber can occur are outlined in the Cobourg Marine Park Plan of Management 2011[4].

The Limmen Bight Marine Park is located approximately 315km south-west of Nhulunbuy, in the south-west Gulf of Carpentaria. The marine park covers an area of 1 399km^2 with water depths ranging from 15 m to 70 m. Areas where hand harvesting can occur are outlined in the Limmen Bight Marine Park – Plan of Management[5].

3.5 Monitoring

The activities of Fishery licensees are monitored through compulsory catch and effort logbooks. Electronic logbooks (e-logs) are used within the commercial sector of the Fishery. The use of e-logs increases reporting efficiency for the fishery and streamlines the process for data entry and analysis by NT Fisheries. Increased efficiency in data entry and analysis allows almost real-time monitoring of catch and effort in the fishing grids. Licensees are required to record fishing details on a daily basis while undertaking fishing operations. These details include time spent fishing (in hours), number of active collectors, collection area, fishing method, number of species collected, and gutted, blanched weight (kg).

There is no formal monitoring system in place for recreational or Aboriginal traditional fishers to report their catch and effort. Estimates of recreational and Aboriginal traditional catch are taken from recreational fishing surveys.

Electronic vessel monitoring systems (VMS) provide information about a vessel's location in real-time and are required to be installed on all motherships operating within the Fishery.

[4] https://denr.nt.gov.au/__data/assets/pdf_file/0006/249045/Cobourg-Marine-Park.pdf
[5] https://denr.nt.gov.au/__data/assets/pdf_file/0008/808514/limmen-bight-marine-park-plan-of-management.pdf

3.6 Sectoral catch

The take of sea cucumber by the recreational fishers, Fishing Tour Operators and Aboriginal fishers has not been quantified, but it is assumed to be negligible (Northern Territory Government Department of Primary Industry and Resources, 2019).

3.6.1 Commercial

There are spatially allocated grid-based catch limits that range from one to 25 tonnes. A licence holder must cease fishing in a grid when the specified amount for that grid has been caught. Licensees can apply to the Director of Fisheries to catch up to five tonnes more in a grid, and up to a combined maximum of 20 tonnes across all grids. Fishing effort in the Fishery is sporadic due to limiting factors such as weather, tides, and physical environment (Figure 2).

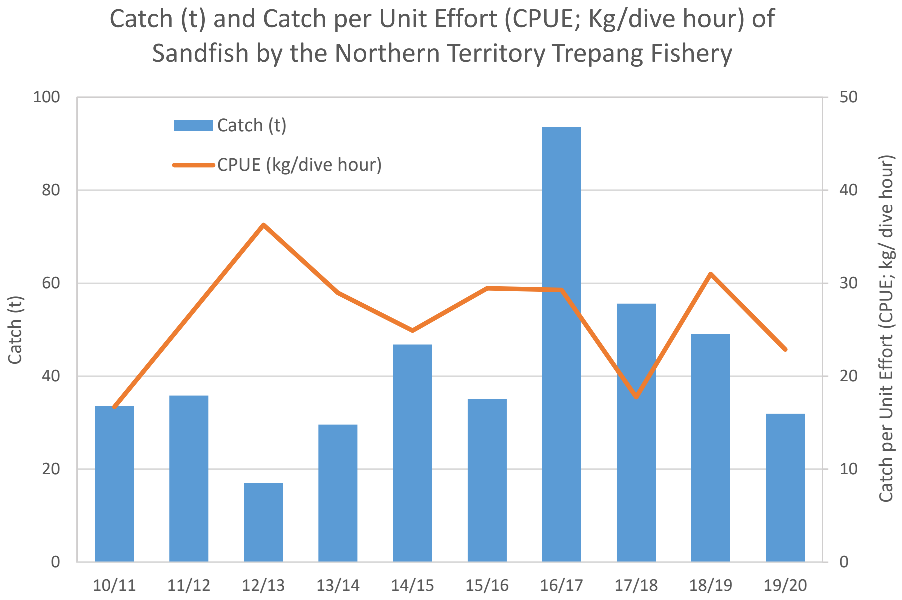

Figure 2. Catch (tonnes) and catch per unit effort (CPUE; kg/dive hour) of Sandfish by the Northern Territory Trepang Fishery.

3.7 Environment

3.7.1 Climate

The climate of northern Australia is tropical monsoonal with two distinct seasons, a summer wet season which occurs broadly between October and March, and a winter dry season between April and September. The winters in northern Australia are influenced by easterly winds generated over inland Australia, resulting in dry and warm conditions with very little rainfall and low relative humidity. The high humidity and thunderstorm activity of the wet season is caused by steady west to north-west winds bringing moisture from the Timor and Arafura Sea. Cyclones may develop in the region between December and April, resulting in severe storms with gale force winds. Typically, cyclones form south of the equator in the Timor or Arafura Seas when sea temperatures are greater than 26.5°C. The monsoonal weather pattern is a major driver of important ecological processes in the marine environment and is a significant factor influencing recruitment of estuarine and coastal fishes in the Northern Territory.

3.7.2 Tides

Tidal types change across the Northern Territory between semi-diurnal (two high and two low tides per day), and diurnal (one high and one low per day) that occur in both the north of the Arafura Sea and in the south of the Gulf (Webb 1981). Considerable variation in tidal range is experienced along the Northern Territory's coast, with ranges exceeding seven metres in the western areas during the spring tide, to less than two metres in areas of the Gulf of Carpentaria. The large tidal movement combined with major inputs of fine silt sediments from numerous rivers create vast areas of high turbidity and ensures lower light penetration.

3.7.3 Physical Environment

The Joseph Bonaparte Gulf, west of Darwin, is an extensive shallow basin that receives significant sediment load from the numerous rivers in the region (Lees 1992). It is dominated by tidal and wind-driven currents according to the season. With the area being comprised of soft substrate expanses with localised rocky outcrops, strong tidal currents, high turbidity (particularly during the wet season), and substantial sediment mobility (Przeslawski et al. 2011).

The area northeast of Darwin (Van Diemen Gulf) is a large, almost fully enclosed, body of water. Mainland landforms along the coast in this area are dominated by extensive low, flat, estuarine, coastal plains fringed at the coast by mud flats/banks often associated with a narrow band of mangroves. The rivers and creeks are typically tide dominated with intertidal flats, mangroves and saline flats/salt marshes with a naturally high turbidity (Roelofs et al. 2005).

The Arnhem Land region has a diverse coastline. The dominant landforms in northwest Arnhem

Land are undulating sand and lateritic plains with sandy beaches and low rocky headlands with mangrove lined saline mudflats in the more protected bays and estuaries. In northeast Arnhem Land, coastal landforms are dominated by floodplains and mangroves with extensive tidal mud and sand flats (Roelofs et al. 2005). The major rivers of this region all have a moderate freshwater output and wave energy is generally low except during short periods of storm and cyclonic activity in the wet (Davies 1986). Water clarity varies within the region. The estuaries and protected bays in the northwest, and the near coastal waters in the east are naturally turbid, whereas the rocky platform and sandy areas in the northwest have low turbidity.

The Gulf of Carpentaria is a large, shallow, muddy marine bay that has marked seasonality in temperature, rainfall, salinity and wind regimes. The region has a diversity of land forms including offshore islands, fringing coral reefs, sandy, muddy and cliff-lined coastal topographies as well as extensive tidal mud/sand flats. The western Gulf of Carpentaria coast is a complex coastline with few river inputs, and is less muddy than the southern Gulf, where extensive open coastline seagrass communities exist (Poiner et al. 1989). Sediments throughout the Gulf are predominantly fine muds, and these are easily resuspended due to the shallow bathymetry resulting in increased turbidity. Cyclones and storms also readily disturb and shift sediments in this shallow environment (Roelofs et al. 2005).

4 Methodology

4.1 Ecological Risk Assessment methodology

This ERA aims to ensure that the management of the Fishery is both effective and efficient in the context of achieving ESD outcomes. The principles of ESD form the basis of fisheries and aquatic resource management in the Northern Territory. In addition to meeting the statutory requirements of the Fisheries

Act and national environmental legislation, this approach also provides the fishing industry and key stakeholders with an ongoing opportunity to contribute to, and influence, fisheries management outcomes.

NT Fisheries will collaboratively develop more effective management arrangements under the Fisheries Act using the comprehensive issue identification, and subsequent risk assessment and priority setting process. The issue identification, risk assessment, reporting process, and final report format, is based on the National ESD Framework How to Guide (see http://www.fisheries-esd.com.au).

4.2 Scope

This risk assessment covers the harvest of sea cucumbers by all sectors within the boundary of the Trepang Fishery.

The report is based on risk identification and assessment work undertaken by an expert panel in November 2020. The identification of issues was informed by the generic ESD component tree approach, with each component tree refined specifically for the Trepang Fishery. This report focuses on the Ecological Wellbeing of the Fishery; the components of 'Human Wellbeing' and 'Ability to Achieve'[6] will be addressed after the process to determine relevant management objectives in the context of social and economic benefits to the community.

Each component tree reflects the contemporary risks of harvesting activities on the retained or non-retained species. It also included broader impacts of the activities on the broader environment. This process did not identify where additional (or reduced) management or research attention is needed, this will be done during the development of the management framework and harvest strategy.

The calculation of risk in the context of a Fishery is usually determined within a specified period, which for this assessment is the next five years, until 2026.

4.3 Issue Identification (component trees)

The component trees for the Fishery are refined versions of the generic trees described in the National ESD Reporting Framework. The generic trees are the results of extensive consideration and refinement during the development of the National Fisheries ESD approach. The component trees are used as the starting point to ensure thorough and consistent identification and evaluation of issues in the Fishery. The component trees in this report were developed through expert consultation and provide a realistic and practical illustration of issues facing the Fishery. Each of these components are broken down into specific sub-components for which operational objectives can then be developed. Figure 3 provides an overview of the component trees reviewed by the expert panel.

[6] The National ESD Framework divides ESD into components, grouped within three main categories relevant to fisheries – contributions to environmental well-being, contributions to human well-being and ability to achieve. http://fisheries-esd.com.au/wp-content/uploads/sites/21/2020/11/WildCaptureFisheries_V1_01.pdf

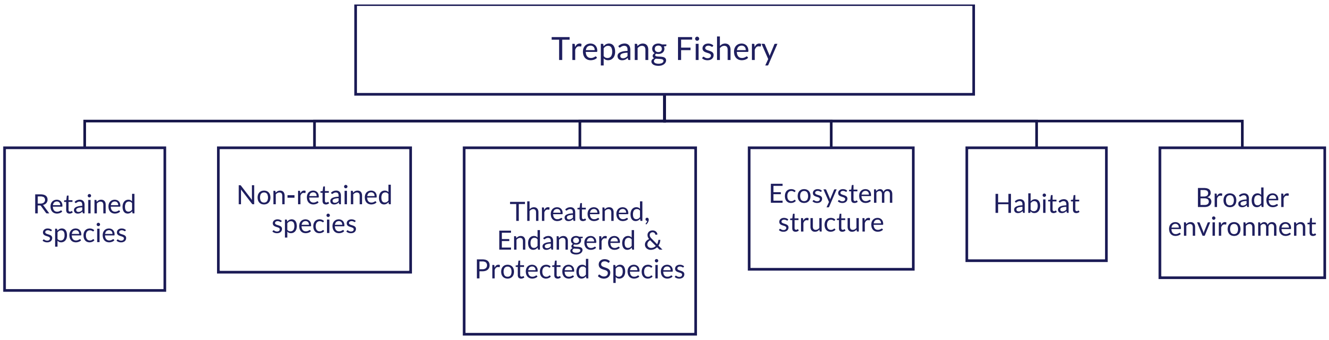

Figure 3. Component tree for the ecological aspects of the Trepang Fishery.

4.4 Risk assessment and prioritisation of issues

Once component trees were developed, focus moved to the assessment and prioritisation of risks attributed to the activity of the Fishery.

The risk assessments for the components of the Fishery were based on existing management arrangements. The ESD assessment and reporting process is consistent with the Australian and New Zealand Standard AS 4360 / ISO 31000 *Risk Management – Principles and Guidelines*. Technical experts and fishery stakeholders considered the potential consequences of an issue, activity or event and how likely those consequences are to occur. The estimated consequences of an event was combined with the likelihood of that event occurring to produce and estimated level of risk.

The expert panel worked through each element of the component tree and conducted a qualitative risk assessment of each issue. The consequence level for each issue was estimated and scored from one to four, with one being minor and four being major (see Appendix 7.1). The consequence estimate was based upon the combined judgement of the expert panel. The level of consequence was estimated at the appropriate scale and context for the issue in question.

For retained species, the consequence assessment was based at the stock level (where information on structure was available). For example, harvesting one sea cucumber is catastrophic for the individual but not for the stock. Similarly, assessments of possible ecosystem impacts were conducted at the level of the whole ecosystem, or specific habitat types, not at the level of an individual patches or individual non-target species.

The likelihood of that consequence occurring was assigned one of four levels from remote (1) to likely (4). Where information was unavailable, an increased likelihood value was applied to accommodate uncertainty. This was based on a judgement of the probability of the events, or chain of events, occurring that could result in a particular adverse consequence. This judgement of conditional probability was again based on the collective experience of the expert panel (see Appendix 7.1). From the consequence and likelihood scores, the overall risk value (Risk = Consequence x Likelihood) was calculated. On the basis of this risk value each issue was assigned a risk rating within one of five categories Negligible, Low, Medium, High or Severe (see Table 4). The expected management outcomes associated with each risk rating are outlined in Table 5.

Table 4. Consequence x Likelihood Risk Matrix (based on AS 4360 / ISO 31000; adapted from Fletcher 2015).

		Likelihood			
		Remote (1)	Unlikely (2)	Possible (3)	Likely (4)
Consequence	Minor (1)	Negligible	Negligible	Low	Low
	Moderate (2)	Negligible	Low	Moderate	Moderate
	High (3)	Low	Moderate	High	High
	Major (4)	Low	Moderate	Severe	Severe

Table 5. Expected outcomes of each risk rating

Risk Levels	Likely Management Action
Negligible	Nil
Low	None specific
Moderate	Specific management and/or monitoring required in Management Framework.
High	Increased management activities needed in Management Framework.
Severe	Increased management activities including a recovery strategy in the Management Framework. Consideration to be given to interim management arrangements to arrest the decline.

To ensure transparency and help stakeholders understand the basis for the risk scores received by each identified issue, a rationale for each risk rating is included.

4.5 Ecologically Sustainable Development reports for higher risk issues

Central to any ESD performance report are the proposed management actions to deal with higher risk/priority issues, including operational objectives, indicators and performance measures.

Once the higher risk/priority issues are identified through this process, they will be addressed during the development of a management framework and associated harvest strategy for the Fishery. The management framework and harvest strategy will include operational objectives, performance indicators, and performance reference points.

5 Performance Reports

Component trees were developed for retained and non-retained species as well as general ecosystem effects. The background colour for each component relates to the risk rating determined by the expert panel according to the following scheme: light blue = negligible, green = low, yellow = moderate, orange = high and red = severe. No specific management is required where the risk is determined to be negligible or low; however, risks that are rated moderate, high or severe require either a full justification or must be addressed through the development of the harvest strategy.

5.1 Retained species

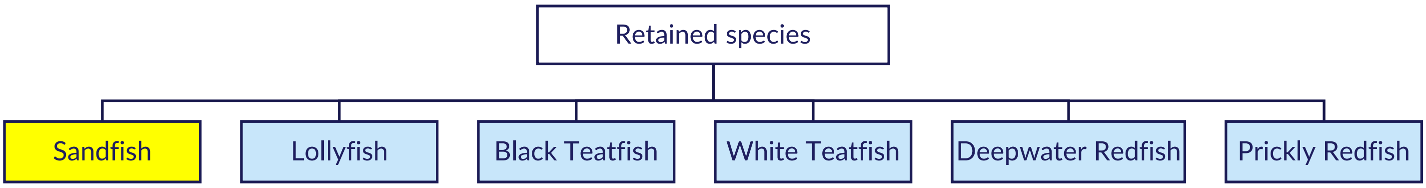

Figure 4. Component tree for retained species in the Trepang Fishery.

For this ERA six species of sea cucumber (*Holothuroidea spp*.) were assessed. Information regarding the biology, vulnerability and stock status of each species is contained in Appendix 7.2.

5.1.1 Primary species

5.1.1.1 Sandfish (Holothuria scabra)

Objective:

To ensure that the harvest of retained species remains within ecologically sustainable limits.

Risk Analysis:

To assist with the risk analysis, information relating to individual species biology, vulnerability and stock status was considered by the expert panel (Appendix 7.2). The expert panel and stakeholders considered a suite of matters in determining a risk rating (Appendix 7.3).

The risk rating for the impact of the Trepang Fishery on the sustainability of Sandfish was determined in accordance with tables 19 and 20 (Appendix 7.1).

Table 6. Risk rating for the impact of the Trepang Fishery on the viability of Sandfish.

Consequences	Likelihood	Risk Rating
Moderate (2)	Possible (3)	Moderate

Justification:

The below statements were used to justify the risk rating assigned in Table 6:

- The Fishery input controls (limited licences, method restrictions and permitted gear) limit the overall fishing effort in the Fishery, and the grid-based catch limits (60 x 60 nautical miles) restricts the harvest of target species within the boundary of the Fishery.
- Despite the input controls and catch limits there is a risk that localised depletion may occur and not be detected at smaller spatial scales (i.e. at the scale of an embayment).
- A likelihood rating of Possible (3) was allocated noting the risk of localised depletion, however it is noted that the likelihood of fishery-wide depletion of Sandfish would be considerably smaller.

5.1.2 Secondary species

5.1.2.1 Other Holothurian species

Objective:

To ensure that the harvest of retained species remains within ecologically sustainable limits.

Risk Analysis:

To assist with the risk analysis, information relating to individual species biology, vulnerability and stock status was considered by the expert panel (Appendix 7.2). The expert panel and stakeholders considered a suite of matters in determining a risk rating (Appendix 7.3).

Risk ratings for the impact of the Trepang Fishery on the viability of each Holothuroidea species, other than Sandfish, were determined in accordance with tables 19 and 20 (Appendix 7.1).

Table 7. Risk rating for the impact of the Trepang Fishery on the viability of Holothuroidea species.

Species	Consequences	Likelihood	Risk Rating
Lollyfish	Minor (1)	Remote (1)	Negligible
Black Teatfish	Minor (1)	Remote (1)	Negligible
White Teatfish	Minor (1)	Remote (1)	Negligible
Deepwater Redfish	Minor (1)	Remote (1)	Negligible
Prickly Redfish	Minor (1)	Remote (1)	Negligible

Justification:

The below statements were used to justify the risk ratings assigned in Table 7:

- No recorded catch for species in the last 10 years within the boundary of the Fishery.
- Based on the known distribution of *Holothuroidea* species, it is likely that the majority of the population of these species is outside the current boundary of the Fishery.
- Current management arrangements, including a grid-based catch limits, would limit the catch of other species if found within the boundary of the Fishery.

5.2 Non-retained species

Due to the highly selective fishing method there are no records and observations of non-retained species harvested within the Fishery.

5.3 Threatened, Endangered and Protected Species

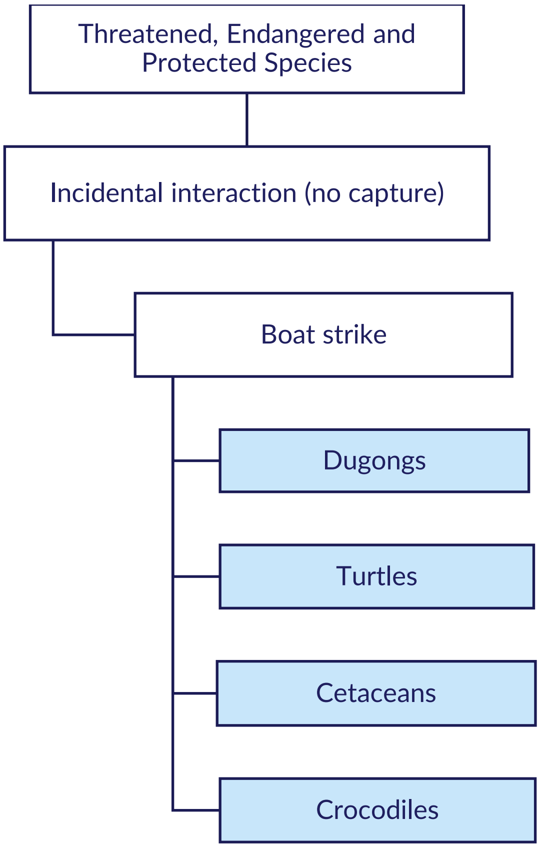

Figure 5. Component tree for issues related to the non-retained species of the Trepang Fishery**.**

5.3.1 Boat Strike

Objective:

To ensure that fishing practices within the Fishery do not interact with TEPS.

Risk Analysis:

Risk ratings for the impact of fishing practises, namely boat strikes, on the sustainability of TEPS was determined in accordance with ERA tables 19 and 21 (Appendix 7.1).

In determining the likelihood and consequence, a suite of matters were considered and are outlined Appendix 7.3.

Table 8. Risk rating for the impact of boat strikes attributes to the Trepang Fishery on the viability of TEPS.

Consequences	Likelihood	Risk Rating
Minor (1)	Remote (1)	Negligible

Justification:

The below statements were used to justify the risk ratings assigned in Table 8:

- There are no reported or observed TEPS interactions in the Fishery.
- Most pelagic species can swim out of the way to avoid a boat strike.
- Other than when transiting to a harvest site, vessels are generally stationary or moving at low speeds and therefore there is only a remote chance that boat strikes will occur.

5.4 General ecosystem effects

The highly selective nature of the commercial Trepang fishing operations and the small size of the fishing fleet were common considerations in the assessment of the Fishery on the general ecosystem.

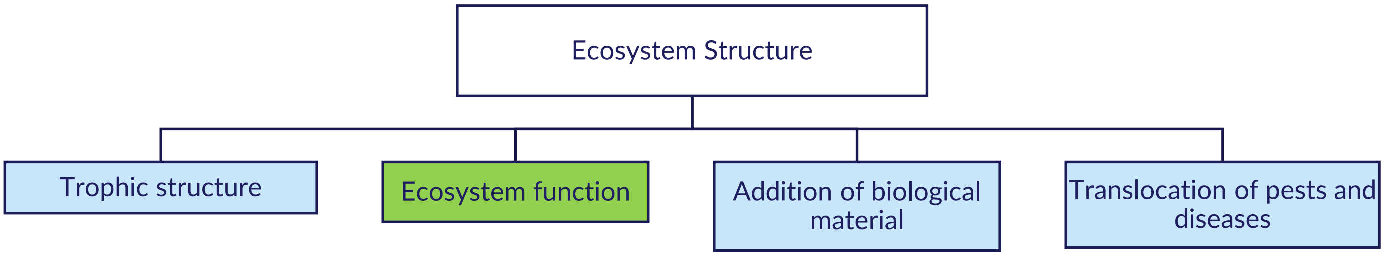

Figure 6. Component tree for the impacts of the Trepang Fishery on the ecosystem structure.

5.4.1 Trophic Structure

Objective:

To ensure that the harvest of retained species are not negatively impacting the trophic structure.

Risk rating:

Risk ratings for the impact of hand collection of sea cucumbers on trophic structure was determined in accordance with ERA tables 19 and 23 (Appendix 7.1).

In determining the likelihood and consequence, a suite of matters were considered and are outlined Appendix 7.3.

Table 9. Risk rating for the impact of hand collection of Trepang on trophic structure.

Consequences	Likelihood	Risk Rating
Minor (1)	Unlikely (2)	Negligible

Justification:

The below statements were used to justify the risk ratings assigned in Table 9:

- Current management arrangements, including catch-grid limits, limit the removal of sea cucumbers within the Fishery.
- Information on predator/prey relationships for sea cucumbers is scarce, however given the complexity of food webs in tropical marine waters, the removal of Holothurians through fishing is unlikely to have a detectable impact on the trophic structure.

  A likelihood rating of Unlikely (2) was allocated noting the lack of information on predator/prey relationships.

5.4.2 Ecosystem function

Objective:

To ensure that Fishery practises are not negatively impacting on the ecosystem function.

Risk rating:

Risk ratings for the impact of fishing practises on ecosystem function was determined in accordance with ERA tables 19 and 23 (Appendix 7.1).

In determining the likelihood and consequence, a suite of matters were considered and are outlined Appendix 7.3.

Table 10. Risk rating for the impact of ecosystem function on ecosystem structure.

Consequences	Likelihood	Risk Rating
Minor (1)	Possible (3)	Low

Justification:

The below statements were used to justify the risk ratings assigned in Table 10.

- There is no evidence of any impacts on the ecosystem function; most conclusions about the benign nature of the Fishery are based on anecdote and ‘common sense’ evaluations.
- Current management arrangements, including catch-grid limits, limit the amount of sea cucumbers removed from an ecosystem.
- Holothurians maintain and improve sediment health through bioturbation (Purcell et al., 2016), and are considered ecosystem regulators.

- A likelihood rating of Possible (3) was allocated noting the risk of removal of Holothurian species at a local level, however it is noted that the likelihood of fishery-wide ecosystem function would be considerably smaller.

5.4.3 Addition of biological material

Objective:

To ensure that Fishery practises are not negatively impacting on the addition of biological material.

Risk rating:

Risk ratings for the impact of addition of biological material on the ecosystem structure was determined in accordance with ERA tables 19 and 23 (Appendix 7.1).

In determining the likelihood and consequence, a suite of matters were considered and are outlined Appendix 7.3.

Table 11. Risk rating for the impact of addition biological material on ecosystem structure.

Consequences	Likelihood	Risk Rating
Minor (1)	Remote (1)	Negligible

Justification:

The below statements were used to justify the risk ratings assigned in Table 11:

- Given the low level of harvest, the addition of biological material from gutting sea cucumbers is unlikely to have a detectable impact on the ecosystem structure.

5.4.4 Translocation of pests and diseases

Objective:

To ensure that translocation of pests and diseases are not introduced to Holothuroidea species in the Fishery.

Risk Rating:

Risk ratings for the impact of translocation of pests and diseases on the ecosystem structure was determined in accordance with ERA tables 19 and 23 (Appendix 7.1).

In determining the likelihood and consequence, a suite of matters were considered and are outlined Appendix 7.3.

Table 12. Risk rating for the impact of translocation of pests and disease on ecosystem structure.

Consequences	Likelihood	Risk Rating
Minor (1)	Remote (1)	Negligible

Justification:

The below statements were used to justify the risk ratings assigned in Table 12:

- Fishing vessels move between different areas, however remain in NT waters.
- Licensees process sea cucumber at sea immediately after harvest, reducing the risk of transporting pests and diseases from biological material to other areas.
- Biosecurity monitoring established in Darwin ports to monitor any potential introduction of pest species.
- There are currently no known diseases to Holothuroidea species within NT waters.

5.5 Habitat

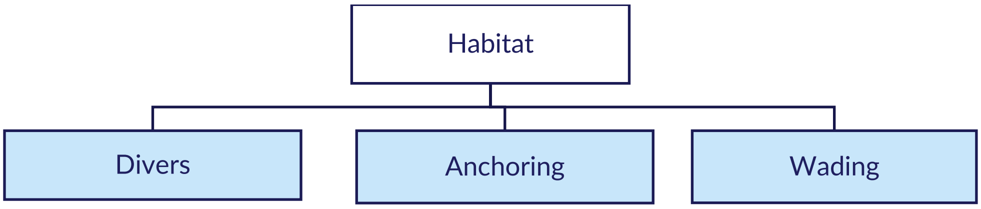

Figure 7. Component tree for the impacts of the Trepang Fishery on the habitat.

5.5.1 Divers

Objective:

To ensure that fishing practises are not negatively impacting the benthic habitat in the Fishery.

Risk rating:

Risk ratings for the impact divers have on the benthic habitat was determined in accordance with ERA tables 19 and 22 (Appendix 7.1).

In determining the likelihood and consequence, a suite of matters were considered and are outlined Appendix 7.3.

Table 13. Risk rating for the impact of divers on seafloor habitats.

Consequences	Likelihood	Risk Rating
Minor (1)	Remote (1)	Negligible

Justification:

The below statements were used to justify the risk ratings assigned in Table 13:

- Habitats where harvesting takes place consist of a sandy substrate.
- Limited number of divers in the Fishery (6 licences with a maximum of 4 divers per licence).

- Divers are highly unlikely to cause disturbance to the seafloor as disturbances to the sandy substrate effect visibility and the ability for divers to harvest.

5.5.2 Anchoring

Objective:

To ensure anchoring does not negatively impact the benthic habitat in the Fishery.

Risk rating:

Risk ratings for the impact anchoring have on the benthic habitat was determined in accordance with ERA tables 19 and 22 (Appendix 7.1).

In determining the likelihood and consequence, a suite of matters were considered and are outlined Appendix 7.3.

Table 14. Risk rating for the impact of anchors used by Trepang fishing vessels on seafloor habitats.

Consequences	Likelihood	Risk Rating
Minor (1)	Remote (1)	Negligible

Justification:

The below statements were used to justify the risk ratings assigned in Table 14:

- Habitats where harvesting takes place consist of a sandy substrate.
- Limited amount of fishing vessels prohibited to operate under a licence in the Fishery.

5.5.3 Wading

Objective:

To ensure wading does not negatively impact the benthic habitat in the Fishery.

Risk rating:

Risk ratings for the impact wading have on the benthic habitat was determined in accordance with ERA tables 19 and 22 (Appendix 7.1).

In determining the likelihood and consequence, a suite of matters were considered and are outlined Appendix 7.3.

Table 15. Risk rating for the impact of wading undertaken by assistants under a Trepang licence on seafloor habitats.

Consequences	Likelihood	Risk Rating
Minor (1)	Remote (1)	Negligible

Justification:

The below statements were used to justify the risk ratings assigned in Table 15:

- There has been very little catch collected whilst wading.
- Limitations on the number of assistants under each licence, with a maximum of 9, including 4 divers.

5.5.4 Broader environment

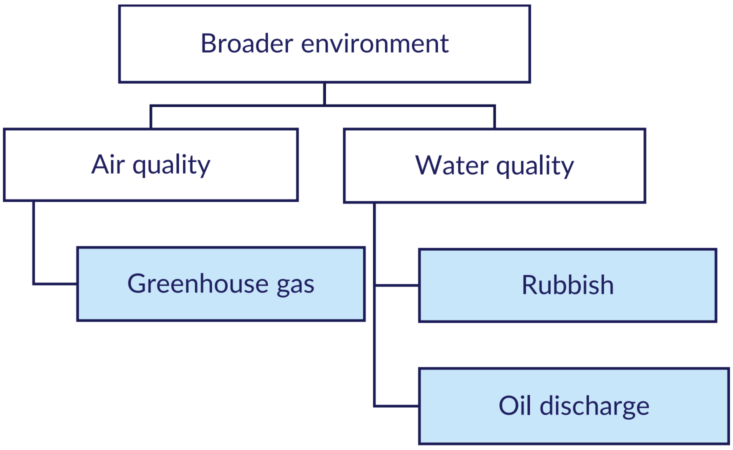

Figure 8. Component tree for the impacts of the Trepang Fishery on the broader environment.

5.5.5 Greenhouse gases

Objective:

To ensure that the small amount vessels within the Fishery are not negatively impacting the broader environment.

Risk rating:

Risk ratings for the impact greenhouse gases have on the broader environment was determined in accordance with ERA tables 19 and 23 (Appendix 7.1).

In determining the likelihood and consequence, a suite of matters were considered and are outlined Appendix 7.3.

Table 16. Risk rating for the impact of greenhouse gases released by Trepang fishing vessels on the broader environment.

Consequences	Likelihood	Risk Rating
Minor (1)	Remote (1)	Negligible

Justification:

The below statements were used to justify the risk ratings assigned in Table 16:

- All fishing vessels produce exhaust emissions. Motherships are fitted with large diesel engines whereas as dories are generally fitted with modern petrol-powered four-stroke outboards.
- The current size of the fishing fleet limit the impacts on the broader environment.

5.5.6 Garbage disposal/Litter

Objective:

To ensure littering from fishing practises do not negatively impact the marine habitat.

Risk rating:

Risk ratings for the impact of littering have on the habitat was determined in accordance with ERA tables 19 and 23 (Appendix 7.1).

In determining the likelihood and consequence, a suite of matters were considered and are outlined Appendix 7.3.

Table 17. Risk rating for the impact of rubbish from Trepang fishing vessels on the broader environment.

Consequences	Likelihood	Risk Rating
Minor (1)	Remote (1)	Negligible

Justification:

The below statements were used to justify the risk ratings assigned in Table 17:

- The disposal of solid, non-degradable waste in Territory coastal waters is regulated through the *Marine Pollution Act 1999*.
- Fishers are aware of the social sensitivities to littering and are cautionary when storing any personal litter on vessels until it can be adequately disposed of.
- The current size of the fishing fleet limits the impact rubbish has on the broader environment.

5.5.7 Oil discharge

Objective:

To ensure that oil discharge from fishing vessels does not negatively impact the marine environment.

Risk rating:

Risk ratings for the impact of oil discharge have on the marine habitat was determined in accordance with ERA tables 19 and 23 (Appendix 7.1).

In determining the likelihood and consequence, a suite of matters were considered and are outlined Appendix 7.3.

Table 18. Risk rating for the impact of oil discharge by Trepang fishing vessels on the broader environment.

Consequences	Likelihood	Risk Rating
Minor (1)	Remote (1)	Negligible

Justification:

The below statements were used to justify the risk ratings assigned in Table 18:

- The current size of the fishing fleet limits the impact oil and fuel spills from fishing vessels would have on the broader environment.

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[11] http://www.fish.gov.au/report/169-White-Teatfish-(Sea-Cucumber)-2018[11]

7 Appendices

7.1 Likelihood and consequence tables

Table 19. Likelihood definitions.

Level	Score	Definition
Remote	1	Never heard of in these circumstances but not impossible within the timeframe (<5% probability)
Unlikely	2	Not expected to occur in the timeframe but it has been known to occur elsewhere under special circumstances (5- <20% probability)
Possible	3	Clear evidence to suggest this is possible in some circumstances within the timeframe (20- <50% probability)
Likely	4	Expected to occur in the timeframe (≥50% probability)

Table 20. Consequence definitions for target species.

Level	Score	Definition
Minor	1	Measurable but minor levels of depletions of fish stock (biomass above 60% of unfished levels)
Moderate	2	Maximum acceptable level of depletion of stock (biomass 40-60% of unfished levels)
High	3	Level of depletion of stock unacceptable but still not affecting recruitment level of the stock (biomass 20-40% of unfished levels)
Major	4	Level of depletion of stock are already affecting (or will definitely affect) future recruitment potential of the stock (biomass <20% of unfished levels)

Table 21. Consequence definitions for Threatened, Endangered and Protected Species.

Level	Score	Definition
Minor	1	Few individuals directly impacted in most years, level of capture/interaction is well below that which will generate public concern
Moderate	2	Level of capture is the maximum that will not impact on recovery or cause unacceptable public concern
High	3	Recovery may be being affected and/or some clear, but short-term public concern will be generated
Major	4	Recovery times are clearly being impacted and/or public concern is widespread

Table 22. Consequence definitions of habitat impacts.

Level	Score	Definition
Minor	1	There are measurable impacts in localised areas (<5% of habitat impacted)
Moderate	2	Levels of impact are measurable at larger scales (5-20% of habitat impacted)

Level	Score	Definition
High	3	The area impacted is sufficient that loss of habitat function is possible (20-50% of habitat impacted)
Major	4	Levels of impact are causing loss of habitat function and there is a risk of the entire habitat being impacted/ removed (>50% of habitat impacted)

Table 23. Consequence definitions for ecosystem structure and broader environment.

Level	Score	Definition
Minor	1	Measurable but minor change in the environment or ecosystem structure but no measurable change to function
Moderate	2	Maximum acceptable level of change in the environment / ecosystem structure with no material change in function
High	3	Ecosystem function altered to an unacceptable level with some function or major components now missing and/or new species are prevalent
Major	4	Long-term, significant impact with an extreme change to both ecosystem structure and function; different dynamics now occur with different species / groups now the major targets of capture or surveys

7.2 Biological information for retained species

7.2.1 Sandfish

Holothuria scabra

Assessment information	
Distribution	Sandfish are widely distributed in the tropical Indo-Pacific, between latitudes 30°N and 30°S excluding Hawaii (Purcell et al., 2012). Sandfish prefer coastal areas to coral reefs and is often found in beds of seagrass. Seagrass plays an important role in triggering larval settlement (Northern Territory Government, 2019; Mercier et al. 2000; Purcell et al. 2012).
Growth and reproduction	Sandfish attain size-at-maturity around 16-25cm in Northern Australia (Purcell et al., 2012). Sexual reproduction is via broadcast spawning which generally occurs in the warm months (December to February). Gametes are released into the water column and settle when reached a larval stage at 10 – 14 days (Hamel et al. 2001).
Stock structure	Genetic analyses of Sandfish in Territory waters suggest that there are separate stocks either side of the Wessel Islands (Gardner et al. 2012). Given the difficulty in obtaining relevant biological and catch-and-effort information to assess each individual biological stock, status is reported at the NT-wide level.
Vulnerability	Sandfish are highly susceptible to localised depletion.
Stock status	The harvest of Sandfish dates back to the 1700's when traders from Makassar fished the area then ceased in the early 19th century. Catch fluctuated until the 1980's, prior to this, commercial fishing activity was coordinated by European Australians with assistance from the Aboriginal people of Arnhem Land. Catches of Sandfish peaked at 247 t in 2000 and fluctuated between 100 t and 200 t for the following seven years. Thereafter annual fishing effort decreased, due to difficulties sourcing divers and crew. Catch in 2014 was recorded as zero due to zero fishing effort (Northern Territory Government, 2019). In the past decade fishing effort in the Fishery has been sporadic.

7.2.2 Black Teatfish

Holothuria whitmaei

Assessment information	
Distribution	Black Teatfish range from Western Australia east to Hawaii and French Polynesia, southern China to Lord Howe Island (Purcell et al. 2012). Black Teatfish inhabit reef flats and slopes, and seagrass bed between 0 – 20 m.
Growth and reproduction	On the Great Barrier Reef the species has an annual reproductive event. The Black Teatfish is one of the few tropical species that

Assessment information	
	reproduces during the winter, reproducing between April and June (Purcell et al. 2012).
Stock structure	Stock status in the Northern Territory is undefined, with lack of information on the distribution, abundance and stock structure. There are likely to be populations in the northern Australian states and territories (Roelofs et al. 2018).
Vulnerability	Black Teatfish are highly susceptible to localised depletion.
Stock status	Undefined.

7.2.3 White Teatfish

Holothuria fuscogilva

Assessment information	
Distribution	White Teatfish are distributed from Madagascar and the Red Sea in the west, across to Easter Island and from southern China to south of Lord Howe Island (Purcell et al. 2012). White Teatfish commonly inhabit sandy areas, reefs and outer barrier reef slopes in waters with a depth of 10 to 15 m (Purcell et al. 2012).
Growth and reproduction	White Teatfish attains size-at-maturity at 100g (Purcell et al. 2012).
Stock structure	Unknown in NT waters.
Vulnerability	White Teatfish are highly susceptible to localised depletion.
Stock status	Under the Status of Australian Fish Stocks (Roelofs et al. 2018), White Teatfish are the only sea cucumber species listed. Their stock status in the Northern Territory is classified as undefined.
Fishing activity	In the Trepang Fishery licensees are permitted to harvest White Teatfish, but there has been no historical catch records stating the catch of these species in the last 10 years (Roelofs et al. 2018). In 2015, White Teatfish were harvested under a research permit, enabling exploratory diving outside the boundary of the Fishery. This could be due to the area of the Fishery is shallower than the apparent depth preference for this species.

7.2.4 Lollyfish

Holothuria atra

Assessment information	
Distribution	Lollyfish are widespread in the Indo-Pacific. This species can be found around East Africa, Madagascar, Red Sea, India, north Australia, Philippines, China and south Japan. Lollyfish inhabit inner and outer flats, reefs and seagrass beds between 0 and 20 m.

Assessment information	
Growth and reproduction	In the Great Barrier Reef, Lollyfish reproduce in January, May-June, and November-December (Purcell et al. 2012). This species reproduce asexually by fission in natural conditions (Purcell et al. 2012). The reproductive cycle of Lollyfish in the NT is not known.
Stock structure	Unknown in NT waters.
Vulnerability	Lollyfish are highly susceptible to localised depletion.
Stock status	Undefined.
Fishing activity	Trepang Fishery licensees are permitted to harvest Lollyfish, however there has been no historical catch records stating the catch of these species in the last 10 years.

7.2.5 Deepwater Redfish

Actinopyga echinites

Assessment information	
Distribution	Deepwater Redfish are found throughout the western central Pacific, Asia, Africa, Indian Ocean region, China, southern Japan and north Australia (Purcell et al. 2012). Deepwater Redfish inhabit shallow waters, mostly on reef and seagrass beds down to 10 m depth with relatively high densities of up to 1 individual per m^2.
Growth and reproduction	Spawning occurs in the dry season, size of maturity is reported to be 12 cm, or a weight between 45 and 90 g (Purcell et al. 2012).
Stock structure	Unknown in NT waters.
Vulnerability	Species are highly susceptible to localised depletion.
Stock status	Undefined.
Fishing activity	Trepang Fishery licensees are permitted to harvest Deepwater Redfish, however there has been no historical catch records stating the catch of these species in the last 10 years.

7.2.6 Prickly Redfish

Thelenota ananas

Assessment information	
Distribution	Prickly Redfish can be found in the Red Sea, Mascarene Islands, Maldives, north Australia, the Philippines, China, southern Japan and islands of the Central Western Pacific as far east as French Polynesia (Purcell et al. 2012). Prickly Redfish inhabit reef slopes, hard bottoms with coral rubble and patches in waters between 1 and 25 m.
Growth and reproduction	The species retains size at maturity at 200 g and reproduces annually during the warm season (Purcell et al. 2012).
Stock structure	Unknown in NT waters.

Assessment information	
Vulnerability	Species are highly susceptible to localised depletion.
Stock status	Undefined.
Fishing activity	Trepang Fishery licensees are permitted to harvest Prickly Redfish, however there has been no historical catch records stating the catch of these species in the last 10 years.

7.3 Sources of consideration for each component

Assessment information	
Sandfish	• Single company operating reduces the potential for competitive fishing in the Fishery • Small number of commercial licences and little effort within the Fishery • The vast majority of trepang harvest is taken by the commercial sector, with negligible take by other sectors • No formal stock assessment undertaken in NT waters • Management controls in place such as grid limits restricting catch • Potential for localised depletion of stocks due to the ability for commercial fishing to concentrate effort in a few grids • Unknown species composition and population within grids • Limited genetic variability between stocks in shallow and deep populations (Gardner et al. 2012) • Apparent regional differences in average sizes may impact on local productivity • The probability of increased catchability over time due to technological advances (e.g. plotters, sonar, improved weather forecasts etc.) • Grid limits set on historical data • Difficult to assess and manage sea cucumber stocks at the embayment level in Territory waters and so localised depletion may go undetected.
Lollyfish, Black Teatfish, White Teatfish, Deepwater Redfish, Prickly Redfish	• Potential for risk ratings to change in the future if markets for other species develop • No recorded catch for species in the last 10 years within the boundary of the Fishery • No formal stock assessment undertaken in NT waters • Based on the known distribution of *Holothuroidea* species, no species other than Sandfish, is likely to be found within the current boundary of the Fishery • Current management arrangements including a grid catch-limits, would limit the catch of other species if found within the boundary of the Fishery.

Assessment information	
Threatened, Endangered and Protected Species	• There are no reported or observed TEPS interactions in the Fishery • Most pelagic species can swim out of the way to avoid a boat strike • Other than when transiting to a harvest site, trepang vessels are generally stationary or moving at low speeds and therefore there is only a remote chance that boat strikes will occur.
General ecosystem effects	
Trophic structure	• Research scant on predator/prey relationships • It is unknown what other species replace Sandfish in the ecosystem • Holothurians enhance the productivity of benthic biota and ecosystem biodiversity by excreting inorganic nitrogen and phosphorus, and host an array species such as Platyhelminthes, Polychaetes, Arthropods and Gastropods (Purcell et al. 2016; Plagányi et al. 2020) • Holothurians do have chemical defences, but are known to be predated on by benthic invertebrates and fishes, at all life history stages (Purcell et al. 2016) • Current management arrangements including grid catch-limits, which limit the removal of trepang from the Fishery • Given the complexity of food webs in tropical marine waters, the removal of *Holothuroidea* species through fishing is unlikely to have a detectable impact on the trophic structure.
Ecosystem function	• Holothurians play an important role as regulators in the ecosystem • There is no evidence of any impacts on the ecosystem function; most conclusions about the benign nature of the Fishery are based on anecdote and 'common sense' evaluations • Current management arrangements, including catch-grid limits, limits the amount of species removed from an ecosystem • Holothurians maintain and improve sediment health through bioturbation (Purcell et al. 2016), and are considered ecosystem regulators • A likelihood rating of Possible (3) was allocated noting the risk of removal of Holothurian species at a local level, however it is noted that the likelihood of fishery-wide ecosystem function would be considerably smaller.

Assessment information	
Addition of biological material	• Due to the high selectivity of hand harvesting there are no discards • Addition of biological material is made when processing of trepang occurs on board the vessel and guts are disposed of overboard • Given the low level of harvest, the addition of biological material is unlikely to have a detectable impact on the ecosystem structure.
Translocation of pests and diseases	• Fishing vessels move between different areas however remain in NT waters • Licensees process trepang at sea immediately after harvest, reducing the risk of transporting pests and diseases from biological material to other areas • There are currently no known serious diseases to *Holothuroidea* species within NT waters • Skippers are responsible for maintaining vessels and gear to a standard where all biological matter is removed before translocating • Ballast water should be exchanged in accordance with the Australian Ballast Water Management Requirements in order to comply with the *Biosecurity Act 2015* • DITT's Aquatic Biosecurity Unit monitors and manages the risk of new marine pests arriving in the Territory. Current monitoring focuses on marinas, wharves and ports around the NT coastline. This is where marine pests are most likely to be introduced.
Habitat	
Divers	• Habitats where harvesting takes place consist of a sandy substrate • The impact divers have on the seafloor is highly unlikely to occur as disturbances to the sea floor effect visibility and the ability for divers to harvest • Limited number of divers in the Trepang Fishery (six licences with a maximum of four divers per licence).
Anchoring	• Habitats where harvesting takes place consist of a sandy substrate • Anchors used by motherships may have an impact on substrates and benthic communities • Sand anchors are usually deployed on barren ground to minimise impacts on the sea floor • Limited amount of fishing vessels prohibited to operate under a licence in the Trepang Fishery.

Assessment information	
Wading	• Wading occurs in sandy/muddy intertidal areas • There has been very little catch collected whilst wading • Limitations on the number of assistants under each licence, with a maximum of nine, including four divers.
Broader environment	
Greenhouse gas	• All trepang fishing vessels produce exhaust emissions. Motherships are fitted with large diesel engines whereas as dories are generally fitted with modern petrol-powered four-stroke outboards • The current size of the fishing fleet limit the impacts on the broader environment • Due to the small size of the fishing fleet in the Fishery, greenhouse gas emissions impacting the broader environment are considered very low.
Rubbish	• The disposal of solid, non-degradable waste in Territory coastal waters is regulated through the *Marine Pollution Act 1999*. There are substantial penalty provisions for non-compliance with these regulations and most fishers generally store rubbish on board for disposal on return to port • Compliance with these rules is generally considered high, but there may be instances where solid, non-degradable waste such a plastic bags, containers or cans are thrown or blown overboard. This rubbish is washed ashore and clearly visible along the coastline • Social pressure and stewardship also serve as effective deterrents to littering • Due to the small size of the fishing fleet in the Fishery, the risks of rubbish impacts on the broader environment are considered very low.
Oil discharge	• Trepang fishing vessels produce exhaust emissions that may discharge oil directly into the water column • The majority of vessels in the Fishery are equipped with four stroke engines that have minimal exhaust emissions • Due to the small size of the fishing fleet in the Fishery, the risk of oil discharge negatively impacting the broader environment is considered very low.

7.4 List of attendees at each workshop

7.4.1 Expert Panel Workshop

	Affiliation
Thor Saunders	NT DITT, Fisheries Research
Eliza Kimlin	NT DITT, Fisheries Management
Will Bowman	NT DITT, Fisheries Management
Mark Grubert	NT DITT, Fisheries Research
Tim Skewes	Sea cucumber consultant
Tim Nicholas	WA DPIRD, Fisheries Management
Amie Steele	WA DPIRD, Fisheries Management
Mathew Hourston	WA DPIRD, Fisheries Research
Lachlan Strain	WA DPIRD, Fisheries Research

7.4.2 Key Stakeholder Workshop

	Affiliation
Chauncey Hammond	Tasmanian Seafoods
Mark Webster	Tasmanian Seafoods
Anton Krsinich	Tasmanian Seafoods
Peter Pender	Northern Land Council
Bunug Galaminda	Yagbani Aboriginal Coorporation
Ross McDonald	Anindilyakwa Land Council
Paul Capon	Anindilyakwa Land Council

7.5 Summary of the Trepang Fishery ERA Stakeholder Workshop

Friday 12 February 2021 – 8:30 am to 10:45 am

Facilitator: Dr Thor Saunders (NT Fisheries).

Participants: Eliza Kimlin (NT Fisheries), Rebecca Oliver (NT Fisheries), Chauncey Hammond (Tasmanian Seafoods (TSF)), Mark Webster (TSF), Anton Krsinich (TSF), Peter Pender (Northern Land Council), Bunug Galaminda (Yagbani Aboriginal Coorporation), Ross McDonald (Anindilyakwa Land Council (ALC)), Paul Capon (ALC), Dr Tim Skewes.

Apologies: Katherine Winchester (Northern Territory Seafood Council), Veronica Toral-Granda (Charles Darwin University).

Introduction

Ms Kimlin opened the Trepang Fishery ecological risk assessment (ERA) stakeholder workshop. Dr Saunders outlined the aim of the workshop was to review and provide comments on the expert panel's assessment of the impacts of the Trepang Fishery on the marine environment. Dr Saunders explained that the ERA was the first step in the process and the outcomes of the ERA would be used to inform harvest strategy development, and prioritise monitoring, research and management activities. Dr Saunders provided an overview of the Northern Territory (NT) ERA process.

To provide context for the ERA workshop, Ms Kimlin provided an overview of the current management in the Trepang Fishery. Dr Saunders provided information on the biology, distribution and stock structure of Sandfish; the primary target species.

Review of the draft Trepang Fishery ERA report

Background information

Participants recommended the following information be included as background information in the draft NT Trepang Fishery ERA report:

- Wildlife Trade Operation accreditation does not apply to Black Teatfish and White Teatfish as they are CITES listed. To export these species a 'non-detrimental finding' needs to be issued by the Australian Government.
- Results from previous research permits issued to TSF in 2015/16 for exploratory fishing outside the Fishery boundary.
- Catch is reported as whole weight, calculated by applying a conversion ratio of 0.5 to gutted and blanched weight.

Risk assessment outcomes

Dr Saunders outlined each component tree of the ERA and provided participants with an overview of the information considered and justification as to how the expert panel reached the level of consequence and level of likelihood to determine the risk rating.

Retained Species

Sandfish

The Fishery allows for the take of all sea cucumber species. As Sandfish has compromised 100% of catch in the past 10 years, Sandfish was assessed separately from other Holothurian species.

General comments:

- Concerns that there is no recreational limit given reports that high recreational take is occurring in other jurisdictions. Should this occur in the NT, it could result in localised depletion. The group noted there was no recorded recreational catch or reports to indicate this was an issue in the NT.
- Concerns over the risk of localised depletion in areas close to communities that obtain an Aboriginal Coastal Licence (ACL). It was noted that ACL licences were not designed for harvesting large commercial quantities, but as a starting point for communities to enter the commercial fishing industry and provide harvest for local sale. Additionally, ACL holders are required to complete logbooks, so following an expansion of ACL conditions that enable sea cucumber harvest, catches would be monitored.
- TSF stated they are looking to pursue MSC certification across all Australian sea cucumber fisheries.

Group considerations:

- Single company operating reduces the potential for competitive fishing in the Fishery.

Participants agreed with the expert panel's consequence level, however based on current fishing operations and low catch proposed that the likelihood be decreased to 'Possible' (3), which would result in the risk rating remaining at a 'Moderate' risk.

Outcome: Expert Panel to consider the additional information provided by the stakeholder workshop and the proposal to decrease the likelihood to 'Possible' (3) noting the current fishing operations and low catch.

Other Holothurians

General comments:

- TSF advised that Lollyfish was considered to be a low value species on the current market, and not retained in the Fishery.
- Concerns over lack of information on current distribution of Lollyfish within the Fishery.
- The group noted that if significant changes occur to catches and market value of other Holothurian species, that they should be re-assessed. NT Fisheries advised monitoring would continue and provisions exist under the *Fisheries Act 1988* to put in management measures to control catches if required.

Group considerations:

- Potential for risk ratings to change in the future if markets for other species develop.

Outcome: Participants agreed with the expert panel's risk rating.

Non Retained Species

Stakeholders noted that due to the highly selective fishing method there are no records or observations of non-retained species harvested within the Fishery, and therefore non-retained species were not assessed.

Threatened, Endangered and Protected Species

Boat strike

Group comments:

- Two dories operate per commercial vessel.
- No specific recreational vessels harvesting sea cucumber in the NT and therefore not considered a risk.

Outcome: Participants agreed with the expert panel's risk rating.

Ecosystem Structure

Trophic structure

General comments:

- Concerns around impacts on trophic structure around Groote Island given localised effort.

Group considerations:

- Research scant on predator/prey relationships.
- It is unknown what other species replace Sandfish in the ecosystem.

Participants agreed with the expert panel's consequence level, however based on the lack of information on the role Holothurians play in the trophic structure suggested that the likelihood be increased to 'Unlikely' (2) or 'Possible' (3), which leaves a risk rating at 'Negligible' or a 'Low' risk.

Outcome: Expert panel to consider the additional information provided by the stakeholder workshop and the proposal to increase the likelihood to 'Unlikely' (2) or 'Possible' (3) noting the lack of information on the role Holothurians play in the trophic structure.

Ecosystem Function

Group comments:

- Sediment turnover plays an important role in ecosystem regulation.
- Research is scant to support the role Holothurians have on nutrient recycling.
- The role of sea cucumbers in the ecosystem is likely to be localised given their sessile nature.

Group considerations:

- Holothurians play an important role as regulators in the ecosystem.

Outcome: Participants agreed with the expert panel's risk rating.

Addition of biological material

Outcome: Participants agreed with the expert panel's risk rating.

Translocation of pests and diseases

Outcome: Participants agreed with the expert panel's risk rating.

Habitat

Divers

Group comments:

- Divers are pulled behind the dories, creating little disturbance to the benthic habitat.

Outcome: Participants agreed with the expert panel's risk rating.

Anchoring

Outcome: Participants agreed with the expert panel's risk rating.

Wading

Group comments:

- Wading makes up for less than 5% of commercial harvest operations.

Outcome: Participants agreed with the expert panel's risk rating.

Broader Environment

Greenhouse gases

Outcome: Participants agreed with the expert panel's risk rating.

Garbage disposal/Litter

Outcome: Participants agreed with the expert panel's risk rating.

Oil discharge

Outcome: Participants agreed with the expert panel's risk rating.

Next Steps

Outcomes of the ERA will be used to review management of the Trepang Fishery, inform harvest strategy development, and to prioritise research and monitoring. It was indicated to workshop participants that NT Fisheries would provide comments recorded at the workshop to the expert panel for consideration. Following the expert panel's review of the comments, NT Fisheries will finalise the Trepang Fishery ERA and provide it to all stakeholders.

Dr Saunders closed the workshop at 10:45 am.